

Social Support Lowers Cardiovascular Reactivity to an Acute Stressor

STEPHEN J. LEPORE, PhD, KAREN A. MATA ALLEN, BA, AND GARY W. EVANS, PhD

This study examined whether social support can reduce cardiovascular reactivity to an acute stressor. College students gave a speech in one of three social conditions: alone, in the presence of a supportive confederate, or in the presence of a nonsupportive confederate. Systolic and diastolic blood pressure were measured at rest, before the speech, and during the speech. While anticipating and delivering their speech, supported and alone subjects exhibited significantly smaller increases in systolic and diastolic blood pressures than did nonsupported subjects. Supported subjects also exhibited significantly smaller increases in systolic blood pressure than did alone subjects before and during the speech. Men had higher stress-related increases in blood pressures than did women; but gender did not moderate the effects of social support on cardiovascular reactivity. These results provide experimental evidence of potential health benefits of social support during acute stressors.

Key words: stress, social support, cardiovascular reactivity.

INTRODUCTION

Several well-controlled, prospective studies have revealed links between social ties (both quantity and quality) and mortality, as well as links between social ties and a major cause of mortality in the United States, coronary heart disease (for reviews, see 1-6). Thus, low levels of social integration and social support might increase coronary-related morbidity and mortality (1-7). Social support could influence biological processes related to cardiovascular health indirectly by influencing health behaviors or psychological responses to stressors (8). Social support also could influence certain biological processes directly, such as neuroendocrine or hemodynamic functioning, which might affect cardiovascular health (7-9). The present study investigates the latter pathway by testing whether social support offered during an acute stressor reduces cardiovascular reactivity. There are two significant reasons to test experimentally whether social support can reduce cardiovascular reactivity to an acute stressor. First, the theory that support buffers, or protects, individuals from the pathological effects of stressors generally has been tested with correlational data, which are inherently ambiguous and plagued by

threats to internal validity. Second, there is a need to explore specific mechanisms through which support might reduce coronary risk. Heightened stress-reactivity might have an etiological role in cardiovascular disease or signify a correlated pathogenic process (10). Therefore, if social support attenuates cardiovascular reactivity to stressors, it might reduce coronary-related health risk.

Three recent experiments have tested whether social support can reduce cardiovascular reactivity. Kamarck et al. (13) had women complete a mental arithmetic and concept formation tasks alone (no support) or in the presence of a female friend (support). In the support condition, the friend touched the subject's wrist throughout testing, but also wore a headset and completed questionnaires to avoid distracting or arousing evaluation apprehension in the subject. The supported group had smaller heart rate reactivity during both tasks and smaller systolic blood pressure reactivity during the mental arithmetic task than did the alone group. Gerin et al. (12) had two female confederates argue with a female subject while a third female confederate defended (supported) the subject's position. In the no-support condition, two female confederates argued with the subject while a third female confederate sat by quietly (no support). Supported subjects had smaller increases in blood pressure and heart rate than did nonsupported subjects. Finally, Edens et al. (11) studied reactivity to a mental-arithmetic and a mirror-tracing task in women in five different social conditions: alone, friend-touch, friend-no touch, stranger-touch, and stranger-no touch. The friend/stranger wore a headset, read magazines, and did not talk with the subject. There was evidence of buffering in the arithmetic task only: subjects with a friend present had smaller increases in heart rate

From the Department of Psychology, Carnegie Mellon University, Pittsburgh, Pennsylvania, (S.J.L.); School of Social Ecology, University of California, Irvine, Irvine, California (K.A.M.A.); College of Human Ecology, Cornell University (G.W.E.), New York.

Address reprint requests to: Stephen J. Lepore, PhD, Department of Psychology, Carnegie Mellon University, Pittsburgh, PA 15213-3890.

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and diastolic blood pressure during the task than did subjects with a stranger present. In contrast to the findings by Kamarck et al. (13), Edens et al. (11) found that the touched subjects had greater increases in heart rate and blood pressures than did the untouched subjects.

Edens et al. (11) concluded that presence of a friend rather than touch was the important factor in reducing reactivity in their study and the study by Kamarck et al. (13). However, this explanation does not account for the findings by Gerin et al. (12), which suggested that presence of a supportive stranger reduces reactivity (without physical touch). An alternative explanation of the Edens et al. (11) findings is that the presence of a stranger (or a stranger's touch) heightened stress during the task. The stranger might have been perceived as a threat or a distraction. An observer might only be construed by a subject as supportive if he or she is a friend who is implicitly supportive (i.e., friend present but not saying anything directly supportive), as in the Kamarck et al. (13) study, or is a stranger who is explicitly supportive (i.e., stranger making supportive gestures and comments), as in the Gerin et al. (12) study. Of course, if the presence of a nonsupportive stranger increases stress, there is an alternative to the stress-buffering interpretation of the Gerin et al. (12) data. Specifically, the difference in reactivity between the support and no-support subjects after social harassment could have resulted from heightened reactivity in subjects in the harassment-no support condition rather than to reduced reactivity in the harassment-support condition. A test of this alternative requires a third group that experiences the stressor alone. If support buffers individuals from stress, then reactivity should be lower in the support condition than in either the alone or no-support conditions. If the apparent buffering effect of support is an artifact of heightened reactivity in the no-support condition, then reactivity would be higher in the no-support group than in either the alone or support group; but there would be no difference between the alone and support groups. Finally, if support attenuates stress reactions and lack of support potentiates stress reactions then the support condition would have the lowest reactivity, the no-support group the highest reactivity, and the alone group would lie in between.

Although the few studies on social support and cardiovascular reactivity suggest that support might attenuate reactivity, there is scant information on how it does so. One possible explanation is that social support reduces subjective stress or negative affect (3, 8). However, both Kamarck et al. (13) and

Gerin et al. (12) found no effects of social support on subjects' self-reported stress and negative affect after stress exposure. These findings suggest that the buffering effects of social support might not be mediated by stress appraisals—an interpretation that is consistent with theories suggesting that support may have a more specific, direct impact on autonomic reactivity (8, 9, 13). It is also possible that subjective stress was not adequately measured in the previous studies. Thus, another test is warranted to examine whether subjective stress can mediate the effects of social support on cardiovascular reactivity.

The present study extends previous research in this area in several ways. First, we sampled both men and women; the social support-reactivity studies discussed above all used female subjects. Second, the support manipulation in the present study was checked. That is, we tested whether subjects in the support condition actually perceived the confederate to be more supportive than did subjects in the no-support condition. Such data help rule out rival explanations of buffering effects of social support. Third, the stressor and the support manipulation were designed to reflect naturalistic situations. Fourth, social support was offered explicitly by a stranger, rather than a friend, to test whether strangers can effectively reduce stress. As discussed above, this test requires a control group of individuals experiencing stress alone. Finally, subjective speech stress was measured with a psychometrically sound instrument to test whether stress appraisals mediate the buffering effects of social support.

METHODS

Subjects

Ninety college students (43 men; 47 women; mean age = 20.8 years) each received \$10.00 to participate in the study. The racial distribution matched that of the university from which the sample was drawn: 48% white, 27% asian, 16% latino, and 9% other races.

Procedure

Subjects were randomly assigned (within gender) to one of three experimental conditions: speech alone; speech in the presence of a supportive confederate; or speech in the presence of a nonsupportive confederate. The experiment took place in a laboratory equipped with a one-way observation mirror, two comfortable chairs, a table with a speaker's podium, an automated blood-pressure machine (Critikon Dinamap Vital Signs Monitor 1846), and a pitcher of water and cups. Shortly after arriving to the laboratory, subjects in the Support and No-Support condition were joined by a same-sex confederate. Three men and three

women served as confederates throughout the study. Informed consent was obtained and the experimenter explained that we were interested in studying "physiological and cognitive responses to the environment" and in comparing blood pressures of individuals when they are at rest vs. when they are involved in an activity.

Resting blood pressure was measured from the subject's non-dominant arm. The subject was alone and seated while systolic (SBP) and diastolic (DBP) blood pressures were automatically measured every 2 minutes for four times. Final readings were used as indicators of resting blood pressure because these were, on average, the lowest readings. Next, the subject was told that his/her "active blood pressure reading" would be taken while he/she delivered a speech. The subject had 10 minutes alone to prepare a speech on euthanasia. A list of arguments for and against euthanasia was provided to increase the amount of content available for the speech and to facilitate sustained speaking. After the speech preparation period, confederates in the Support and No-Support conditions returned to the laboratory with speech notes in hand. In the Support and No-Support conditions a rigged coin-toss determined that the subject would speak first. During the speech, subjects stood behind the podium and faced the observation mirror. Subjects knew they were being observed and filmed. They were told to speak for 6 minutes and not to begin until the experimenter knocked on the mirror from the observation room. The experimenter started the blood pressure machine, left the room, and knocked on the mirror 30 seconds after the first blood pressure reading.

Behaviors of confederates in the Support and No-Support conditions were carefully controlled and rehearsed. The support behaviors were designed to provide emotional and esteem support, which seem to be effective as stress-buffers (14). Support behaviors included expressions of positive affect and validation of the subject's feelings (15). The first supportive comment, "Remember, it will all be over in a few minutes," was made before the first blood pressure reading, when the subject was waiting for the experimenter's knock (speech cue). The second supportive act followed the first blood pressure reading, still before the speech had begun. Specifically, the confederate poured a cup of water and asked the subject if he/she would like some (all refused). After the next blood pressure reading, which was taken during the speech, the confederate complimented the subject's argument by nodding approvingly and saying, "That's good!" At the end of the speech, the confederate said, "You did fine." The confederate was attentive to the subject during the speech, but did not stare. The confederate also smiled while making supportive comments and maintained an open-body posture. In the No-Support condition, the confederate was reserved and inattentive to the subject. The nonsupportive confederate did not initiate conversation, nod, smile, or make supportive comments. In the few instances a subject attempted to elicit help, the confederate responded minimally, but not rudely, by saying, "I don't know" or "Do your best." After their speech, subjects completed a self-report scale of psychological stress experienced during the speech; subjects in the Support and No-Support conditions also rated the confederate's supportiveness.

Measures

Blood pressure reactivity. Cardiovascular reactivity to stressors is generally measured by the amount of change in cardiovascular functioning over resting states after exposure to a stressor (16). It is also useful to statistically covary resting levels of the dependent

measure to control for the effect of the initial values of the covariates on reactivity (17). Keeping with these approaches, we calculated subjects' reactivity before the speech by subtracting their resting SBP and DBP readings from the respective SBP and DBP readings taken in the period before the speech. Reactivity during the speech was calculated by subtracting the resting SBP and DBP readings from the mean of the respective SBP and DBP readings taken during the speech. The first reactivity measure reflects anticipatory stress; the second reactivity measure reflects stress during the speech. In addition, the appropriate baseline values were statistically covaried in the analyses. The resulting baseline-adjusted blood-pressure reactivity scores represent blood-pressure variability that is not accounted for by individual differences in resting states of blood pressure (18).

Perceived social support. Subjects rated the confederate's supportiveness ($\alpha = .98$) on a 6-item, 7-point bipolar adjective scale (supportive-unsupportive; close-distant; rejecting-accepting; friendly-unfriendly; warm-cold; helpful-unhelpful). Previous research (19) offers evidence of the scale's validity: confederates who offered support to subjects after they got poor test results were rated higher in supportiveness than were unsupportive confederates.

Perceived stress. Subjects rated their psychological stress ($\alpha = .92$) on a 6-item, 7-point bipolar adjective scale (stressed-relaxed; uncomfortable-comfortable; anxious-not anxious; not nervous-nervous; calm-excited; worried-content). The scale reliably discriminates between individuals experiencing minimal stress and individuals experiencing high levels of stress from either noise exposure or from giving a speech (20). The scale also has overlaps with many items from another adjective-checklist stress scale that has been extensively validated (21, 22).

Speaking duration. Subjects' speaking duration was measured to test for differences across the social groups. Different speaking times could moderate group blood pressures independent of the social manipulation (cf. 12). Speaking time was clocked in seconds by trained observers viewing the videotapes of the speeches. Interobserver reliability was high (Ebel = .97).

Speech performance. Speech quality was measured to test for internal validity threats. If the confederate's presence distracted subjects from their speech, then distraction rather than support could systematically influence cardiovascular reactivity. Two trained, naive observers rated the quality ($\alpha = .92$) of subjects' videotaped speeches using a 6-item, 5-point scale (e.g., easy to identify and comprehend major points; evidence provided for major points; ideas well organized). Scores could range from below average (1) to above average (5). Interobserver reliability was high (Ebel = .90).

RESULTS

Blood Pressure Reactivity

A one-way analysis of variance (ANOVA) revealed no effect of the social support manipulation (Support, Alone, and No Support) on baseline SBP or DBP (Support mean = 110/67; Alone mean = 110/65; No Support mean = 109/65). The speech task and pre-speech anticipation period evoked large cardiovascular responses. Immediately before the speech, SBP increased 17% (mean = 18.58 mm Hg, SD = 12.25 mm Hg) and DBP increased 21% (mean = 13.74 mm

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Hg, SD = 10.00 mm Hg) over resting levels; during the speech, SBP increased 21% (mean = 22.60 mm Hg, SD = 12.59 mm Hg) and DBP increased 29% (mean = 19.24 mm Hg, SD = 9.52) over resting levels. These magnitudes of response are consistent with those found in previous reactivity studies (20).

Three-way (Social Condition \times Subject's Sex \times Measurement Period) mixed-factor analysis of covariance (ANCOVA), with resting SBP as a covariate, was used to analyze the effects of the social manipulation on SBP reactivity immediately before and during the speech. Social condition had three levels (Support, Alone, No Support) gender had two levels (Male, Female), and period had two levels (Anticipating Speech, During Speech). A parallel analysis was used to test the effects of social support on DBP reactivity, except the covariate was resting DBP. There was an overall effect of social condition [$F(2,83) = 12.66, p < .001$], gender [$F(1,83) = 10.83, p < .001$], and period [$F(1,84) = 14.87, p < .001$] on baseline-adjusted SBP reactivity, but there were no two- or three-way interactions. SBP reactivity was greater in men (mean = 23.10 mm Hg, SD = 10.90 mm Hg) than in women (mean = 18.43 mm Hg, SD = 10.81 mm Hg), which is consistent with previous research (23). SBP reactivity also was higher during the speech (mean = 22.60, SD = 12.59 mm Hg) than while anticipating the speech (mean = 18.57 mm Hg, SD = 12.25 mm Hg), which is explained partially by the effects of speaking on blood pressure (24). Because there were no interactions between the social condition and either gender or period, Duncan's multiple range test was performed on the baseline-adjusted SBP reactivity scores averaged across gender and period (see Ref. 25 for discussion on extending Duncan's test to covariance analysis). Results (Figure 1) indicated that (a) subjects in the Support condition had small SBP reactivity than subjects in the No Support ($p < .05$) and Alone ($p < .05$) conditions and (b) subjects in the No-Support condition had higher SBP reactivity than subjects in the Alone condition ($p < .05$).

There also were significant overall effects of social condition [$F(2,83) = 8.82, p < .001$], gender [$F(1,83) = 5.79, p < .05$], and period [$F(1,84) = 31.07, p < .001$] on baseline-adjusted DBP reactivity. There were no significant two- or three-way interactions. The pattern of effects was similar to that observed with SBP reactivity: DBP reactivity was higher in men (mean = 18.35 mm Hg, SD = 8.89 mm Hg) than in women (mean = 13.29 mm Hg, SD = 8.77 mm Hg) and higher during the speech (mean = 19.24 mm Hg, SD = 9.52 mm Hg) than while anticipating the speech (mean = 13.74 mm Hg, SD = 10.00 mm Hg).

Duncan's test was performed on the baseline-adjusted DBP reactivity scores averaged across gender and period. Results (see Figure 2) indicated that subjects in the Support condition had smaller DBP reactivity than subjects in the No-Support condition ($p < .05$), but supported subjects did not have significantly smaller DBP reactivity than subjects in the Alone condition ($p > .05$). In addition, subjects in the No-Support condition had higher DBP reactivity than subjects in the Alone condition ($p < .05$).

Speaking Duration and Performance

One-way ANOVAs revealed no significant overall effect of the support manipulation on speaking time (Support mean = 190.31 sec, SD = 44.34 sec; Alone mean = 192.24 sec, SD = 37.72 sec; No Support mean

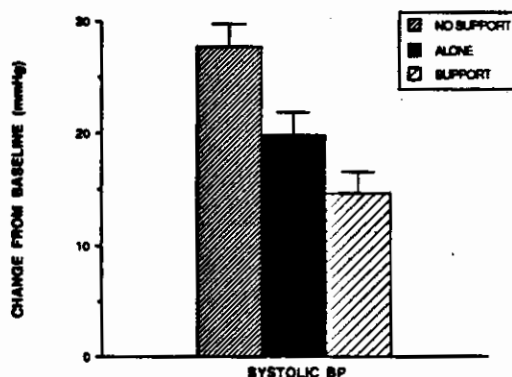


Fig. 1. Effect of social support on change (from baseline) in systolic blood pressure averaged across gender and period. Data shown represent the mean and standard error of the mean.

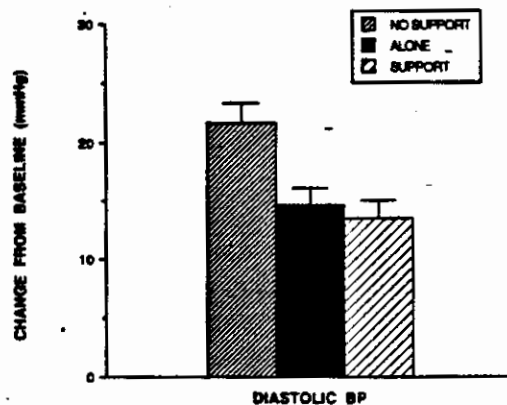


Fig. 2. Effect of social support on change (from baseline) in diastolic blood pressure averaged across gender and period. Data shown represent the mean and standard error of the mean.

= 192.81 sec, SD = 24.65 sec). Thus, the group differences in blood pressure reactivities cannot be attributed to differences in speaking time. One-way ANOVAs also revealed no significant overall effect of the support manipulation on speech quality (Support mean = 3.73, SD = 1.02; Alone mean = 3.95, SD = 1.36; No Support mean = 4.33, SD = 1.41). Thus, it seems that the social support manipulation did not alter cardiovascular reactivity by distracting some subjects from their speech.

Perceived Social Support and Perceived Stress

Subjects' ratings of supportiveness were higher for supportive confederates (mean = 5.01, SD = .68) than for nonsupportive confederates (mean = 3.01, SD = .94) [$t(58) = 9.39, p < .001$], indicating that the support manipulation was effective. However, there were no overall effects of the social support manipulation on levels of perceived stress during the speech. It is noteworthy, however, that the trend in levels of perceived stress was consistent with the cardiovascular reactivity trend (Support mean = 3.73, SD = 1.03; Alone mean = 3.96, SD = 1.36; No Support mean = 4.33, SD = 1.41). On average, subjects reported moderate levels of stress.

DISCUSSION

The present study provided experimental evidence of the stress-reducing effects of social support. Subjects who gave a speech in the presence of a supportive confederate had smaller cardiovascular reactivity in comparison with their counterparts who gave a speech in the presence of a confederate who responded in an appropriate, but neutral manner. Subjects also had smaller SBP reactivity when they gave a speech in the presence of a supportive confederate than when they gave the speech alone; although DBP reactivity was not smaller for subjects who were supported vs. alone. The effects of social support on cardiovascular reactivity were not moderated by task period or gender. However, as expected, blood pressures were higher during delivery than during anticipation of the speech and were higher for men than for women. The manipulation check indicated that supported subjects indeed perceived the confederate to be more supportive than did the nonsupported subjects.

The relation of the support provider to the recipient seems to be a potential moderator of the effect of the support provider's presence and behaviors on

the recipient's stress response. The mere presence of another person seems to reduce subjects' stress when that person is a friend (11, 13). However, when the support provider is a stranger, his or her mere presence does not seem to reduce subjects' stress reactions (11). Moreover, in the present study, the mere presence of a stranger seemed to increase the stress responses of subjects beyond the level that they would have experienced if they were alone. Thus, it seems that the mere presence of friends but not the mere presence of strangers can reduce stress responses. This effect may occur because stressed subjects implicitly view friends but not strangers as being supportive. The present findings, and those of Gerin et al. (12), suggest that when the potential supporter is a stranger, he or she must make explicit offers of support if the recipient is to manifest any benefits.

What mechanisms could explain both the stress-enhancing effects of the nonsupportive stranger and the stress-buffering effects of the supportive stranger in the present study? At least three plausible explanations can be considered. These include mechanisms related to negative evaluation apprehension, distraction, and stress appraisals. The apprehension explanation suggests that apprehension, or uncertainty, about the confederate might have been higher in subjects in the No-Support condition than in subjects in the Support condition, thus explaining the difference in the reactivity or arousal levels of these two groups during the acute stressor (see 26). The distraction explanation suggests that the presence of a nonsupportive confederate was more distracting than the presence of a supportive confederate or no audience at all. The nonsupportive confederate could be construed as more unpredictable and, hence, more distracting. Splitting one's attention between two stimuli—the speech and the confederate—could heighten arousal (26). Finally, the stress-appraisal explanation suggests that the social support reduces stress by altering stress appraisals, or reducing the perceived stressfulness of stressors. Receiving support, which in the present study included performance feedback, expressions of positive affect, and validation of one's behavior, should reduce the threat value of the speech situation and, thus, reduce cardiovascular reactivity. In contrast, lack of feedback and uncertainty about the confederate should increase the threat value of the speech situation and, thus, increase cardiovascular reactivity.

The pattern of cardiovascular responses in the present study is inconsistent with both the evaluation apprehension and distraction explanations. If

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apprehension and distraction explained the reactivity results, then the Alone group should have had the smallest reactivity because they lacked a visible audience that could distract them or arouse apprehension. However, the Support group had smaller SBP reactivity than the Alone group. The distraction hypothesis seems even less plausible when we consider that subjects in the Support condition could have been distracted more from the speech task than subjects in the No-Support condition. This possibility is not unreasonable because the supportive confederate made direct comments and gestures toward the subject that could be distracting. Yet, the Support group had smaller SBP and DBP reactivity than the No-Support group. Moreover, there were no significant social group differences in speech duration or quality, which would be expected if there were differences in levels of distraction.

The lack of association between social support and subjective stress discredits the stress appraisal explanation of the present results. This finding is consistent with other studies (12, 13) that have failed to find an effect of social support on subjective stress. There are several plausible reasons why social support did not significantly alter subjective stress. First, the measurement approach could be problematic. Subjective stress scales may be sensitive to large differences between stressed and nonstressed groups, but insensitive to subtle differences in subjective stress in individuals who are all facing stressors but under different social conditions. In addition, subjective stress in laboratory experiments may dissipate shortly after subjects stop performing the stressful task. Subjective stress measures taken after the stressor exposure, while the subject is at rest, could underestimate subjective stress during the performance of the stressful task. Second, perceived stress and negative affect might not be mediated by affective or cognitive mechanisms or might be mediated by an affective channel (e.g., positive affect) or cognitive channel (e.g., perceived control) that has yet to be studied.

In sum, the present results suggest that explicit social support offered by a stranger during an acute stressors can reduce subjects' cardiovascular reactivity and that the presence of a nonsupportive stranger during an acute stressor can increase cardiovascular reactivity. If social support also reduces individuals' reactivity to naturally occurring stressors, it is possible that this mechanism might explain the association between social support and lowered risk for coronary-related deaths and disease. The finding that nonsupportive strangers can increase stress responses should be considered in the design

of future experimental studies on the stress-buffering effects of social support and, perhaps, be studied in its own right. In addition, the present results suggest that the benefits of social support generalize to men and women. Future research on social support and reactivity should therefore not be limited to one gender.

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