Social Support, Social Intimacy, and Cardiovascular Reactions to Acute Psychological Stress

Phillips, Anna; Gallagher, S; Carroll, Douglas

DOI:
10.1007/s12160-008-9077-0

Post-print, not final published version. Cite this article as: Phillips, A.C., Gallagher, S., & Carroll, D. (2009). Social support, social intimacy, and cardiovascular reactions to acute psychological stress. *Annals of Behavioral Medicine,* 37, 38-45. DOI: 10.1007/s12160-008-9077-0. http://dx.doi.org/10.1007/s12160-008-9077-0

Social support, social intimacy, and cardiovascular reactions to acute psychological stress

Anna C. Phillips*, Stephen Gallagher, Douglas Carroll

School of Sport and Exercise Sciences
University of Birmingham
Birmingham B15 2TT
United Kingdom

*Corresponding author: Anna C. Phillips, PhD, Tel: +44 121 414 4398, Fax: +44 121 414 4121, E-mail: A.C.Phillips@bham.ac.uk

Abstract

Background: Exaggerated cardiovascular reactions to psychological stress are considered a risk factor for cardiovascular morbidity. Social support may reduce such risk by attenuating cardiovascular reactivity to stress. Purpose: To examine the effects of three independent social support variables and their interaction on cardiovascular reactivity to acute stress. The variables were stranger or friend presence; active supportive or passive presence, and male or female presence. Methods: Cardiovascular reactions to mental arithmetic stress were measured in 112 healthy young women tested in one of eight distinct independent conditions: active supportive male friend; active supportive female friend, passive male friend; passive female friend; active supportive male stranger; active supportive female stranger, passive male stranger; and passive female stranger. Results: Support from a friend rather than a stranger was associated with attenuated blood pressure reactivity, but only when the supporter was a male friend. Support from a male stranger or female friend was associated with augmented blood pressure reactivity. Conclusions: This interaction between the intimacy and sex of the supporter on cardiovascular reactivity extends the findings of previous laboratory studies of social support and can, to an extent, be interpreted in terms of Social Comparison Theory.

Keywords: acute psychological stress; cardiovascular reactivity; social support;

1. Introduction

Large magnitude cardiovascular reactions to acute psychological challenge are regarded as risk factors for cardiovascular disease (1, 2) and several prospective studies have now shown consistently that high reactivity confers a modest additional risk for elevated blood pressure and other cardiovascular outcomes (e.g. 3-5). In addition, epidemiological evidence attests to a negative association between social support and disease outcomes, including cardiovascular morbidity and mortality, such that those with poorer social support had a greater risk of cardiovascular disease and death from cardiovascular causes (e.g. 6-9). It has been hypothesised that social support may enhance cardiovascular health, at least in part, by attenuating the cardiovascular reactions to stress exposure (10, 11).

A number of studies have now tested the proposition that the presence of supportive others attenuates cardiovascular reactivity (12). Most studies have, for convenience, tested student samples, particularly female students. Two broad paradigms have been employed. In one, the behaviour of the supportive other(s) is orchestrated to offer active social support when participants are faced with a psychologically challenging task. In the other, the supportive other is largely passive; however, their relationship with the participant is contrived to vary. For the most part, studies that have examined the effects of active social support have had students give a speech, usually on a controversial topic, and compared cardiovascular reactions to this task in different social contexts: alone, with challenging or non-supportive others present, with actively supportive others present. In general, those with supportive others present exhibited lower reactivity than those tested in other conditions (13-15). A larger number of studies have examined the effects of the more passive presence of others on cardiovascular reactions to an acute psychological challenge, most commonly mental arithmetic. Although there are exceptions (16-18), people tested with a friend present have generally been observed to show lower reactivity than those tested alone and/or with a stranger present (19-23).

From these studies, the issue arises as to which is more potent in this context: the supportive behaviour of the other(s) present or their intimacy with the participant. To

date, we know of only one study that has collected data that bear directly on this issue (13). Female college students presented a speech, either in the presence of actively supportive friends or strangers or in the presence of non-supportive strangers. Those actively supported, whether by friend or stranger, exhibited smaller cardiovascular reactions than those tested with the non-supportive stranger. In addition, for systolic blood pressure reactivity, those supported by a friend showed smaller reactions than those supported by a stranger. This suggests that both social support and intimacy are factors that contribute to the attenuation of stress reactivity. However, the inclusion of a non-supportive friend condition in this study would have permitted a fuller picture to emerge of the relative potency of these two influences.

Accordingly, the present study revisited the issue of the relative influence of the behaviour of the other person present and their relationship with the participant using a full factorial design. In addition, few studies have examined the effects of the sex of supportive other on cardiovascular reactions to challenge and the results are inconsistent. Supportive females have been reported to attenuate reactions to a speech task whereas supportive men had no such effect (24). In contrast, another study found no main effect of sex of supporter (25). We have recently reported that women undergoing a mental stress test in their homes in the presence of their male partners showed attenuated reactions relative to men tested with their female partners present (26). Clearly, sex of supporter warrants further attention. Thus, in the current study, in addition to studying the effects of active versus passive support and the impact of the presence of a friend versus a stranger, we also examined the impact of the sex of other person present on cardiovascular reactions to acute psychological stress. We hypothesised that active support, particularly when provided by a friend would result in attenuated reactivity; we had no clear expectations regarding the sex of the supporter.

2. Method

2.1. Participants

Participants were 112 female undergraduate students from the University of Birmingham, recruited between October and March in 2006-07 and 2007-08. Their mean (SD) age

was 19.7 (1.29) years, and mean (SD) body mass index was 22.9 (2.91) kg/m^2. Participants were excluded if they were suffering from an acute illness, taking any prescription medication (excluding the contraception pill) or suffering from any long standing cardiovascular disease. The inclusion of only female participants was determined largely by the complexity of the current design (see below) and the focus of previous research in the field which, in the main, was carried out on young women. The study was approved by the appropriate ethics committee and was therefore performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki. Participants received course credits for taking part.

2.2. Design

The study employed a one-session between-subjects factorial design, in which the nature and behaviour of the other person present during stress testing were manipulated. The study tested three independent variables and their interaction: stranger or friend presence; active supportive or passive presence, and male or female presence. In combination, this yielded eight distinct independent conditions: active supportive male friend; active supportive female friend, passive male friend; passive female friend; active supportive male stranger; active supportive female stranger, passive male stranger; and passive female stranger. There were 14 participants per condition.

2.3. Apparatus

Weight and height were measured in the laboratory using standard scales and height metre. Systolic blood pressure (SBP), diastolic blood pressure (DBP), and heart rate (HR) were measured intermittently using a semi automatic-oscillometric blood pressure monitor (Dinamap 1846, Critikon). The cuff was placed over the brachial artery on the non-dominant arm

2.4. Psychological stress task

The paced auditory serial addition test (PASAT) (27) was used as the psychological stress task. The PASAT has been shown in numerous studies to consistently perturb the

cardiovascular system (e.g. 26, 28, 29), and to demonstrate good test-retest reliability (30). Briefly, single digit numbers were presented by audio CD player. Participants were asked to add together each pair of numbers and say the answer out loud, while retaining the previous number in order to add it to the next number presented. The test lasted for 4 minutes with the numbers being presented faster as the test progressed. Numbers were presented at rates of 2.4, 2.0, 1.6, and 1.2 seconds apart during each minute, respectively, with a 5 second break at the end of each minute of the task. Elements of competition and social evaluation were involved in the test. A false leader board was in view of the participant, who was instructed to try to beat the scores on the board. The experimenter wore a white laboratory coat and scored the answers overtly while sitting on a high stool at a distance of 1m facing the participant, and the laboratory was in semi-darkness, with a desk lamp focusing on the participant. These conditions were engineered to add to the psychological separation between themselves and the participant, friend, or stranger. The participant was seated in front of a large television screen which allowed them to see themselves live throughout the test, and were instructed to look at the screen at all times. They were also informed that they were being video taped and their videos were to be assessed by "independent body language experts", but no such assessment was made. The experimenter also sounded a loud aversive noise using a buzzer once during the first five of every ten trials at random time points (6 times in total). Participants began the test with a score of 1000 points; for every incorrect answer 5 points were deducted from their score.

Immediately on task completion, participants completed a self report measure about the psychological impact of stress task and the support they had received. This consisted of nine items which were rated on 7-point likert scales (0 = 'not at all' to 6 = 'extremely'). Over seven items, participants rated their task performance, and how difficult, stressful, arousing (exciting), confusing, and engaging they found the task. There were two questions about how psychologically close they felt to the person sitting next to them during the task, and how supportive that person was throughout the task. Finally, participants who brought a friend were asked to indicate, again on a 7-point scale, the closeness of their relationship to that person.

2.5. Support manipulations

Assignment to condition was by a pre-arranged random schedule. Participants were informed that they would be asked either to bring a close friend with them or to attend alone. On arrival at the session, participants were informed that there would be someone (friend or stranger) sitting next to them during the stress task using the following prompt "Normally you would be tested alone, but this time we have allowed someone to sit next to you to support you during this difficult and stressful task. However, you should not talk to your support person, other than to say hello at the outset. Nor should let your supporter distract you, as to do well on the task requires your full and complete concentration.". If the participant was assigned to the "friend" condition, she was asked to bring her best friend (locally) and that this was not to be a romantic partner. Following the random schedule, half of the participants assigned to the "friend" condition were asked to bring their closest male friend, and half their closest female friend. At the start of the testing session, the friend was asked to remain outside the laboratory and was given an information sheet describing their role in the experiment. If the participant was assigned to the "stranger" condition, they were allocated either a male or female stranger, one of the collaborators, to sit with them during the task; this person was also given an information sheet about the experiment and asked to wait outside. Friends and the stranger collaborators assigned to the supportive condition were provided with a script containing brief encouraging prompts (e.g. keep going, you're doing really well; you're doing much better than I would). He/she was asked to speak them aloud at designated times during the stress task in such a way that the participant did not realise they were being read out. Designated times were immediately prior to the task, once after each minute of the task, and immediately afterwards. The task was paused briefly so that these supportive interjections would not interfere with task performance. If the friend or stranger was assigned to the passive condition, he/she was given an information sheet describing the experiment but no script of prompts, and was asked to remain silent throughout the study.

2.6. Procedure

Prior to arrival participants were asked not to exercise or drink alcohol for 12 hours before the session; not to consume caffeine or nicotine for 2 hours before; and not to eat for 1 hour before the session. On arrival, participants gave informed consent and were weighed and measured and their body mass index calculated. The blood pressure cuff was then attached and a reading taken to acquaint participants with the sensation of cuff inflation. There was then a 20-minute formal baseline rest period, after 10 minutes of which, the friend or stranger entered the room and was seated to the right-hand side of the participant, just out of view. As indicated above, the participant was instructed to make no contact with the friend or stranger other than to say hello at the outset, and told to avoid letting the friend or stranger distract them during the task, as their full concentration would be needed. After the baseline period, the task was explained to the participant and a 20-second practice task was allowed, during which they responded as they would in the actual task. Participants then underwent the 4-minute task, followed by an 8-minute recovery period during which they completed the task rating scale of the task and the support and closeness measures The friend or stranger remained seated next to the participant during recovery. SBP, DBP, and HR readings were initiated at the start of the 14th, 16th, 18th and 20th minute of baseline rest, and the 2nd and 4th minute of the task.

2.7. Data reduction and analyses

The four resting baseline measures were averaged to yield a baseline value for each of the cardiovascular parameters. The two task measures were similarly averaged to yield a task value. For each parameter, reactivity was calculated as the simple arithmetic difference between baseline and task values. The data were interrogated using analysis of variance (ANOVA). First off, a simple repeated measures (baseline, task) ANOVA was undertaken to determine whether, irrespective of support condition, the stress task perturbed cardiovascular activity. Second, analyses shifted to the baseline cardiovascular values and a series of 2 (friend, stranger) × 2 (support, passive) × 2 (male, female) ANOVAs were undertaken. Third, in order to test the main hypotheses, a series of 2 × 2 × 2 ANCOVAs were conducted on the reactivity values. The appropriate baseline cardiovascular value was entered as a covariate in each of these analyses to control for baseline effects on reactivity. Where appropriate, post-hoc tests were undertaken using

the Duncan's Multiple Range test. A subsequent ANCOVA was undertaken to discount the possibility than any support effects were the result of confounding. In this analysis, PASAT performance was entered as a covariate, since we have previously found it to be a good measure of task engagement and to correlate with cardiovascular reactivity (26). Throughout, partial η^2 is reported as a measure of effect size.

3. Results

3.1. Manipulation Check

Analysis of post-task responses to the question 'How psychologically close did you feel to the person sitting next to you?' revealed a highly significant main effect of whether the support was from a friend or stranger, $F(1,104) = 29.50$, $p < .001$, $\eta^2_p = .221$; the means (SD) were 2.7 (1.62) and 1.3 (1.20) for friend and stranger, respectively. The only other significant effect was that those in the active support condition rated themselves as feeling closer to the person sitting next to them than those in the passive condition, $F(1,104) = 4.72$, $p = .03$, $\eta^2_p = .043$; the means (SD) were 2.3 (1.53) and 1.7 (1.61) for active and passive support, respectively. Analysis of responses to the question 'How supportive did you feel the person sitting next to you was?' yielded a highly significant effect of whether the support was active or passive, $F(1,104) = 79.02$, $p < .001$, $\eta^2_p = .432$. The means (SD) were 3.5 (1.29) and 1.3 (1.48) for the active and passive conditions, respectively. There was also a main effect of whether the supporter was a friend or stranger; $F(1,104) = 14.67$, $p < .001$, $\eta^2_p = .124$, with friends (mean = 2.9, SD = 1.71) being seen as more supportive than strangers, (mean = 1.9, SD = 1.72). No other significant effects emerged. Finally, as indicated, those participants who brought a friend were asked "how close are you to the person you brought with you?". There were no differences in the rated closeness of their relationship to the friend consequent on their sex (male friend mean = 4.4, SD = 1.19, female friend mean = 4.6, SD = 0.92) or whether friends were allocated to the active (mean = 4.4, SD = 1.19) or passive support condition (mean = 4.6, SD = 0.92).

3.2. Social Support and Cardiovascular Activity at Baseline

There were no significant main or interaction effects of friend/stranger presence, active/passive support, or sex of supporter on SBP, DBP, or HR at baseline.

3.3. Cardiovascular reactions to stress

The task elicited substantial increases in cardiovascular activity: for SBP, $F(1,111) = 328.49$, $p < .001$, $\eta^2_p = .747$; for DBP, $F(1,111) = 450.65$, $p < .001$, $\eta^2_p = .802$; and for HR, $F(1,111) = 263.88$, $p < .001$, $\eta^2 = .704$. The mean (SD) values for baseline and task are presented in Table 1.

[Insert Table 1 about here]

3.4. Social Support and Cardiovascular Reactivity

There were no main effects of whether the person present was supportive or passive, was a friend or stranger, or was male or female on SBP reactivity. However, there was a significant two-way interaction between friend versus stranger and the sex of the supporter, $F(1,104) = 5.34$, $p = .02$, $\eta^2_p = .049$. This reflects a difference between the effect of male friend and female friend and a male stranger and female stranger such that SBP reactivity was lower when the support was from a male friend (mean = 12.3, SD = 7.36) versus a female friend (mean = 17.5, SD = 8.87), and lower when support was from a male friend versus a male stranger (mean = 17.1, SD = 8.28). This interaction effect is illustrated in Figure 1. There was also a significant 3-way interaction $F(1,104) = 4.63$, $p = .03$, $\eta^2_p = .043$, illustrated in Figure 2, inspection of which indicates that active as opposed to passive social support was associated with attenuated SBP reactivity but only when the active supporter was a male friend or female stranger. When a female friend or male stranger was actively supportive, SBP reactivity was increased.

[Insert Figures 1 and 2 about here]

For DBP reactivity, again there were no significant main or interaction effects. However, the two-way interaction between friend/stranger presence and sex of supporter approached significance, $F(1,104) = 2.94$, $p = .09$, $\eta^2_p = .027$, such that DBP reactivity

was attenuated when support was from a male friend (mean = 9.9, SD = 5.74) than a male stranger (mean = 13.4, SD = 5.44). For HR reactivity, there was a trend for a main effect of the sex of supporter; $F(1,104) = 3.72$, $p = .06$, $\eta^2_p = .035$, such that HR reactivity was greater when support was from a female (mean = 20.1, SD = 12.33) than from a male (mean = 15.8, SD = 10.73).

3.5. Task performance and subjective impact of the task

There were no significant main or interaction effects of the sex of support, type of support, or friend versus stranger on PASAT performance score. Analysis of the post-task PASAT evaluations revealed only two significant effects: for ratings of task difficulty there was a main effect of whether the support was from a friend or a stranger, $F(1,104) = 9.71$, $p = .002$, $\eta^2_p = .085$. The task was perceived to be more difficult when the support was from a friend (mean = 4.9, SD = 0.84) than from a stranger (mean = 4.4, SD = 0.85). Further, for task stressfulness, there was a significant interaction between active versus passive support and whether the support was from a friend or stranger, $F(1,104) = 9.49$, $p = .003$, $\eta^2_p = .084$, such that the task was perceived to be more stressful when support was passive and from a friend.

3.6. Social support and cardiovascular reactivity adjusting for potential confounders

PASAT performance score was significantly negatively correlated with rating of task difficulty, $r(110) = -.50$, $p < .001$; and positively correlated with ratings of own performance, $r(110) = .69$, $p < .001$, and engagement with the task, $r(110) = .33$, $p < .001$. Accordingly, because of issues of colinearity, the reactivity analyses above were repeated with only the PASAT performance score entered as an additional covariate. The significant effects reported above remained following such adjustment. The trend observed for a two-way interaction between presence of a friend/stranger and sex of supporter for DBP reactivity remained but was closer to reaching significance ($p = .06$); and the trend for a main effect of sex for HR reactivity was now significant, $F(1,103) = 3.87$, $p = .05$, $\eta^2_p = .036$, with the presence of a male eliciting lower HR reactivity than the presence of a female.

4. Discussion

It is clear that the major manipulations of social support in this study were effective. Participants reported greater support in the active support condition, and felt closer to the supporter when he/she was their friend as opposed to a stranger. Analysis of cardiovascular reactivity yielded some interaction effects; support from a friend as opposed to a stranger was associated with attenuated SBP reactivity, but only when the supporter was a male friend. This interaction between friend/stranger presence and sex of supporter also emerged as a trend for DBP reactivity. Active support was also associated with reduced SBP reactivity, but again only when the support was provided by a male friend or a female stranger.

Previous studies have shown that the support of a friend rather than a stranger was, in the main, associated with reduced reactivity (19-23). What the present data add is that the sex of the supporter is important in determining whether this attenuation effect is observed; support from a male friend was associated with relatively reduced BP reactivity whereas support from a female friend was associated with increased BP reactivity. In addition, support from a male tended to be associated with lower HR reactivity irrespective of support condition. This contrasts with one study where support from a female friend was associated with attenuated reactivity (24) and another where no effect of the sex of the supporter was found (25).

It is possible that the effects in the current study have emerged because females, despite their self-report declarations, feel less supported and more evaluated by other females, particularly friends whose opinion they value. This interpretation is supported by Social Comparison Theory (31) which considers that individuals have a propensity to look to others in order to evaluate their own abilities, and are most likely to look to those similar to themselves in order to generate an accurate view of their abilities. Accordingly, women are most likely to feel evaluated by other women similar to them – their female friends. Empirical support for this notion can be found in a study where women with a female friend present had higher reactivity than when tested alone (32), which was attributed to the friends' supporting behaviour increasing evaluation apprehension and

self-consciousness in the participants. Similarly, women receiving support from a female friend who was able to monitor their performance exhibited similar magnitude reactivity to when they were tested alone; when the friend was not able to monitor their performance (low evaluation potential) SBP reactivity was attenuated (23). These studies suggest that women feel evaluated by females, and particularly female friends, when they are in a position where they can monitor their performance. In this previous research (23, 32), women were tested only with female friends, making it impossible to discern whether women would or would not feel evaluated in the presence of supportive male friends. In a study where no overall differences in reactivity emerged between supported and unsupported participants, women who rated themselves as highly supported by their female friend exhibited greater DBP reactivity, whereas the opposite pattern emerged for men (33). This lends further support to the idea that women may have a propensity to feel evaluated by their female friends in challenging contexts where their performance is being assessed. Unlike our study, however, this previous study did not test women with male friends, and so direct comparison is difficult.

Less easy to explain is the effect of support from a male friend, which attenuated SBP reactivity in comparison to support from a female friend or male stranger. Comparison with previous literature is difficult given that, to our knowledge, no study with female participants has compared the effects of the presence of male friends versus strangers on reactivity. Most studies have tested only female participants with their female friends or female confederates present. However, it is possible that females feel less evaluated when support is provided by a male friend as this person is less similar to themselves than a female friend. Further, a previous study where women were tested either with or without the presence of their spouse/partner showed attenuated SBP and HR reactivity when their spouse/partner was present (26). Similarly, in response to the cold pressor test, participants tested with their spouse present were characterised by attenuated reactivity (34). In contrast, the presence of and/or support from a male stranger could be perceived by female participants as threatening and accordingly more physiologically provocative, although, in the absence of corroborative self-report data, this must remain speculative. Some additional support for our speculation that women feel more evaluated

or threatened by female friends and male strangers can be found from post-task ratings of how evaluated participants felt during the task, although it should be noted that these data were only available for 64 participants, i.e. for eight participants per condition. Participants in the female friend (mean = 2.8) and male stranger (mean = 2.8) conditions felt more evaluated than participants in the female stranger (mean = 2.1) and male friend (2.3) conditions, although this effect did not reach the conventional criteria for statistical significance ($p = .14$). Further, for the whole sample, the task was regarded as more difficult when they were tested with a friend present. However, this was not specific to those tested with a female friend, although this condition was associated with a higher difficulty rating (mean = 5.0) than the male friend condition (mean = 4.8).

The present study has several limitations. First, the sample size was relatively small, although an equal number of participants were randomised to each of the experimental conditions, and previous studies have been conducted with similar or smaller numbers (13-15, 20, 21, 23-25, 32, 35). Secondly, it would have been interesting to compare the influence of active/passive support from a male/female friend/stranger on reactivity in males. However, this study was already a 2 × 2 × 2 design consisting of eight different experimental conditions; testing males would have provided a 16-group design, making results difficult to interpret, and a much larger sample size would be necessary. In addition, it is worth noting that the vast majority of previous social support and reactivity research has been conducted on women. Further, only blood pressure and heart rate are reported here. Although, it would have been useful to have included the more comprehensive assessment of haemodynamics from impedance cardiography measurement, equipment failure restricted the analysis of these data. Finally, speculation about whether females feel more evaluated by their female friends and male strangers than by a male friend or female stranger would be better supported had we had data for all participants on how evaluated they felt. This, and the absence of direct support from the literature, means that our explanation in terms of Social Comparison Theory must remain tentative.

In summary, the present results extend the findings of previous laboratory studies of social support in a number of ways. First, they show that the social intimacy of the supporter may be more important determinant of blood pressure reactivity than their behaviour. Second, they indicate that this intimacy effect very much depends on the sex of the supporter. Third, Social Comparison Theory is rarely evoked in this context. However, our finding that the presence of close female friends is actually associated with augmented rather attenuated reactivity is precisely what the theory would predict. Future studies could usefully examine the source of this effect, and whether male participants display similar patterns of blood pressure reactivity in the presence of supportive female and male friends.

Acknowledgements

The authors would like to acknowledge the valuable help of Stephanie Chapman, Sarah Cross, Anjuli Dare, Christopher Hale, Thomas Harris, Ed Parker, Robert Schilling, and Aimee Stevens who recruited the participants, and assisted in data collection and entry.

References

1. Lovallo WR, Gerin W. Psychophysiological reactivity: mechanisms and pathways to cardiovascular disease. Psychosom Med 2003;65:36-45.
2. Schwartz AR, Gerin W, Davidson KW, et al. Toward a causal model of cardiovascular responses to stress and the development of cardiovascular disease. Psychosom Med 2003;65:22-35.
3. Carroll D, Ring C, Hunt K, Ford G, Macintyre S. Blood pressure reactions to stress and the prediction of future blood pressure: effects of sex, age, and socioeconomic position. Psychosom Med 2003;65:1058-1064.
4. Markovitz JH, Raczynski JM, Wallace D, Chettur V, Chesney MA. Cardiovascular reactivity to video game predicts subsequent blood pressure increases in young men: The CARDIA study. Psychosom Med 1998;60:186-191.
5. Treiber FA, Kamarck T, Schneiderman N, Sheffield D, Kapuku G, Taylor T. Cardiovascular reactivity and development of preclinical and clinical disease states. Psychosom Med 2003;65:46-62.
6. Berkman LF, Syme SL. Social networks, host resistance, and mortality: a nine-year follow-up study of Alameda County residents. Am J Epidemiol 1979;109:186-204.
7. House JS, Robbins C, Metzner HL. The association of social relationships and activities with mortality: prospective evidence from the Tecumseh Community Health Study. Am J Epidemiol 1982;116:123-140.
8. Orth-Gomer K, Johnson JV. Social network interaction and mortality. A six year follow-up study of a random sample of the Swedish population. J Chronic Dis 1987;40:949-57.
9. Rosengren A, Orth-Gomer K, Wedel H, Wilhelmsen L. Stressful life events, social support, and mortality in men born in 1933. BMJ 1993;307:1102-1105.
10. Smith TW, Gerin W. The social psychophysiology of cardiovascular response: An introduction to the special issue. Ann Behav Med 1998;20:243-246.
11. Kamarck TW, Peterman AH, Raynor DA. The effects of the social environment on stress-related cardiovascular activation: current findings, prospects, and implications. Ann Behav Med 1998;20:247-256.

12. Lepore SJ. Problems and prospects for the social support-reactivity hypothesis. Ann Behav Med 1998;20:257-269.
13. Christenfeld N, Gerin W, Linden W, et al. Social support effects on cardiovascular reactivity: is a stranger as effective as a friend? Psychosom Med 1997;59:388-398.
14. Lepore SJ, Allen KA, Evans GW. Social support lowers cardiovascular reactivity to an acute stressor. Psychosom Med 1993;55:518-524.
15. Gerin W, Pieper C, Levy R, Pickering TG. Social support in social interaction: a moderator of cardiovascular reactivity. Psychosom Med 1992;54:324-336.
16. Allen MT, Boquet AJ, Jr., Shelley KS. Cluster analyses of cardiovascular responsivity to three laboratory stressors. Psychosom Med 1991;53:272-288.
17. Sheffield D, Carroll D. Task induced cardiovascular activity and the presence of a supportive or undermining other. Psychol Health 1996;11:583-591.
18. Snydersmith M, Cacioppo JT. Parsing complex social factors to determine component effects: I. Autonomic activity and reactivity as a function of human association. J Soc Clin Psychol 1992;11:263-278.
19. Fontana AM, Diegnan T, Villeneuve A, Lepore SJ. Nonevaluative social support reduces cardiovascular reactivity in young women during acutely stressful performance situations. J Behav Med 1999;22:75-91.
20. Gerin W, Milner D, Chawla S, Pickering TG. Social support as a moderator of cardiovascular reactivity in women: a test of the direct effects and buffering hypotheses. Psychosom Med 1995;57:16-22.
21. Kamarck TW, Manuck SB, Jennings JR. Social support reduces cardiovascular reactivity to psychological challenge: a laboratory model. Psychosom Med 1990;52:42-58.
22. Kamarck TW, Annunziato B, Amateau LM. Affiliation moderates the effects of social threat on stress-related cardiovascular responses: boundary conditions for a laboratory model of social support. Psychosom Med 1995;57:183-194.
23. Kors DJ, Linden W, Gerin W. Evaluation interferes with social support: effects on cardiovascular stress reactivity in women. J Soc Clin Psychol 1997;16:1-23.

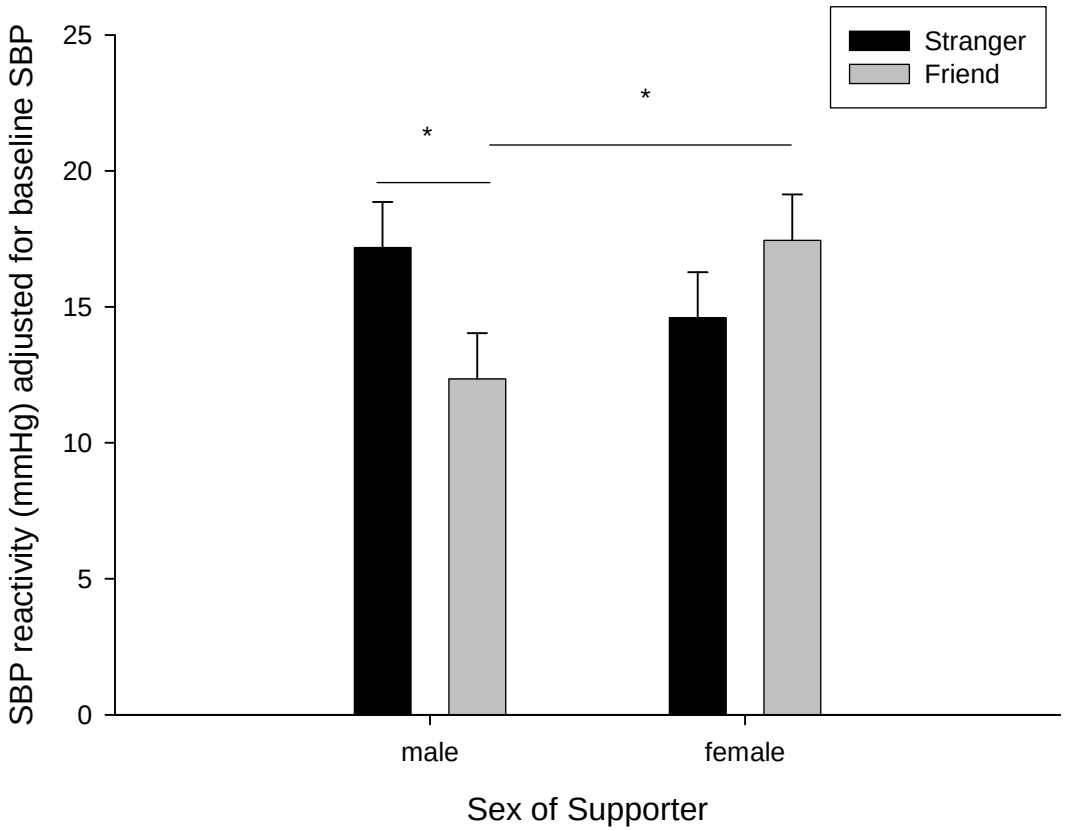
24. Glynn LM, Christenfeld N, Gerin W. Gender, social support, and cardiovascular responses to stress. Psychosom Med 1999;61:234-242.
25. Uno D, Uchino BN, Smith TW. Relationship quality moderates the effect of social support given by close friends on cardiovascular reactivity in women. Int J Behav Med 2002;9:243-262.
26. Phillips AC, Carroll D, Hunt K, Der G. The effects of the spontaneous presence of a spouse/partner and others on cardiovascular reactions to an acute psychological challenge. Psychophysiology 2006;43:633-640.
27. Gronwall D. Paced auditory serial addition task: a measure of recovery from concussion. Percept Motor Skills 1977;44:367-373.
28. Ring C, Carroll D, Willemsen G, Cooke J, Ferraro A, Drayson M. Secretory immunoglobulin A and cardiovascular activity during mental arithmetic and paced breathing. Psychophysiology 1999;36:602-609.
29. Winzer A, Ring C, Carroll D, Willemsen G, Drayson M, Kendall M. Secretory immunoglobulin A and cardiovascular reactions to mental arithmetic, cold pressor, and exercise: effects of beta-adrenergic blockade. Psychophysiology 1999;36:591-601.
30. Willemsen G, Ring C, Carroll D, Evans P, Clow A, Hucklebridge F. Secretory immunoglobulin A and cardiovascular reactions to mental arithmetic and cold pressor. Psychophysiology 1998;35:252-259.
31. Festinger LA. Theory of Social Comparison Processes. Hum Rel 1954;7:117-140.
32. Allen KM, Blascovich J, Tomaka J, Kelsey RM. Presence of human friends and pet dogs as moderators of autonomic responses to stress in women. J Pers Soc Psychol 1991;61:582-589.
33. Sheffield D, Carroll D. Social support and cardiovascular reactions to active laboratory stressors. Psychol Health 1994;9:305-316.
34. Allen K, Blascovich J, Mendes WB. Cardiovascular reactivity and the presence of pets, friends, and spouses: the truth about cats and dogs. Psychosom Med 2002;64:727-739.
35. Lepore SJ. Cynicism, social support, and cardiovascular reactivity. Health Psychol 1995;14:210-216.

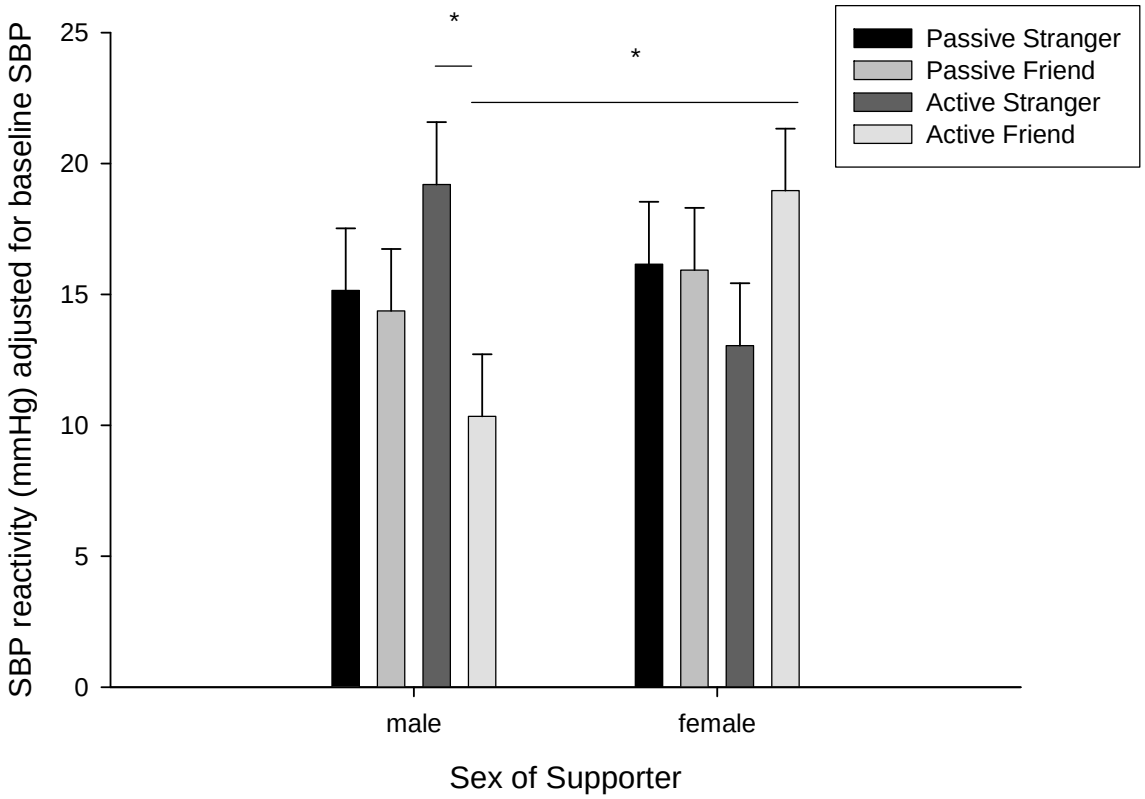
Table 1: Mean (SD) baseline and task cardiovascular values

	Baseline	Task
SBP (mmHg)	116.5 (8.11)	131.9 (12.45)
DBP (mmHg)	69.0 (7.36)	80.5 (9.56)
HR (bpm)	69.5 (12.68)	87.5 (17.07)

Figure 1: Interaction between support from friend or stranger, and sex of supporter for SBP reactivity.

Figure 2: Interaction between active versus passive support, support from friend or stranger, and sex of supporter for SBP reactivity.


Stranger
Friend
*
*
25
20
15
10
5
0
SBP reactivity (mmHg) adjusted for baseline SBP
male
female
Sex of Supporter


SBP reactivity (mmHg) adjusted for baseline SBP
25
20
15
10
5
0
*
*
Passive Stranger
Passive Friend
Active Stranger
Active Friend
male
female
Sex of Supporter