Social Support Versus Social Evaluation: Unique Effects on Vascular and Myocardial Response Patterns

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Objectives: This study examined the effects of companion presence and evaluation on cardiovascular reactivity to an acute stressor. **Methods:** Eighty-two women completed a speech task in one of four conditions: with an evaluative companion present, with a nonevaluative companion present, alone while being evaluated by a companion with a video camera, or alone while the companion waited outside. **Results:** A significant interaction between companion condition and evaluative condition on systolic blood pressure was found; women who were evaluated while alone demonstrated significantly greater reactivity than did women who were in the nonevaluative alone condition. Furthermore, both potential for evaluation and the presence of a companion had important influences on hemodynamic parameters underlying the blood pressure response. Specifically, those in evaluative conditions showed greater myocardial responding than those in nonevaluative conditions and those in alone conditions showed greater vascular responding than did those with companions present. Taken together, those in the evaluative alone condition demonstrated systolic blood pressure responses reflecting both myocardial and vascular contributions. **Conclusions:** Social support and social evaluation have unique effects on vascular and myocardial responding. The implications for future research include focus on the stress-buffering model of social support and the value of including impedance cardiography measures in investigations of cardiovascular functioning. **Key words:** cardiovascular reactivity, social support, evaluation, vascular resistance, impedance cardiography.

CVD = cardiovascular disease; **SBP** = systolic blood pressure; **DBP** = diastolic blood pressure; **MAP** = mean arterial pressure; **TPR** = total peripheral resistance; **TPRI** = total peripheral resistance index; **CO** = cardiac output; **CI** = cardiac index; **PEP** = preejection period; **SV** = stroke volume; **BMI** = body mass index; **BSA** = body surface area.

INTRODUCTION

Social support measured in terms of structure (i.e., number of network members) as well as function (i.e., supportive behaviors) is predictive of development of and mortality from cardiovascular diseases (CVD (1,2)). Social support is associated with improvements in health-related behaviors, including diet, smoking, exercise, and medication adherence (3). However, a strong relationship between social support and cardiovascular health outcomes remains after statistically controlling for these behaviors (4–7). Therefore, it has been proposed that social support also confers direct health benefits by reducing the frequency and/or degree of an individual's cardiovascular response to stress (8).

According to the cardiovascular reactivity hypothesis, individuals experiencing more frequent or more extreme physiological responses to psychosocial stressors have a higher risk for CVD (9). Although there are some inconsistent findings, several lines of evidence support this hypothesis (10). Blood pressure hyperreactivity to psychological stressors has been demonstrated in those with hypertension (11) and in healthy individuals with increased risk of future hypertension (12). Prospectively, large epidemiological studies with follow-up periods of 20 years or more have shown that blood pressure responses to a cold pressor task are predictive of subsequent essential hypertension in initially normotensive samples (13,14). Several studies have found that cardiovascular reactivity is predictive of subsequent resting blood pressure at follow-ups of 1 to 7 years in children (15,16), adolescents (17), young adults (18), and middle-aged adults (17).

Despite the suggestion that social support confers direct health benefits by moderating the frequency and/or degree of an individual's cardiovascular response to stressors (8), the effects of experimental manipulations of social support on cardiovascular reactivity are inconsistent. Some studies have shown response-attenuating effects of support (19–21), whereas others have shown heightened reactivity in the presence of a supportive partner (22) or no effects of support on reactivity (23,24). Support manipulations resulting in reactivity-attenuating benefits may have both reduced evaluation potential and/or provision of facilitative verbal feedback (25,26).

Given the observed pattern of differences across studies, the potential for evaluation may interfere with the stress-buffering effects of a supportive presence, especially in cases in which no verbal feedback is provided. However, to date, no study has directly tested this assertion by comparing social support conditions with and without the potential for evaluation. To address these inconsistencies across studies of social support and cardiovascular reactivity, the current study was designed to directly test the hypothesis that differences in the degree to which the support person has the potential to evaluate the task performance of the participant will influence cardiovascular reactivity.

Moreover, the potential significance of social support effects on blood pressure is unclear because the underlying mechanisms driving the blood pressure changes are not well studied. Therefore, to elucidate possible mechanisms by which blood pressure is altered, the current study also included impedance cardiography measures of hemodynamic function to calculate cardiac output (CO), total peripheral resistance (TPR), stroke volume (SV), and to measure preejection period (PEP).

Blood pressure is an end point that reflects two component processes: CO and TPR. Individuals can be classified based on their typical patterns of responding to psychosocial stressors,

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with myocardial responders tending to respond primarily with increases in CO and decreases in PEP and vascular responders responding primarily with increases in TPR (27,28). Those at greater risk for cardiovascular diseases, including black males compared with white males (29), high-hostile compared with low-hostile individuals (30), normotensive men compared with normotensive women (31), and individuals reporting greater depressive symptoms compared with their less depressed counterparts (32) tend to demonstrate greater vascular responding to stressors. Existing data demonstrating the impact of social support on myocardial versus vascular responding is limited.

In the current study, increases in blood pressure and heart rate were expected in all groups during the stress period, relative to baseline. A main effect for evaluation was expected; those in the evaluative conditions were expected to demonstrate greater heart rate and blood pressure reactivity to the stress task than were those who were not evaluated by a companion. In addition, an interaction between companion condition and evaluation condition was expected, with those in the evaluative companion condition exhibiting the greatest blood pressure and heart rate reactivity and those in the nonevaluative companion condition exhibiting the least.

In terms of impedance measures, it was hypothesized that those in the evaluative conditions would demonstrate primarily vascular responding marked by increases in TPR rather than myocardial responding. In contrast, it was predicted that those in the nonevaluative conditions would demonstrate primarily myocardial response patterns marked by increases in CO and decreases in PEP rather than vascular responding.

METHOD

Participants

Participants were 82 women between the ages of 18 and 30 years recruited from introductory psychology courses. Women received partial course credit and information regarding their blood pressure as compensation for their participation. Participants were required to bring to the experiment a female companion between the ages of 18 and 30 years whom they had known for at least 1 month. Only same-sex friends were used to avoid the potential ambiguity of opposite-sex interactions. Companions received partial course credit for their participation if they were introductory psychology students and received $10 for their participation if they were not. To control for the effects of health status on physiological parameters of interest, those who smoked, had heart disease, high blood pressure, or high cholesterol were excluded from taking part as the primary participant. There was no attempt to control for phase of menstrual cycle because menstrual cycle phase does not appreciably influence blood pressure stress responses (33). This study was approved by The Ohio State University Behavioral & Social Sciences Institutional Review Board. Data were collected from January to June 2004.

Physiological Measures

A Dinamap model 1846 oscillometric blood pressure monitor (Critikon, Inc., Tampa, FL) was used to measure systolic blood pressure (SBP) and diastolic blood pressure (DBP). Electrocardiogram (ECG) data were collected through three disposable spot electrodes placed on the participant's chest in a lead II configuration. Impedance data were collected using the Minnesota model 304B impedance cardiograph (IFM, Greenwich, CT). Four disposable impedance cardiograph electrode bands were placed in a standard tetrapolar configuration around the participant's neck and chest. Electrode gel was applied to the strips to facilitate skin contact. A personal computer using Mindware software (HRV 2.18; IMP 2.18) was used to view and edit the data collected through impedance cardiograph and ECG.

Data were collected in a sound-attenuated laboratory. Throughout the protocol, ECG and impedance data were collected beat-by-beat and blood pressure data were recorded each minute, except during the acclimation period in which blood pressure measures were taken every 2 minutes.

Stroke volume was computed using the Kubicek equation with rho set at 135 ohm/cm (34). Cardiac output was computed as the product of heart rate (HR) and SV. Total peripheral resistance was calculated as mean arterial pressure (MAP)/CO * 80 (dyne * s/cm^5) (35). SV, CO, and TPR were adjusted for body surface area (BSA) and expressed as stroke volume index, cardiac index (CI), and total peripheral resistance index (TPRI), respectively (36). Preejection period, a sensitive index of beta-adrenergic stimulation of the heart (28), was also assessed through impedance cardiography.

Body Composition

Measures of height and weight were assessed for the subsequent calculation of body mass index (BMI; weight divided by height squared (BMI = kg/m^2)). Measures of waist and hip circumference were measured in centimeters in triplicate using a standard flexible tape measure for the calculation of waist–hip ratio (WHR; abdominal circumference/hip circumference (37)).

Demographic and Psychosocial Measures

Participants were asked to provide information regarding their age, race, education level, and their own and family history of cardiovascular disease. Participants were also asked about their use of caffeine, alcohol, and prescription drugs over the previous 12 hours to ensure compliance with participation criteria.

Because hostility may be associated with stronger cardiovascular reactions to stress (38) and therefore may be an important moderator, hostility was assessed using the 50-item Cook-Medley Hostility Scale (39). This scale is a set of true–false items derived from the Minnesota Multiphasic Personality Inventory, which has good internal consistency, $\alpha = 0.88$, and test–retest reliability, with *r*'s between 0.85 and 0.89 (40).

The 14-item version of Cohen's Perceived Stress Scale was used to determine if groups were comparable in subjective experiences of stress and coping using the past week as the timeframe (41). This measure shows adequate reliability (41). To determine if groups were equivalent in sensitivity to evaluation, the Brief Fear of Negative Evaluation (FNE) scale was used (42). This is a 12-item scale measuring the fear of being evaluated negatively by others. Adequate test–retest correlations and internal consistency have been demonstrated for this scale and the measure is highly correlated to the full length FNE (42).

The college version of the Interpersonal Support Evaluation List was used to assess adequacy of participants social support networks. This is a 48-item true–false test, which assesses tangible support, appraisal support, belongingness, and self-esteem support. The measure has high test–retest reliability and internal consistency (43).

Each participant also completed questions from the Social Relationships Index (SRI) with regard to the companion accompanying her. This measure assesses the positivity as well as negativity related to a social tie. The full SRI was developed as a self-report version of the social support interview (44,45). The scale has demonstrated good test–retest reliability and internal consistency (46). Using responses on this measure, friendship quality was classified as "supportive" or "ambivalent" as described by Uno, Uchino, and Smith (47).

Individual questions assessing subjective feelings of being evaluated and being supported were administered at the end of each experimental period (baseline 1, baseline 2, stressor, recovery). Participants were asked to rate their feelings on a 5-point Likert scale with 1 being "little" and 5 being "much." Participants also completed the Positive and Negative Affect Scale (PANAS) at four time points to assess their affective responses to each experimental period. The PANAS is highly reliable with reliability coefficients between 0.84 and 0.90 (48).

Stressor

A speech task was used to elicit acute stress reactions. Participants were given 2 minutes to construct and 3 minutes to deliver a speech. Standardized instructions were provided by videotape. The topic of the speech was a scenario in which participants are wrongly accused of shoplifting a wallet from a department store and must defend themselves from this accusation. Participants were expected to continue speaking for 3 full minutes. If a participant stopped speaking, she was prompted by the researcher to continue speaking. Speeches were recorded on a closed-circuit system, and participants were instructed that their speeches would be rated later for poise, articulation, and quality of arguments.

Manipulation of Companion Presence and Evaluative Context

Participants were randomly assigned to one of four conditions: nonevaluative alone condition, evaluative alone condition, nonevaluative companion condition, or evaluative companion condition. In all conditions, the researcher observed the participant by video camera from another room and was present in the room with the subject only during initial consent signing to bring questionnaire measures at appropriate time points and during debriefing.

In the nonevaluative alone condition, each participant was informed that her friend would wait in the waiting area while she completed the protocol. In the evaluative alone condition, each participant was informed that her friend would be watching her performance from another room by video camera and evaluating her performance on a number of speech dimensions, including speed, poise, clarity, volume, and quality of the arguments.

In the nonevaluative companion condition, companions were seated next to participants as they completed the stressor. Participants were informed that their friends would be present to provide silent support. Companions wore headphones that produced white noise and completed a distracting task (questionnaires) to reduce the actual evaluation. Finally, in the evaluative companion condition, companions were seated next to participants as they performed the speech. Participants and friends were informed that the role of the friend was to evaluate the participant on the previously noted performance dimensions.

Procedure

Each participant was instructed to arrive at the laboratory accompanied by a companion after having abstained from caffeine and alcohol for at least 12 hours. Participants and companions were shown a videotaped explanation of the study, and written informed consent was obtained. Companions were then asked to go to a waiting area while participants completed psychosocial questionnaires.

Next, participants' weight, height, and waist and hip circumference were measured, and they were then fitted with four impedance bands, three spot electrodes, and a blood pressure cuff. Participants were subsequently seated comfortably and instructed to relax while quiet music was played. After a 15-minute acclimation period, baseline measures were taken for 10 minutes (baseline 1).

Participants were then randomly assigned to condition. For those in companion present conditions, friends were brought into the laboratory and seated next to participants. Videotaped standardized instructions directed the participant to continue to relax for 10 more minutes and (when applicable) the companion to begin filling out the questionnaires. Companions were also instructed not to speak to or touch the participant. A second baseline period of 10 minutes (baseline 2) was measured.

After baseline 2, participants and companions (when applicable) were played videotaped instructions explaining their assigned condition. Videotaped instructions for the speech task were then presented and data were collected during the 2-minute preparation and the 3-minute speech task. On completion of the speech, the experimenter asked the companions in the companion present conditions to wait in the waiting area for the remainder of the study.

Finally, participants were informed that the stressor period was concluded and were asked to relax for a 10-minute recovery period while listening to quiet music. At the conclusion of the recovery period, monitoring equipment was removed and companions were asked to come into the laboratory. Participants and companions were debriefed and given copies of the informed consent for their own records.

Analytic Strategy

Analyses were first conducted to determine if any baseline differences existed between the four experimental groups in demographic, descriptive, or companion characteristics. A series of one-way analyses of variance (ANOVAs) were conducted for each psychosocial measure using experimental group as the between-subjects comparison. Potential group differences in family history of cardiovascular disease and race were assessed using χ^2 analyses.

Next, study hypotheses were addressed. Heart rate and impedance measures were averaged across each minute of the protocol. Data from the last 5 minutes of each baseline period, the recovery period, and the entire 5-minute stressor were averaged to obtain a single score for each measure and each period. As previously described, participants were alone during the acclimation period and baseline 1. During baseline 2, those assigned to a companion-present condition were accompanied by their companions as they continued to relax for 10 minutes. At this point, participants were not yet informed if they were assigned to be evaluated by their companions. Therefore, the purpose of baseline 2 was to determine if mere companion presence would affect baseline parameters compared with being alone.

t tests determined that individuals with companions present did not differ from participants who were alone during baseline 2 on any cardiovascular parameter (HR, SPB, DPB, TPR, CO, PEP) (all t values $\leq$0.88, all p values $\geq$.38) or on the PANAS positive or negative affect subscales (all t values $\leq$0.47, all p values $\geq$.64). Because mere companion presence did not affect physiological or affective responses, baseline 1 and baseline 2 measures were averaged for all physiological variables as well as for the PANAS. Baseline refers to this averaged value throughout this report. Reactivity (change) scores were calculated for each physiological variable (HR, SBP, DBP, CI, TPRI, and PEP) by subtracting the average baseline values from the average stressor values.

To determine if the stressor was associated with significant cardiovascular reactivity, a series of one-way repeated-measures ANOVAs were conducted, with experimental period (experimental period: baseline versus stressor versus recovery) as the independent variable and each physiological variable of interest (HR, SBP, DBP, CI, TPRI, and PEP) as dependent variables. Similarly, to determine if the stressor induced measurable changes in affect, a series of one-way repeated-measures ANOVAs were conducted with PANAS scores as the dependent variables. Post hoc Fisher least significant difference (LSD) pairwise comparisons were used to identify which time periods were significantly different.

Affective responses to the stressor were examined using 2 (companion: present versus absent) $\times$ 2 (evaluation: high versus low) ANOVAs with values on the PANAS positive and negative affect subscales reported immediately after the stressor. Similarly, to determine if there were differences in perceived evaluation and support by experimental condition, 2 (companion) $\times$ 2 (evaluation) ANOVAs were conducted on ratings of feeling "evaluated" and "supported" during the stressor. Again, post hoc tests LSD pairwise comparisons were used to identify which time periods were significantly different.

The main analyses to determine if differences in support condition resulted in differential physiological reactivity were conducted using a series of 2 (companion) $\times$ 2 (evaluation) ANOVAs with change scores from baseline to stressor for each physiological variable, separately. Post hoc tests for simple main effects were used to determine group differences in the case of significant interactions.

RESULTS

Demographic and Descriptive Measures

The participants in the four experimental conditions did not differ with respect to any demographic or descriptive measures assessed (see Table 1). Specifically, groups did not differ significantly in age, height, weight, BMI, or waist–hip

TABLE 1. Demographic and Descriptive Variables for Experimental Groups

	Evaluative Companion (n = 21)	Nonevaluative Companion (n = 20)	Evaluative Alone (n = 20)	Nonevaluative Alone (n = 21)
Age (years)	19.6 (0.6)	20.1 (2.0)	19.9 (0.6)	19.7 (1.0)
Height (cm)	165 (5.0)	167 (11.9)	165 (7.2)	164 (5.2)
Weight (kg)	67.9 (10.4)	68.0 (11.9)	64.1 (9.9)	70.7 (15.0)
Body mass index (kg/m^2)	24.89 (3.4)	24.39 (3.4)	23.48 (3.5)	26.18 (5.4)
Waist–hip ratio	0.79 (0.04)	0.77 (0.04)	0.78 (0.05)	0.79 (0.04)
Percent with first-degree family history of cardiovascular disease	71%	50%	55%	48%
Length of friendship (months)	31 (54)	32 (42)	26 (45)	28 (39)

Data are given as means (standard deviations). One-way analyses of variance indicated that there were no significant differences between groups on any of these variables (p values ≥.19).

ratio (all F values ≤1.62, all p values ≥.19). The majority of participants (68%) identified themselves as white/Caucasian. In addition, 20% identified themselves as black/African-American, 6% as Asian, and 2% as Hispanic. Three participants did not indicate their race. A χ^2 test of independence indicated that there was no difference between conditions in the percentage of participants identifying themselves as a given race (χ^2 (12) = 13.51, p = .33).

Frequency analysis demonstrated that 56% of the total sample reported a family history of cardiovascular disease defined in this study as myocardial infarction, angina pectoris, hypertension, or heart disease in one or more first degree relatives (see Table 1). χ^2 analyses indicated no significant difference between groups in the frequency of family history of cardiovascular disease (χ^2 (3) = 2.93, p = .40).

Groups did not differ significantly in scores on any baseline psychosocial measure. Specifically, one-way ANOVAs indicated that groups did not differ significantly on Cohen's Perceived Stress Scale, Fear of Negative Evaluation, Cook-Medley Hostility Inventory total score or subscales, Interpersonal of Support Evaluation List subscales, or Test of Negative Social Exchange subscales (all F values (3,78) ≤1.68, p values ≥.17).

The average companion age was 19.7 years (standard deviation [SD] = 1.2) and participants reported knowing their friends for an average of 29 months (SD = 44.4) (see Table 1). One-way ANOVAs indicated that there was no statistically significant group difference in companion age (F (3,77) = 0.80, p = .50) or length of friendship (F (3, 78) = 0.06, p = .98). Most participants (82%) were accompanied by companions of the same race. In terms of relationship quality, 57% of participants reported supportive relationships with the companion accompanying them, and 43% reported ambivalent relationships. χ^2 tests of independence revealed no significant group difference in relationship quality (χ^2 (3) = 0.68, p = .88).

Manipulation Checks

Physiological Response to Stressor

One-way ANOVAs indicated that there was a significant effect for time for each cardiovascular parameter measured (all F (2,156–158) ≥33.57, p values <.001; see Table 2). Post hoc LSD pairwise comparisons revealed that, as expected, the stressor elicited statistically significant decreases in PEP and increases in HR, SBP, DBP, TPRI, and CI relative to baseline (p values <.01).

Affective Response to Stressor

One-way ANOVAs indicated significant main effects for experimental period on the PANAS positive affect subscale (F (2,154) = 33.19, p < .001) and negative affect subscale (F (2,154) = 63.95, p < .001). Post hoc LSD pairwise comparisons indicated that both positive and negative affect were higher during the stressor than during baseline (p values <.001).

Group Differences in Subjective Feelings of Support and Evaluation

ANOVAs revealed a statistically significant interaction between the companion and evaluation conditions for feeling

TABLE 2. Physiological Variables at Each Experimental Period

	Baseline	Stressor	Recovery
Systolic blood pressure (mm Hg) (n = 80)	103 (7.3)^a	116 (11.7)^b	106 (7.8)^c
Diastolic blood pressure (mm Hg) (n = 80)	59 (5.8)^a	70 (7.1)^b	61 (6.1)^c
Heart rate (beats/min) (n = 80)	68 (10.0)^a	83 (12.6)^b	70 (9.8)^c
Total peripheral resistance index (dynes-sec/cm^5) (n = 79)	1572.6 (332.5)^a	1634.8 (341.6)^b	1452.5 (324.7)^c
Cardiac index (L/min/m^2) (n = 80)	4.0 (0.8)^a	4.5 (1.1)^b	4.1 (0.9)^c
Preejection period (ms) (n = 80)	115 (13.8)^a	103 (14.9)^b	112 (13.6)^c

Data are given as means (standard deviations). Repeated-measures analyses of variance were used to compare measures across experimental periods. Values within the same row with different superscripts are significantly different at the alpha <0.01 level.

"evaluated" (F (1,81) = 5.79, p = .02). Post hoc tests for simple main effects demonstrated that those in the evaluative companion condition reported significantly greater subjective feelings of evaluation than did those in the nonevaluative companion condition (t (39) = 2.25, p = .03). Those who were alone during the task did not differ significantly in feelings of evaluation regardless of evaluative condition (t (39) = 0.75, p = .46). For feeling supported, ANOVA revealed a significant main effect for evaluation level on feelings of support (F (1,81) = 8.28, p = .005). Those in the evaluative conditions reported feeling significantly more supported than did those in the nonevaluative conditions.

Group Differences in Subjective Affect Poststress

The series of 2 (companion) × 2 (evaluation) ANOVAs on subjective affect measures after the stressor indicated that there was a significant main effect of evaluative condition on the negative affect subscale of the PANAS (F (1,77) = 6.87, p = .01) with those in the evaluative conditions reporting greater negative affect than did those in the nonevaluative conditions.

Group Differences in Physiological Response to the Stressor

Results indicated a significant interaction effect between companion condition and evaluation condition on change scores for SBP (F (1,77) = 4.07, p = .047) (see Fig. 1). Post hoc tests for simple main effects indicated that those in the evaluative alone condition showed significantly greater SBP reactivity than did those in the nonevaluative alone condition (t (38) = 2.61, p = .01). Among those with a companion present, no differences were seen (t (39) = 0.45, p = .66).

A main effect for evaluation on HR reactivity approached significance (F (1,77) = 3.81, p = .055). Those in the evaluative conditions showed an average increase of 17 beats/minute (SD = 10.09), whereas those in the nonevaluative conditions showed an average increase of 13 beats/minute (SD = 7.94). Similarly, a main effect for evaluation on DBP reactivity approached significance (F (1,77) = 3.56, p = .06) with those in the evaluative conditions showing a 12-mm Hg (SD = 6.17) increase and those in the nonevaluative conditions showing a 10-mm Hg (SD = 5.77) increase.

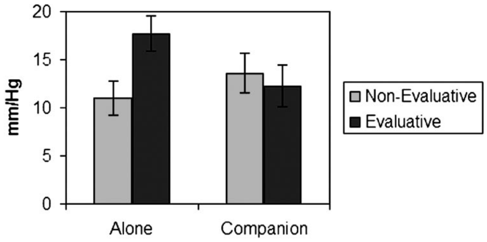

Figure 1. Mean change scores (±1 standard deviation) in systolic blood pressure (SBP) (mm Hg) elicited by the stressor, by experimental condition. A significant interaction is noted (p = .05). Those in the evaluative alone condition exhibited significantly greater SBP reactivity than did those in the nonevaluative alone condition. Potential for evaluation did not influence SBP reactivity when a companion was present.

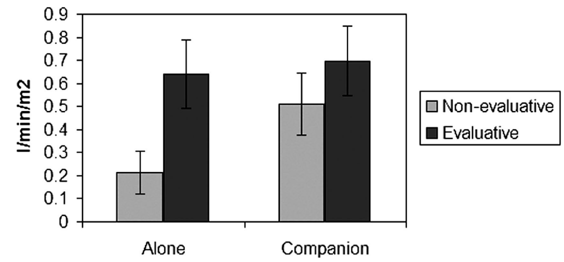

Figure 2. Mean change scores (±1 standard deviation) in cardiac index (CI) (L/min/m^2) elicited by the stressor, by experimental condition. A significant main effect for evaluation level (p = .03) demonstrates that those in the evaluative conditions exhibited significantly greater CI reactivity than did those in the nonevaluative conditions.

A significant main effect was seen for evaluation level on CI reactivity (F (1,77) = 5.24, p = .03). Those in the evaluative conditions exhibited an average increase of 0.67 L/min/m^2 (SD = 0.67) in CI, whereas those in the nonevaluative conditions showed an increase of 0.35 L/min/m^2 (SD = 0.53) (see Fig. 2). Similarly, a significant main effect for evaluative condition was seen for PEP change scores (F (1,77) = 6.43, p = .01). Those in the evaluative conditions exhibited an average decrease of −14.98 ms (SD = 11.60), while those in the nonevaluative conditions exhibited an average decrease of −8.85 ms (SD = 9.60) (see Fig. 3).

Finally, a main effect of companion presence on TPRI reactivity was evidenced (F (1,76) = 4.21, p = .04). The average increase in TPRI was 16.97 dynes-s/cm^5 (SD = 142.23) for those in the companion present conditions, whereas the average increase for those in the alone conditions was 100.61 dynes-s/cm^5 (SD = 208.67) (see Fig. 4).

DISCUSSION

It has been hypothesized that the presence of a supportive person during stress may be beneficial to health by attenuating one's cardiovascular response to the stressor (8). However, results of studies using social support manipulations have been inconsistent with some studies showing that social support attenuated reactivity, and others showing either increased reactivity or no effect (25). The basis for these inconsistencies may be that, in some instances, the support person was an evaluative threat, resulting in increased rather than attenuated reactivity (25,26,49). However, it is difficult to interpret the pattern of results across

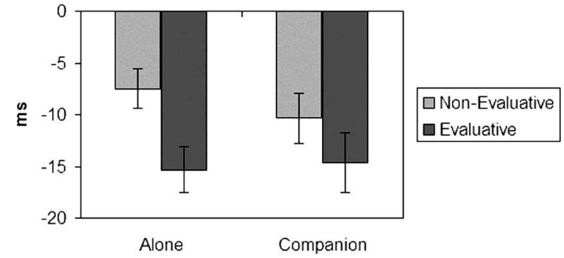

Figure 3. Mean change scores (±1 standard deviation) in preejection period (PEP) (ms) elicited by the stressor, by experimental condition. A significant main effect for evaluation (p = 0.01) indicates that those in evaluative conditions exhibited significantly greater PEP reactivity than did those in the nonevaluative conditions.

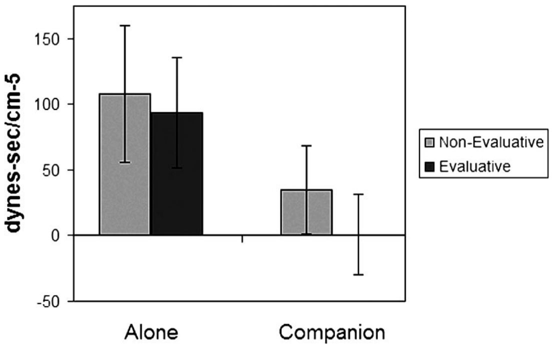

Figure 4. Mean change scores (±1 standard deviation) in total peripheral resistance index (TPRI) (dynes-sec/cm^5) elicited by the stressor, by experimental condition. A main effect for companion condition ($p = .04$) was seen with those in the alone conditions exhibiting significantly greater TPRI reactivity than those in the companion present conditions.

studies because studies differ in design. The current study is unique in that it was designed to specifically test whether social support can have either attenuating or augmenting effects on cardiovascular reactivity depending on the manner in which it is presented. The primary hypothesis tested was that the presence of a companion would attenuate cardiovascular reactivity to a stressor if that person were not an evaluator of task performance, but would increase cardiovascular reactivity to a stressor if that person were an evaluator.

Contrary to prediction, the current investigation found that the presence of a companion neither attenuated nor increased HR, SBP, and DBP reactivity when compared with the nonevaluative alone condition. The nonevaluative alone condition was designed to be equivalent to control conditions used in many studies of acute stressors (e.g., (19,22)). Therefore, these findings are in clear contrast to the hypothesis that, compared with an alone condition, nonevaluative support attenuates reactivity to acute stressors, whereas support with potential for evaluation increases reactivity. The current study does not support the hypothesis that inconsistent results across previous studies can be explained by differences in the potential for evaluation.

The stress-buffering model of social support postulates that beneficial effects of social support are seen only in conditions of sufficient stress (1,50). Therefore, it is possible that attenuating benefits of social support were not seen in the nonevaluative companion condition because the stressor did not elicit sufficient physiological stress responses to allow for effects of companion presence. In the current study, the average increase in SBP was 14 mm Hg overall. Indeed, higher reactivity has been noted in previous studies using similar stressors. For example, Smith et al. (51) reported average responses to a speech stressor of 20 mm Hg for those under low evaluative threat and 27 mm Hg for those under high evaluative threat. Because the current study used only one stressor, a stress-buffering model comparing different levels of stress could not be tested. This is a promising area for future research.

The current study was also designed to test mechanisms underlying the blood pressure changes by simultaneously measuring TPR, CO, and PEP. It was hypothesized that those in the high evaluation conditions would demonstrate greater vascular responding as evidenced by increases in TPRI, whereas those in the low evaluation conditions would demonstrate greater myocardial responding as evidenced by increases in CI and decreases in PEP. Results indicated a main effect of evaluation on CI and PEP reactivity. However, contrary to prediction, those in the evaluative conditions exhibited greater responses in CI and PEP than did those in the nonevaluative conditions. In addition, contrary to prediction, evaluation did not exert a main effect on TPRI responding. Instead, a main effect of companion presence was seen; those in the alone conditions demonstrated significantly greater TPRI responding than did those in the companion present conditions.

Exaggerated vascular responding may result in detrimental health effects through several pathways. First, although myocardial reactivity peaks quickly and habituates relatively rapidly during acute stress, vascular reactivity increases over the stressor period (52). Frequent or extended peripheral vasoconstriction may lead to sustained increases in resting peripheral resistance over time, potentially resulting in the development of a hypertensive state (53). Exaggerated vascular responding may result in endothelial dysfunction and subsequent vascular remodeling (54). In the current study, the fact that companion presence resulted in attenuated vascular responses suggests the possibility that this form of social support leads to less detrimental pressor responses, although overall SBP reactivity was not attenuated. These results suggest that one mechanism underlying associations between greater social support and better health is the reduction of vascular responding in the presence of a preferred companion.

Subjective appraisals of support and evaluation did not predict the relationship between the experimental manipulations and the physiological outcomes. This is consistent with other studies that have found subjective affect to be a poor predictor of the effects of support manipulations on physiological outcomes (e.g., (20,21,25)). In the current study, social support was operationally defined as the presence of a companion who could not evaluate task performance. Regardless of perceived support and evaluation, the experimental manipulations resulted in different physiological responses to the stress task. The fact that subjective perceptions of the experimental conditions did not mediate the relationship between experimental manipulations and physiological reactivity may have resulted from several factors. For example, the measure of perceived support in the current study was a one-item measure; this may not have been adequate to accurately and fully capture the construct of perceived support. In addition, the experimental manipulations used may have resulted in cognitive or affective changes that could be not consciously recognized and reported. Moreover, the presence of a companion may have affected perceptions other than support that were not measured.

In terms of the support manipulation, a limitation of the current study is that only silent social support was used. As described earlier, examination of patterns across studies of the effects of support on cardiovascular reactivity suggests that manipulations resulting in attenuation of cardiovascular reactivity may be characterized by reduced potential for evaluation and/or provision of verbal feedback from the companion (25,26). The current study examined only the effects of evaluation. To create a nonevaluative support condition, companions were prevented from hearing subject responses and completed questionnaires while participants gave their speeches. Therefore, companions were prevented from providing any verbal or nonverbal feedback to the participant, which may have reduced the perception of support. Indeed, individuals in the evaluative companion condition reported higher perceived support than did individuals in the nonevaluative companion condition. However, as described previously, perceptions of support did not mediate the effects of the support manipulations on cardiovascular reactivity measures. Future research comparing conditions of silent support versus interactive support on measures of impedance cardiography and affect would be useful. Moreover, a focus on potential cognitive or affective mediators other than perceived support may be key.

The fact that women in evaluative conditions reported greater perceived support than did those in nonevaluative conditions is particularly interesting in light of the finding that evaluation by a companion was related to greater myocardial responding. Myocardial responding may be more likely when stressors are appraised as challenging rather than threatening (27). The perception of a task as challenging versus threatening depends on one's assessment of the difficulty of the task and one's perceived ability to meet those demands. Individuals who believe that the task outweighs their resources to cope will experience a given stressor as a threat, whereas individuals who believe they have adequate resources to cope will experience the task as a challenge (27). Although threat perception was not directly measured in the current study, individuals who were evaluated by their companions reported greater feelings of support. Conceptually, greater feelings of support will add to a person's perceived coping resources and reduce the perception of threat.

The current study used female participants between the ages of 18 and 30 years. Therefore, these results may not generalize to males or other age groups. Men typically show greater cardiovascular reactions to performance-oriented stressors than do women (55). In addition, men may be less responsive to manipulations of support than are women (56). In terms of age differences, both men and women tend to show greater SBP reactivity with age as a result of age-associated increases in both CO and TPR during stress (57). Therefore, the overall magnitude of reactivity noted would likely be higher in an older group, and this may influence the degree to which support manipulations exert an effect.

In the current study, only one task was used, so the stress-buffering effects of social support could not be compared across stressors of different magnitude. When measuring a trait characteristic such as cardiovascular reactivity that shows crosstask stability, but also situational stereotypy, assessing individuals' reactions to multiple stressors provides a more complete picture of their overall response patterns (58).

In summary, these results indicate that although the presence of a companion did not attenuate overall blood pressure responses as measured by SBP and DBP, it did attenuate detrimental vascular responding. This study also demonstrated unique effects of companion presence versus companion evaluation on physiological reactivity. Evaluation by a companion increased myocardial responding as evidenced by CI and PEP reactivity, whether a companion was present or not. However, companion presence attenuated vascular responding, as evidenced by TPRI reactivity, whether the companion was evaluative or not. Therefore, relatively high SBP reactivity was seen for those in the evaluative alone condition because they had a tendency to exhibit both TPRI and CI responding.

Finally, the results of this study did not support the notion that potential for evaluation prevents attenuating effects of social support, and it did not demonstrate an attenuating benefit of nonevaluative social support. Future research should focus on alternative reasons for discrepancies between studies, including the fact that the presence of another may exert differential influence depending on the intensity of the stressor as delineated by the stress-buffering model. In addition, future research should use impedance measures in addition to measures of SBP, DBP, and heart rate. As demonstrated by the current study and others (e.g., (59)), differences in component processes underlying blood pressure change may be evidenced even when blood pressure changes are not significantly different between groups. In addition, assessing these underlying components allows for a better understanding of mechanisms linking reactivity to disease outcomes.

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