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It's Good to Be the King: Neurobiological Benefits of Higher Social Standing

Modupe Akinola[1] and Wendy Berry Mendes[2]

Abstract

Epidemiological and animal studies often find that higher social status is associated with better physical health outcomes, but these findings are by design correlational and lack mediational explanations. In two studies, we examine neurobiological reactivity to test the hypothesis that higher social status leads to salutary short-term psychological, physiological, and behavioral responses. In Study 1, we measured police officers' subjective social status and had them engage in a stressful task during which we measured cardiovascular and neuroendocrine reactivity. In Study 2, we manipulated social status and examined physiological reactivity and performance outcomes to explore links among status, performance, and physiological reactivity. Results indicated that higher social status (whether measured or manipulated) was associated with approach-oriented physiology (Studies 1 and 2) and better performance (Study 2) relative to lower status. These findings point to acute reactivity as one possible causal mechanism to better physical health among those higher in social status.

Keywords

social status, psychophysiology, stress, performance

Higher social status, defined as material (i.e., wealth) or subjective, predicts better mental and physical health outcomes (Singh-Manoux, Marmot, & Adler, 2005). In epidemiological studies, higher subjective status has been associated with positive health trajectories (Adler, Epel, Castellazo, & Ickovics, 2000), better self-rated health and psychological well-being (Hu, Adler, Goldman, Weinstein, & Seeman, 2005; Singh-Manoux et al., 2005), lower prevalence of cardiovascular (CV) disease (Kubzansky, Kawachi, & Sparrow, 1999; Singh-Manoux, Adler, & Marmot, 2003), and lower mortality rates (Kopp, Skrabski, Rethelyi, Kawachi, & Adler, 2004). Yet, many of these studies are correlational, with confounds such as healthier environments and easier access to health care for high-status individuals, potentially obfuscating the paths by which higher social standing confers positive benefits.

In two studies, we explored how social status may get *under the skin* to influence health by examining acute changes in neurobiological stress responses. In Study 1, we measured subjective social status (SSS) among police officers and explored the relationship between SSS and physiological reactivity during an acute social stressor. In Study 2, we manipulated social status (higher vs. lower) in the lab and examined the subjective, physiological, and behavioral outcomes associated with status roles.

Experimental Effects of Social Status

Social status has been defined as the amount of prestige, esteem, or respect held by others in a social group (Anderson & Kilduff, 2009; Blader & Chen, 2012; Fiske, 2010). While few studies have experimentally explored how status influences social interactions, insights on the effects of status can be gleaned from experimental investigations of its related construct, *power*. Power, conceptualized as having control over critical resources or outcomes, is causally related to status in that power can lead to the acquisition of status and vice versa (Magee & Galinsky, 2008). Experiments examining the cognitive and behavioral effects of power find that higher relative to lower power improves executive functioning (Smith, Jostmann, Galinsky, & van Dijk, 2008), enhances action orientation (Galinsky, Gruenfeld, & Magee, 2003), increases emotional independence (Anderson, Keltner, & John, 2003), and strengthens commitment to goals and persistence on goal-relevant tasks (Guinote, 2007). Less common, are studies examining neurobiological consequences of experimentally induced social status or power. One study assigned females to dominant or subordinate social positions and found subordinate positions were associated with greater systolic blood pressure relative

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to dominant positions (Mendelson, Thurston, & Kubzansky, 2008). Another study found that merely activating high power can elicit an adaptive pattern of CV reactivity (i.e., challenge) compared to low power which elicits a maladaptive CV pattern (i.e., threat; Scheepers, de Wit, Ellemers, & Sassenberg, 2012). We extend this work on the effects of hierarchical differentiation by examining acute changes in neuroendocrine and autonomic systems associated with measured and manipulated social status.

Overview of Studies

In two studies, we examine neuroendocrine and CV reactivity to test our hypothesis that higher social status is associated with salutary psychological, physiological, and behavioral responses. We examined changes in neuroendocrine and CV reactivity associated with distinct motivational states and more adaptive physiological functioning. Since anabolic steroids, like testosterone (T), rise in response to power, dominance, and the desire to gain or maintain status (Mazur & Booth, 1998; Mehta & Josephs, 2006; Schultheiss & Rhode, 2002) and index approach-related behaviors, we expected higher status would be associated with greater increases in T relative to lower status.

Additionally, we examined CV reactivity within the challenge and threat framework, which differentiates adaptive from maladaptive stress states and considers the activation of two primary stress systems—the sympathetic–adrenal–medullary axis and the hypothalamic–pituitary–adrenal axis—during active, goal-relevant tasks (Blascovich & Mendes, 2010). Challenge states are characterized by efficient CV profiles, approach motivation, and higher resource relative to demand appraisals. In contrast, threat states involve less efficient CV profiles and are associated with withdrawal motivation and higher demand relative to resource appraisals. We measured cardiac indicators,[1] for example, cardiac output (CO), a measure of oxygenated blood processed via the heart on a given minute, indicating cardiac efficiency. In challenge and threat states, heart rate (HR) increases, but in challenge states, CO tends to increase from baseline more than in threat states. We expected that higher relative to lower status would engender approach-related physiological reactivity; that is, challenge rather than threat profiles. This prediction is consistent with theories of power which suggest that elevated power is associated with approach-related tendencies (Keltner, Gruenfeld, & Anderson, 2003).

In Study 1, police officers rated their SSS and then engaged in a stress task during which we measured their physiological changes. We expected higher SSS to be associated with greater increases in T and larger increases in cardiac reactivity (e.g., HR and CO), consistent with challenge profiles. As Study 1 was correlational, in Study 2 we establish causality between social standing and adaptive physiological reactivity by manipulating social status and examining behavioral and physiological consequences.

Study 1

Method

Participants

Eighty-one male police officers ($M_{age} = 40.8$, $SD = 8.7$) from a New England Police Department were recruited for the study with the help of the Commissioner and command staff. The racial composition was diverse: 54% White, 31% Black, 12% Latino, and 3% Asian.[2]

Procedure

Participants arrived at the police department between 12 p.m. and 6 p.m. and completed questionnaires assessing their emotions and SSS (Adler et al., 2000). After 20 min, participants provided a saliva sample. We then applied sensors to obtain CV responses. Participants were seated and relaxed for 5 min while we obtained baseline levels.

Participants then engaged in the stress task—a modified Trier social stress task (Kirschbaum, Pirke, & Hellhammer, 1993)—adapted to be self-relevant to officers. This version included a 5-min role-play with a disgruntled citizen complaining about an incident experienced with another officer (Akinola & Mendes, 2012; Schroeder & Lombardo, 2004). The disgruntled citizen, an actor, alleged he had been subjected to physical and verbal abuse by an officer and that this treatment was unwarranted. Participants were instructed to gather information about the incident and placate the citizen while being evaluated by two members of our research team. This task is widely used to determine advancement to sergeant. Officers were provided materials for the role-play and were given 2 min to prepare.

Following preparation, officers completed questionnaires assessing their emotions and appraisals regarding the upcoming stress task. Evaluators then entered the room and sat facing the officer. The actor playing the disgruntled citizen entered the room and executed a scripted role-play. After the stress task, participants provided a second saliva sample, timed 20 min after the start of the role-play.

Materials

SSS Scale. Participants completed two SSS scales, which consisted of a ladder with 10 rungs with instructions modified to fit the particular sample: "Think of this ladder as representing all the people at the police department [in the US]. At the top of the ladder are the people who are the best off ... At the bottom are the people who are the worst off ... " (Adler et al., 2000). Participants placed an X on the rung representing their standing. The two versions only differed in the reference group with one comparing to "people at the police department" and the other comparing to "people in the US." In past research, the more narrowly defined reference group showed stronger correlations to health outcomes (Ghaed & Gallo, 2007).

Physiological Responses. Saliva samples were obtained using IBL SaliCap sampling devices. Upon study completion, saliva

Table 1. Correlations Among Subjective Social Status (SSS) and Dependent Variables (Study 1).

			Pre-stressor	Appraisals	Baseline	Reactivity		
Variables	SSS (Police)	SSS (United States)	Negative Affect Index	Threat Ratio	T	T	HR	CO
SSS (police)	—	0.18	−0.09	0.10	−0.06	0.22†	0 .22†	0.28*
SSS (United States)	0.26*	—	−0.02	−0.21†	0.24*	0.03	0.16	−0.09
Negative affect index (pre-stressor)	−0.15	−0.01	—	0.63***	−0.08	0.02	0.07	−0.23
Threat ratio	0.02	−0.16	0.61***	—	−0.10	0.03	0.04	0.01
T baseline	−0.14	0.18	0.02	−0.06	—	−0.07	0.24†	−0.01
T reactivity	0.27*	0.23*	−0.12	0.06	−0.07	—	0.15	−0.14
HR reactivity	0.25*	0.18	0.05	0.04	0.17	0.19†	—	0.24†
CO reactivity	0.37**	0.02	−0.28*	0.02	−0.07	0.18	0.27*	—

Note. CO = cardiac output; HR = heart rate; T = testosterone.
Zero-order correlations appear below the diagonal; first-order correlations appear above and control for participant age and race.
†$p < .10$. *$p < .05$. **$p < .01$. ***$p < .001$.

samples were stored at −80°C until shipped to Salimetrics. Samples were assayed for T using a highly sensitive enzyme immunoassay (Salimetrics, PA). The T test used 25 µl of saliva per determination, has a lower limit of sensitivity of 1 pg/ml, and average intra- and interassay coefficients of variation are 2.5% and 5.6% respectively.

CV measures (electrocardiogram [ECG] and impedance cardiography [ICG] signals) were recorded continuously using an ambulatory recording device, the Vrije University Ambulatory Monitoring System version 4.6. Signals were examined offline; data were inspected for artifacts then averaged in 1-min bins using Vrije University software to reliably extract HR and CO.[3]

Self-Reported Emotions and Appraisals. We assessed demand and resource appraisals prior to the stress task. Participants appraised the demands of the situation (e.g., the upcoming task will be very demanding) and their resources (e.g., I have the abilities to perform well on the task) on a 1 (*strongly disagree*) to 7 (*strongly agree*) scale (Mendes, Gray, Mendoza-Denton, Major, & Epel, 2007). Demand and resource appraisals were averaged separately and a "threat ratio" (demands/resources) was created, with larger ratios indicating greater threat. Self-reported emotions were also assessed using the Positive and Negative Affect Schedule (Watson, Clark, & Tellegen, 1988). Participants rated their feelings on 20 emotional states (10 positive; 10 negative) on a 1 (*not at all*) to 5 (*a great deal*) scale. Positive and negative emotion scales were calculated (αs ranged from .85 to .90), so we created a negative affect index (negative minus positive emotion) which provided an index of negative affect without buffering effects of positive emotion.

Results

Subjective Social Standing

Ratings of SSS when using the local reference group (other officers) yielded values higher than the midpoint of the scale ($M = 6.18$, $SD = 2.2$). When the reference group was larger (i.e., people in the United States), mean ratings were higher ($M = 6.62$, $SD = 1.0$; range 4–9), but did not significantly differ from local reference group ratings, $t(77) = 1.80$, $p = ns$.

Self-Reported States

We observed no changes in officers' self-reported emotions from baseline to pre-stressor ($M_{\text{baseline}} = -2.1$, $SD = 0.8$; $M_{\text{pre-stressor}} = -2.1$, $SD = 0.9$, $t(79) = 0.0$, $p = ns$. This lack of self-reported changes in emotions was belied by the changes in physiological responding. For example, officers' HR increased from baseline to the stress task approximately 26 beats per minute, $SD = 13.4$, $t(75) = 17.0$, $p < .0001$.

Correlations Between SSS and Dependent Variables

We then tested our primary question, was subjective social standing related to subjective affect and physiological reactivity? We examined both zero-order and first-order correlations, controlling for age and race (Table 1). First, we noted that SSS-United States and SSS-police were moderately correlated ($r = .26$, $p < .05$), suggesting they may reflect different perceptions of status. We observed only one significant correlation with SSS-United States and T at baseline (Table 1). The higher officers rated themselves on global SSS, the larger the T levels at rest. Moreover, this correlation only appeared when age and race were used as covariates.

In contrast, SSS-police ratings were associated with a broader response profile of reactivity. Higher social standing relative to other officers was related to more adaptive stress reactivity: higher T responses and greater CO and HR reactivity; responses associated with approach-oriented reactivity. These correlations were generally robust to covariates, though all correlations between SSS-police and stress reactivity were slightly reduced when controlling for age and race. Consistent with observing no significant changes in negative affect following the stress task, we did not observe any correlations between social standing and self-reported affective changes.

Discussion

Results from Study 1 were consistent with the predicted association between social standing and approach-oriented physiological reactivity during a stress task. Participants scoring higher on the SSS-police scale exhibited increases in CO, HR, and T during the stress task. We observed no correlations with local standing and baseline T suggesting that the effect of social standing exerts its influence when the system is activated.

Consistent with the "local-ladder effect" (Anderson, Kraus, Galinsky, & Keltner, 2012) the effects were observed primarily when the reference group was other officers, as we noted smaller (and non-significant) relations between social status and neurobiological reactivity when the reference group was others in the United States. This finding aligns with research showing that the relationship between social status and psychosocial, behavioral, and health outcomes differs depending on whether a broad or narrow reference group is used (Ghaed & Gallo, 2007). Our data suggest that the local reference group tracks more closely with stress reactivity, which may partly explain the discrepancy in CV risk observed in large-scale studies examining social status.

Though supportive of the prediction that social standing would correspond with more approach-oriented physiological reactivity, Study 1 is correlational. Therefore, in Study 2, we attempt to establish a causal link between status and beneficial physiological stress responses by manipulating social standing prior to an interaction task.

Study 2

We manipulated participants' status roles before engaging in a cooperative task with another person. In addition to measuring neuroendocrine responses, we examined behavioral and performance outcomes. We also expanded the autonomic reactivity to examine additional sympathetic nervous system reactivity: pre-ejection period (PEP) and parasympathetic reactivity: heart rate variability (HRV). PEP indexes the time from the left ventricle contracting to the aortic valve opening, and in both challenge and threat states PEP decreases significantly. In performance-based tasks, PEP can differentiate challenge and threat profiles with challenge participants showing greater decreases. Thus, we expected PEP to decrease more (i.e., greater sympathetic activation) for higher relative to lower status positions. Additionally, since status can influence persistence on goal-relevant tasks (Guinote, 2007), we measured respiratory sinus arrhythmia (RSA), a measure of HRV. Psychophysiologists infer greater decreases in RSA to indicate increased mental load, effort, or conscious control (Jorna, 1992; Kassam, Koslov, & Mendes, 2009; Mulder, Mulder, Meijman, Veldman, & Van Roon, 2000). To the extent that higher social status would engender persistence, higher status would result in greater decreases in RSA than lower status.

In sum, we expected that male participants randomly assigned to higher status positions would exhibit more approach-orientated physiology (higher T, greater CO and HR, lower PEP, and lower RSA) and better performance on a cooperative task relative to those assigned to lower status positions.

Method

Participants

We recruited 84 (67 White, 14 Asian, 3 Indian) male participants (mean age = 20.5; *SD* = 1.8) from the university study pool and flyers.[4] Participants received $25 for participating plus a $9 bonus.

Procedure

We scheduled participants for 90 min during afternoon hours. Participants were randomly assigned to higher or lower status positions during an interaction with a partner (confederate). We used White confederates[5] trained to execute a scripted interaction.

Initial Interaction. The participant and confederate were escorted to different rooms. Non-operating sensors were applied to the confederate to mimic the appearance of the participant. The participant completed consent and questionnaires serving as a cover story for our status assignments.

Physiological Assessments. After 30 min, participants provided a saliva sample. Sensors were then applied to monitor physiological changes. Participants were seated while we collected 5 min of CV responses. Throughout the experiment, we obtained ECG (Biopac, Goleta, CA) and ICG (HIC-2000, Instrumentation for Medicine, Chapel Hill, NC). ECG and ICG signals were integrated with Biopac MP150 hardware. Signals were examined offline; data were visually inspected for artifacts and then averaged in 1-min bins using Mindware software (Gahanna, OH; Mendes, 2009).

Status Manipulation. We then connected the audiovisual system allowing the participant and confederate to see and hear each other via 32″ monitors. They were told they would work on several tasks requiring one "leader" and one "support" person and questionnaire responses determined the status assignments.[6] They would first prepare and deliver a videotaped speech on why they deserved their assigned roles—to be reviewed by their partner later in the study—and then complete tasks together.

We (surreptitiously) disconnected the audio feed to the confederate allowing them to be unaware of the status manipulation, while the participant believed both were aware. We then provided instructions for the speech which included having the participant define what leadership is (or describe the important role support people play in assisting leaders) and describe the qualities that made them well-suited to be the leader (or to support their partner). After the speech instructions, the audio and visual feed were disconnected and the participant was cued when to begin the speech.

Cooperative Task. After the speech, the confederate was escorted into the participant's room and seated beside the participant so both could view a computer monitor. They were told they would work on a "puzzle" task using a video game-like interface and would earn a bonus by completing each puzzle quickly (all participants received the same bonus). It was during this task that participants were expected to enact their leader or supporter roles. After receiving instructions, both completed questionnaires assessing their expectations of their partner and the task.

We held constant the participant's cognitive and metabolic demands by having the participant serve as the "driver" or physical navigator, operating the mouse and keyboard, whereas the confederate served as the "passenger" or conceptual navigator, telling the participant where to go. The confederate's role was scripted, coordinated, and timed so that all participants had a consistent experience. In sum, the participant navigated a virtual person through a maze while the "partner" provided navigation instructions. Upon completion, the confederate was escorted out of the room and the participant completed questionnaires. A second saliva sample was obtained 20 min after task initiation.

Resource Allocation Task. Participants learned they earned a $9 performance bonus and based on their status role needed to decide how to split the $9. Their partner did not know how much they earned so they could allocate as much or as little as they wanted. Participants were asked to leave the dollar amount (provided in singles) in an envelope and to keep the remaining money. Participants were left alone for this. Afterward, the experimenter removed the sensors, probed for suspicion, debriefed, and paid participants.

Materials

Status Assignment Questionnaires. Participants completed three questionnaires capturing lay conceptions of leadership qualities, but with ambiguity regarding status roles. The questionnaires included the Narcissistic Personality Inventory (Raskin & Terry, 1988) and the Interpersonal Adjectives scale (IASR; Wiggins, Trapnell, & Phillips, 1988), which includes 35 adjectives each descriptive of an interpersonal trait (e.g., "dominant"; "authoritative"; "sympathetic"). We also included two thematic apperception tests (Morgan, 1935), in which participants viewed ambiguous pictures and described what they saw.

Neuroendocrine Assessment. Participants provided a saliva sample upon arrival and following the cooperative task. Saliva samples were stored in a −80°C freezer until shipped overnight to a laboratory in Dresden, Germany. Saliva samples were assayed for T using a highly sensitive enzyme immunoassay. Intra- and interassay coefficients were less than 10%.

Cooperative Task. The "puzzle task" was the video game Portal by Valve Corporation, which shows a first-person viewpoint of a character racing through mazes using a portal gun creating interspatial doorways between flat planes. Participants completed three 3-min trials of the task with 30-s breaks between trials. Faster times indicated better performance.

Pre-task and Post-task Questionnaires. We assessed participants' perceptions of their partner prior to and following the cooperative task. Prior to the task, participants rated their expectations of their partner on 16 adjectives from the personality dominance subscale of the IASR. We created a scale of pre-task expectations by averaging four dominance-related items (assertive, forceful, dominant, and firm: $\alpha = .79$) and four support-related items (helpful, kind, accommodating, and supportive; $\alpha = .71$). Following the task, participants rated how much they liked their partner, whether their partner was someone with whom they would be friends, and whether they thought their partner was fair, using 7-point scales ranging from 1 (*not at all*) to 7 (*a great deal*). We created a "liking" scale by averaging responses to these 3 items ($\alpha = .86$). We also created a "competence" scale using 2 items assessing how well the participant believed their partner performed and how smart their partner was ($\alpha = .67$).

Results

Participant Attrition

One participant was excluded for suspicion; 2 participants did not have sufficient saliva for neuroendocrine assays; 15 participants' CV data were lost because of electrical interference or equipment malfunction. Varying degrees of freedom reflect this data loss.

Manipulation Check

We observed a main effect of status for the dominance-related items from the IASR, $F(1, 82) = 9.57$, $p < .003$ and the support-related items, $F(1, 82) = 11.64$, $p < .001$. Lower status participants expected their partner to be more dominant ($M_{\text{low}} = 4.52$, $SD = 0.9$) than did higher status participants ($M_{\text{high}} = 3.90$, $SD = 0.9$). In contrast, higher status participants expected their partners to be more supportive ($M_{\text{high}} = 5.54$, $SD = 0.6$) than did lower status participants ($M_{\text{low}} = 4.98$, $SD = 0.8$).

Correlations Among Primary Dependent Variables

We then examined the correlations between our dependent variables organized by method category (Table 2). Across method category, only a few correlations were significant underscoring the independence of these measures. However, within method category, there were several significant correlations in the expected direction.

Table 2. Correlations Among Primary Dependent Variables (Study 2).

	Perceptions of Partner		Physiological Reactivity					Performance	
Variables	Competence	Liking	T	HR	CO	PEP	RSA	Puzzle	Dollars
Competence	—	0.65***	−0.01	0.22†	0.10	−0.12	−0.24†	−0.24†	0.45***
Liking	0.62***	—	0.14	0.35**	0.06	−0.25*	−0.27*	−0.26*	0.38**
T reactivity	0.02	0.17	—	0.32**	0.26*	−0.18	−0.27*	−0.38**	0.05
HR reactivity	0.23†	0.34**	0.32**	—	0.39**	−0.80***	−0.51***	−0.38*	0.14
CO reactivity	0.08	0.02	0.24*	0.39***	—	−0.42**	−0.22†	−0.10	0.18
PEP reactivity	−0.11	−0.18	−0.13	−0.76**	−0.40**	—	0.30*	0.25*	−0.13
RSA reactivity	−0.23*	−0.28*	−0.27*	−0.50***	−0.21†	0.26*	—	0.24†	−0.10
Puzzle	−0.28**	−0.19†	−0.27*	−0.39**	−0.05	0.22†	0.23†	—	0.07
Dollars	0.45***	0.34**	−0.05	0.13	0.15	−0.15	−0.09	0.01	—

Note. CO = cardiac output; HR = heart rate; PEP = pre-ejection period; RSA = respiratory sinus arrhythmia; T = testosterone.
Zero-order correlations appear below the diagonal; first-order correlations appear above and control for participant age and race.
†$p < .10$. *$p < .05$. **$p < .01$. ***$p < .001$.

Partner Perceptions

We next tested how competent the participant perceived their partner, which yielded a main effect of status, $F(1, 82) = 7.98$, $p < .006$ (Table 3). Participants in the lower status role perceived their partners to be *less* competent than participants in the higher status role ($M_{\text{low}} = 5.06$, $SD = 1.0$; $M_{\text{high}} = 5.68$, $SD = 1.0$). These perceptions were obtained after the task and likely reflect reactions to their partner's performance based on status role expectations. Given all confederates performed the same, confederates assigned to be leaders may have seemed disappointing and hence less competent, whereas confederate supporters may have been evaluated as better than expected and thus viewed as more competent. Furthermore, an examination of participants' ratings of how much they liked their partner yielded a main effect of status, $F(1, 82) = 4.20$, $p < .04$. Paralleling the competence ratings, participants in higher status roles liked their (lower status) partners more than participants in lower status roles liked their (higher status) partners ($M_{\text{high}} = 4.72$, $SD = 1.3$; $M_{\text{low}} = 4.18$, $SD = 1.1$).

Physiological Responses

Neuroendocrine Responses. There were no baseline T differences prior to random assignment, so we created T reactivity values. We then examined T reactivity by status assignment and observed a main effect of status, $F(1, 82) = 4.99$, $p < .03$. Higher status participants exhibited larger increases in T ($M_{\text{high}} = 28.44$, $SD = 54.4$) than lower status participants ($M_{\text{low}} = 6.63$, $SD = 28.7$).

Cardiovascular Responses. We did not observe any baseline differences in HR, CO, PEP, or RSA, thus we calculated reactivity scores by subtracting each baseline response from the first minute of the cooperative task. We used respiration rate as a covariate for RSA (Grossman & Taylor, 2007). HR reactivity yielded a main effect of status, $F(1, 67) = 9.33$, $p < .003$. Higher status participants exhibited greater increases in HR compared to lower status participants ($M_{\text{high}} = 21.7$, $SD = 13.7$; $M_{\text{low}} = 12.52$, $SD = 11.0$). Similarly, we observed a main effect of status for CO, $F(1, 73) = 6.09$, $p < .02$, and PEP, $F(1, 74) = 5.28$, $p < .02$. Consistent with the challenge reactivity prediction among higher status participants, higher status roles engendered greater increases in CO and greater decreases in PEP than lower status.

We then examined RSA reactivity and observed a main effect of status assignment, $F(1, 67) = 3.98$, $p < .05$. Higher status participants showed greater decreases in RSA than lower status participants ($M_{\text{high}} = -1.6$, $SD = 1.3$; $M_{\text{low}} = -0.9$, $SD = 1.3$), possibly due to exerting more effort during the cooperative task than those assigned to lower status roles.

Performance on the Cooperative Task

We standardized puzzle completion times by trial and created an average puzzle completion time across trials with the interpretation that faster completion times indicate better performance. We observed a main effect of status condition, $F(1, 83) = 4.78$, $p < .03$, such that participants completed the puzzles faster when they were in the higher status role compared to the lower status role (Figure 1).

Resource Allocation

Finally, we examined bonus money allocation by the participant to their partner. We observed a main effect of status, $F(1, 82) = 5.24$, $p < .02$, such that higher status participants gave *more* money to their partners ($M_{\text{high}} = 4.7$, $SD = 1.6$) than lower status participants ($M_{\text{low}} = 3.9$, $SD = 1.5$).

Discussion

The results of Study 2 demonstrate that one's social status can create powerful changes in performance, physiological reactivity, and money allocation. Specifically, participants assigned higher compared to lower status positions exhibited greater increases in T, HR, and CO, and decreases in PEP and RSA,

Table 3. Participants' Means and Standard Deviations (in Parentheses) for Key Outcome Variables by Status Assignment.

Outcome Variable	Participant Status	
	High Status	Low Status
Perceptions of partner		
Competence	5.68_a (.98)	5.06_b (1.04)
Liking	4.72_a (1.29)	4.18_b (1.07)
Neuroendocrine reactivity		
T	28.44_a (54.44)	6.63_b (28.70)
CV reactivity		
HR	21.68_a (13.68)	12.52_b (11.02)
CO	1.02_a (2.84)	-0.18_b (.84)
PEP	-13.79_a (13.40)	-6.82_b (13.40)
RSA	-1.58_a (1.31)	-0.95_b (1.31)
Performance		
Puzzle	-0.15_a (0.82)	0.21_b (0.77)
Dollars	4.71_a (1.62)	3.93_b (1.49)

Note. CV = cardiovascular; CO = cardiac output; HR = heart rate; PEP = pre-ejection period; RSA = respiratory sinus arrhythmia; T = testosterone. Within a row, means with different subscripts differ at $p < .05$.

more positive partner perceptions, better performance on the puzzle task, and greater generosity toward their partner.

Interestingly, high social status engendered greater generosity than low status. These findings are inconsistent with studies showing that high social class individuals are less generous than low social class individuals (Kraus, Piff, & Keltner, 2011) and with studies manipulating status that find high status makes individuals more self-serving (i.e., less generous and less able to take others' perspectives; Galinsky, Magee, Inesi, & Gruenfeld, 2006). Possible explanations are that higher status participants may have felt more obligated because they worked on a cooperative task (Chen, Lee-Chai, & Bargh, 2001) or they may have been more impressed by their partners than lower status participants and rewarded them more money as they appeared deserving of the bonus. These explanations are consistent with the conceptualization of sociometric status as a form of status that boosts interpersonal connection (Anderson et al., 2012).

Taken together, the psychological, physiological, and behavioral effects seen in Study 2 suggest that while higher status roles engender more salutary outcomes, more harmful outcomes may ensue for lower status roles including negative perceptions, maladaptive physiological reactivity to stress, poorer performance, and less prosocial behavior.

General Discussion

In two studies, we show that higher social status is associated with approach-oriented psychological states as indicated by more adaptive stress reactivity (Studies 1 and 2), positive partner perceptions, better performance, and greater generosity (Study 2). Our findings implicate acute neurobiological reactivity as one possible mechanism explaining long-term beneficial effects of higher relative to lower social status.

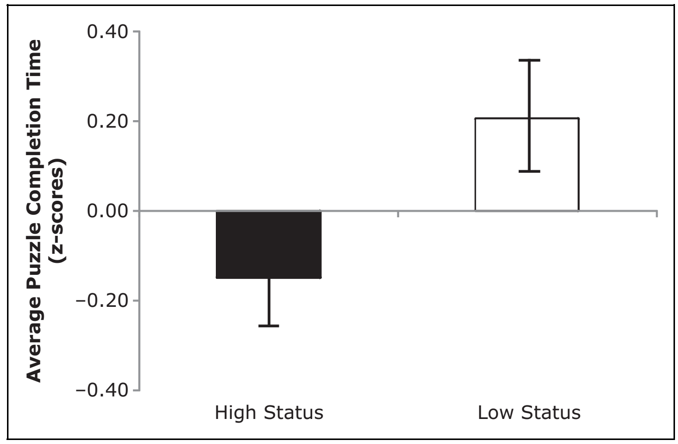

Figure 1. Average puzzle completion time of status assignment.

While previous research shows that low-power positions lead to threat patterns of CV reactivity whereas high-power positions lead to challenge patterns (Scheepers et al., 2012), we extend this work by offering converging evidence of neuroendocrine responses to status, and by demonstrating the behavioral implications associated with neurobiological responses to status. Notably, in both studies, we find that within method category, the relationship between the dependent variables produced several significant correlations. However, across method category, we did not observe strong correlations, consistent with other published studies (Mauss, Levenson, McCarter, Wilhelm, & Gross, 2005; Mendes, Blascovich, Lickel, & Hunter, 2002). This lack of correspondence points to the relative independence of acute responses across biological and nonbiological systems, even when these measures putatively index similar psychological states, and underscores the importance of using both psychological and physiological responses to get a more complete picture of how status can broadly exert influence on individuals.

It is interesting to speculate about the boundary conditions of observing adaptive responses among those higher in social status. Animal research suggests that the psychological and physiological advantages associated with social status can be influenced by personality characteristics of status holders, by how the status hierarchy is maintained, and by the stability of the hierarchy (Sapolsky, 2005). For instance, in stable social periods, high-ranking male baboons relative to low-ranking baboons show increases in T in response to stress (Sapolsky & Ray, 1989), similar to the neuroendocrine responses we observed in our study. However, in unstable social hierarchies, high-ranking male baboons tend to show elevated cortisol and lower T. This research implies that stable social environments are key situational contexts that may influence whether status exerts beneficial psychological, physiological, and behavioral responses. There is preliminary laboratory evidence suggesting that stability is a key contextual factor for human hierarchies (Maner, Gailliot, Butz, & Peruche, 2007) and an important future direction would be to model unstable environments in the lab to examine the effects of status in these and other contexts.

In sum, we offer evidence of salutary psychological, physiological, and behavioral responses to higher social status which may suggest a link between social standing and better physical and mental health outcomes over time. Epidemiological research examining the long-term health implications of acute stress reactivity has offered evidence that benign responses to stress may confer long-term health benefits. For instance, lower CO (one of the markers of threat physiology) has been linked to greater risk of Alzheimer's disease and accelerated brain aging (Jefferson et al., 2010). As this type of experimental evidence accrues, along with the development and precision of predisease biomarkers, social scientists may soon be able to chart how psychological effects of social status affect long-term health outcomes.

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Notes

1. We measured blood pressure to calculate total peripheral resistance, typically used when distinguishing between challenge and threat. Due to excessive movement during the study our blood pressure values produced invalid responses (systolic ranged from 94.0 to 235.0 [Study 1] and from 79.1 to 265.7 [Study 2]).
2. We observed no effect of participant race on our key dependent variables.
3. PEP could not be analyzed in Study 1 as the equipment used prevents manual editing of the Q-point necessary to identify PEP. Instead, a constant is used precluding accurate PEP assessment (Riese et al., 2003).
4. We observed no effect of participant race on our key dependent variables.
5. We used male and female confederates and observed no effect of confederate gender on our key dependent variables. In all analyses, we controlled for confederate gender.
6. Although this manipulation is similar to those used in power studies, there was no mention that the leader had greater control over resources and all participants played the same role regardless of status assignment.

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