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Evaluative Threat and Ambulatory Blood Pressure: Cardiovascular Effects of Social Stress in Daily Experience

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Abstract

Objective—Physiological effects of social evaluation are central in models of psychosocial influences on physical health. Experimental manipulations of evaluative threat evoke substantial cardiovascular and neuroendocrine responses in laboratory studies, but only preliminary evidence is available regarding naturally-occurring evaluative threats in daily life. In such non-experimental ambulatory studies, it is essential to distinguish effects of evaluative threat from related constructs known to alter stress, such as ability perceptions and concerns about appearance.

Methods—94 married, working couples (mean age 29.2 years) completed a one-day (8am to 10pm) ambulatory blood pressure (ABP) protocol with random interval-contingent measurements using a Suntech monitor and Palm Pilot-based measures of control variables and momentary experiences of social-evaluative threat, concerns about appearance, and perceived ability.

Results—In hierarchical analyses for couples and multiple measurement occasions (Proc Mixed; SAS) and controlling individual differences (BMI, age, income) and potential confounds (e.g., posture, activity), higher reports of social-evaluative threat were associated with higher concurrent SBP (estimate = .87, SE = .34) and DBP (estimate = 1.06; SE = .26), both $p < .02$. Effects of social-evaluative threat remained significant when perceived ability and appearance concerns were controlled.

Conclusions—Naturally occurring social-evaluative threat during daily activity is associated with increased SBP and DBP. Given associations between ABP and risk of cardiovascular disease, the findings support conceptual models of threats to the social self as a potentially important influence on physical health.

Keywords

ambulatory blood pressure; social-evaluative threat; psychological stress

Psychological stress and its physiological effects are implicated the development and course of serious physical illness, including cardiovascular disease (CVD) (Cohen, Janicki-Deverts, & Miller, 2007). The threat of negative evaluations by others – or *social-evaluative threat* – is a central source of psychological stress in models of the effects of human stress on physical health (Dickerson, Gruenwald, & Kemeny, 2004). Acceptance, liking, and inclusion by others is a central human concern or social motive, as is the achievement and

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protection of status, prestige, and respect (Leary, Cottrell, & Phillips, 2001; Kenrick, Griskevicius, Neuberg, & Shaller, 2010). Social evaluation often poses a threat to these valued resources. Not surprisingly, in laboratory studies social-evaluative threat evokes increased cortisol release (Dickerson & Kemeny, 2004) and heightened cardiovascular reactivity (e.g., Smith, Nealey, Kircher, & Limon, 1997; Taylor et al., 2010), responses hypothesized to undermine health and promote CVD.

The effects of social-evaluative threat beyond the laboratory are important, not only as a test of the external or ecological validity of laboratory findings. Exposure to psychological stress and related physiological responses measured during daily experience, such as ambulatory blood pressure (ABP), predict indications of CVD (Kamarck et al., 2005). In the one relevant study to date, momentary reports of social-evaluative threat were associated with concurrent increases in ABP in a sample of undergraduates (Lehman & Conley, 2010). Given that evaluative threat was measured rather than manipulated, it is possible that this association reflects correlated or confounded psychological influences on ABP. For example, low levels of self-efficacy, confidence, or perceived ability to meet situational demands evokes heightened cardiovascular reactivity (Wright & Dismukes, 1995), as does concern over one's physical appearance (Stroud, Naiura, & Stoney, 2001). These unmeasured factors could have contributed to effects of evaluative threat on ABP. Further, it is important to examine the association of social-evaluative threat with ABP beyond the undergraduate student population.

To address these issues, we measured the momentary experience of social-evaluative threat, concerns about physical appearance, and confidence in abilities, and related these factors to concurrent variation in ABP in a sample of working adults. Models of social-evaluative threat, stress, and health (Dickerson et al., 2004) provided the basis for the hypothesis that social-evaluative threat would be associated with increases in systolic and diastolic blood pressure (SBP, DBP), when controlling potential artifacts (e.g., posture, activity) and momentary changes in concerns over physical appearance and confidence in one's ability. We also tested gender differences in these associations, and examined negative affect as a mediator of the associations.

Method

Participants

In a project on marriage, work stress, and ABP, we recruited 94 working, married, cohabitating couples. Mean age was 29.6 years (range = 18–63), 66% had a household income of over $40,000, 67.5% were college educated, and 83% were non-Hispanic White. The following exclusion criteria were used: no hypertension, no cardiovascular prescription medications, no history of chronic disease with a cardiovascular component (e.g., diabetes), and no recent history of psychological disorder (e.g., major depressive disorder).

Procedure

The protocol was approved by the University IRB. Participants were recruited through advertisements in local newspapers, and community flyers. After screening, eligible participants gave informed consent and were scheduled for appointments. Participants completed a one day ABP assessment, from 8 am to 10 pm (M=14.4 hours). ABP assessment included working hours and an evening at home with the spouse on the same day. The ABP monitor took a reading at random, once every 30 minutes. Random interval-contingent monitoring minimizes participants' anticipation of ABP assessments that might lead them to alter their activities. Participants underwent from 20 to 35 ABP readings. After each ABP assessment, participants completed questions with a Palm Pilot using the Purdue

Momentary Assessment Tool (Weiss, Beal, Lucy, & MacDermid, 2004), which contained questions on basic ambulatory control variables (e.g., posture), as well as psychosocial processes (see below).

Measures

ABP Monitor—The Oscar 2 (Suntech Medical Instruments, Raleigh, NC) was used to estimate ambulatory SBP and DBP. The Oscar was developed to meet the reliability and validity standards of the British Hypertension Society Protocol (Goodwin, Bilous, Winship, Finn, & Jones, 2007). The cuff was worn under the participants' clothing, and only a small control box (approximately 5.0 × 3.5 × 1.5 inches) attached to the participant's belt was partially exposed. Outliers associated with artifactual readings were identified using the criteria by Marler, Jacobs, Lehoczky, and Shapiro (1988). These included: (a) SBP < 70 mmHg or > 250 mmHg, (b) DBP < 45 mmHg or > 150 mmHg, and (c) SBP / DBP < [1.065 + (.00125 X DBP)] or > 3.0.

Ambulatory Diary Record (ADR)—Participants completed a series of questions following each ABP assessment. It could be completed in 2–3 minutes, and was divided into two sections. The first assessed basic factors that might influence ABP (Kamarck et al., 1998), such as posture (lying down, sitting, standing), activity level (1 = no activity, 4 = strenuous activity), location (work, home, other), talking (no, yes), temperature (too cold, comfortable, too hot), prior exercise (no, yes), and prior consumption of nicotine, caffeine, alcohol or a meal (no, yes). The second section included two items assessing social-evaluative threat (i.e., “Worried about what others think about me” and “Concerned about the impression I am making” Mean = 0.75, SD = .852), appearance concerns (i.e., “Feel satisfied with the way my body looks right now” and “Pleased about my appearance right now” Mean = 2.95, SD = .851), and ability perceptions (i.e., “Confident about my abilities” and “Feel as smart as others” Mean = 3.71, SD = .686), adapted from prior work on state self-esteem (Heatherton & Polivy, 1991). Responses (1=not at all, 5=extremely) for the two items in each case were averaged. This section also included four negative affect items (“sad,” “frustrated,” “stressed,” and “upset”). Responses (1 = not at all; 4 = very much), which were averaged (mean = 1.8, SD = .498).

Overview of Analyses—We utilized proc mixed (SAS institute) to examine the diary ratings and ABP. We modeled the covariance structure for the two repeated measures factors of dyad (i.e., husband, wife) and measurement occasion (i.e., reading number) using the direct (Kronecker) product (Park & Yee, 2002). This was modeled using the “type=un@ar(1)” option that specifies a decreasing covariance structure between measurement occasions further apart in time for each member of the dyad. As recommended (Campbell & Kashy, 2002), we used the Satterthwaite approximation to determine degrees of freedom. Using this approach, we examined extraneous factors that would need to be statistically controlled in further analyses of ABP. Consistent with prior research, age, income, BMI, posture, temperature, recent alcohol use, recent exercise, talking, and concurrent physical activity were independent predictors of higher ambulatory SBP (p's<.05). Age, income, BMI, posture, recent meal consumption, concurrent physical activity, and talking independently predicted ambulatory DBP (p's<.05). Consistent with prior work, these factors were statistically controlled (Marler, Jacob, Lehoczky, & Shapiro, 1988).

Results

Primary analyses

As depicted in Figure 1 (top panel), momentary reports of social-evaluative threat were associated with higher concurrent SBP levels (estimate = .872, SE = .342), t(3493) = 2.55, p

= .011. This effect was not moderated by gender, p > .15 .When concurrent levels of perceived ability/confidence and appearance concerns were also tested simultaneously, social-evaluative threat remained significantly associated with SBP (estimate = .787, SE = .347), t(3625) = 2.27, p = .023. Also as depicted in Figure 1 (bottom panel), momentary reports of social-evaluative threat were associated with higher concurrent DBP levels (estimate = 1.056, SE = .256), t(2987) = 4.12, p <.001. However, this effect was moderated by gender (estmate = 1.015, SE = 2.56), t(2925) = 3.96, p<.001, such that the predicted association was found for women but not men. When concurrent levels of appearance concerns and perceived ability/confidence were also tested simultaneously, social-evaluative threat remained significantly associated with DBP (estimate = 1.094, SE = .262), t(3173) = 4.18, p < .001.

Mediational analyses

As depicted in Figure 2, concurrent changes in state negative affect were a significant mediator of the association between social-evaluative threat and SBP. For DBP however, when considered simultaneously, social-evaluative threat remained a significant predictor (estimate = 1.011, SE = .259), t(3086) = 3.90, p<.001, whereas negative affect only approached significance (estimate = .807, SE = .44), t(3846) = 1.84, p = .067.

Ancillary analyses

In a significant interaction with gender (estimate = 1.252, SE = .546), t(1908) = 2.29, p = .022, greater appearance concerns were associated with higher concurrent DBP for women but not men. A similar interaction approached significance for SBP, p = .068.

Discussion

Laboratory-based experimental manipulations of social-evaluative threat often evoke substantial neuroendocrine responses and CVR (Dickerson & Kemeny, 2004; Smith et al., 1997), consistent with the view that this common psychological stressor could contribute to poor health generally (Dickerson et al., 2004) and to CVD in particular (Smith & Cundiff, 2011). Although some evidence suggests that the experience of social-evaluative threat during daily experience is associated with momentary increases in ABP (Lehman & Conely, 2010), it is possible that closely related psychosocial factors such as concerns about physical appearance or confidence in one's abilities could contribute this association (Stroud et al., 2001; Wright & Dismukes, 1995).

The present results replicated the prior finding that social-evaluative threat during daily experience was associated with higher ABP, and extended those findings by demonstrating that this association was not due to the potentially overlapping effects of appearance concerns or confidence and perceived ability. Importantly, this association was a direct effect in the case of DBP, but was significantly mediated by concurrent negative affect for SBP. The fact that this association was more direct and somewhat stronger for DBP than SBP is consistent with prior theory and research regarding their underlying determinants, in that perceived threat is more closely associated with increased vascular resistance than with cardiac output (Blascovich, 2008). The effect for SBP was not moderated by gender, but the effect on DBP was apparent only among women. Hence, gender may play a role in the extent to which evaluative threat has specific effects on underlying cardiovascular processes. These results provide further evidence that the physiological effects of social-evaluative threat extend beyond the laboratory to daily life, and occur among working adults. Such effects are noteworthy given that cardiovascular stress responses predict future CVD (Chida & Steptoe, 2010), and ABP in particular is an important predictor in this regard (Janicki-Deverts & Kamarck, 2008).

The present findings should be interpreted with some caution, in that the sample is nearly entirely Caucasian and middle and upper-middle-class. Further, the two potential, more specific form of social-evaluative threat – concerns about acceptance, liking, and inclusion versus concerns about status, competence, respect, and prestige (Smith & Cundiff, 2011) – were not distinguished, and either or both of these social motives could have contributed to the observed effects. Also, the measure of evaluative threat was somewhat indirect, inquiring about the experience of such threat rather than specific evaluative stressors (e.g., speaking in front of others) that might cause it. This emphasis on the experience of threat may have contributed to the mediational findings for SBP, in which effects of threat clearly overlapped with the subjective experience of negative affect. However, the effects for DBP are not easily explained in this manner. A more detailed, context specific measure of social-evaluative threat could address this problem, as well as clarify the circumstances in which effects of evaluative threat on ABP are most apparent. Finally, observational methods during daily life provide important evidence of external or ecological validity, but this approach obviously lacks the level of certainty in causal conclusions regarding the effects of social-evaluative threat available in experimental research.

These limitations notwithstanding, the momentary experience of social-evaluative threat during daily activities was associated with increases in ABP. These effects could not be attributed to closely related psychosocial influences, and therefore replicate and extend the limited evidence previously available in non-laboratory studies (Lehman & Conley, 2010). Such associations between social-evaluative threat and physiological response during daily experience provide important support for conceptual models in which chronic or recurring threats to the social self potentially undermine physical health (Dickerson et al., 2004).

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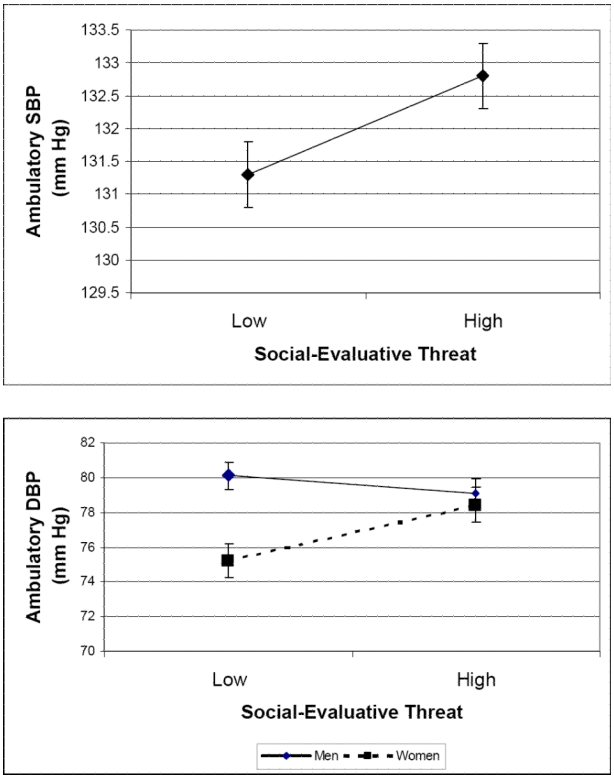

Figure 1.

Association between self-reports of social-evaluative threat assessed via momentary daily experience sampling and concurrent ambulatory systolic (SBP: top panel) and diastolic blood pressure (DBP: bottom panel). Predicted values +/− 1 SD of mean social-evaluative threat, controlling covariates as described in text.

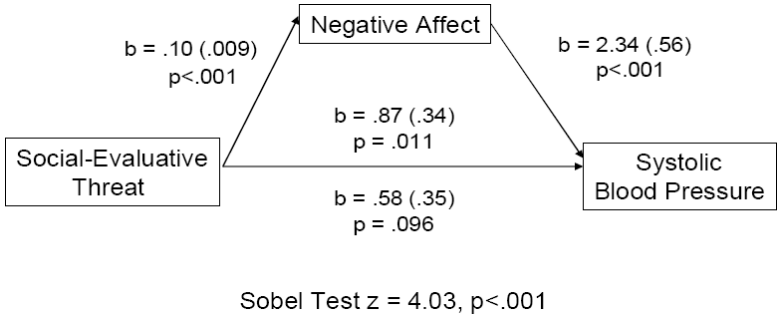

Figure 2.

Mediational analysis of asocial-evaluative threat, negative affect, and ambulatory systolic blood pressure. Unstandardized coefficients (and SE) and significance levels are depicted. The significant association between social-evaluative threat and SBP (values above horizontal line) becomes non-significant when negative affect is controlled (values below the line), and a Sobel test (MacKinnon et al., 2002) indicates a significant mediated effect.