Hostility and Perceived Social Support: Interactive Effects on Cardiovascular Reactivity to Laboratory Stressors

Yung Y. Chen, Ph.D., Suzanne Gilligan, Ph.D., Elliot J. Coups, Ph.D., and Richard J. Contrada, Ph.D.
Rutgers—The State University of New Jersey

ABSTRACT

Background: *Previous research has identified trait hostility and social isolation as possible psychosocial risk factors for coronary heart disease (CHD). However, few studies have examined hostility and social support simultaneously to determine their independent and possible interactive relations with CHD and disease-promoting mechanisms.* ***Purpose:*** *Hypotheses derived from a general interpersonal model were tested in a study examining trait hostility and perceived social support as predictors of cardiovascular reactivity to laboratory stressors.* ***Methods:*** *Healthy college students (53 men, 55 women) performed speech and mental arithmetic tasks while blood pressure and heart rate were monitored.* ***Results:*** *There was an interactive effect of hostility and perceived social support on systolic and diastolic blood pressure (SBP and DBP) reactivity. Higher hostility scores were associated with greater SBP reactivity for participants who were high in perceived social support; whereas for those with low social support scores, greater hostility was associated with somewhat less SBP reactivity. The same pattern was obtained for DBP, but only during the speech task.* ***Conclusions:*** *These findings encourage further research conceptualizing trait hostility within a general interpersonal framework that calls attention to both positive and negative person–environment transactions.*

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INTRODUCTION

Research on psychosocial determinants of coronary heart disease (CHD) points to trait hostility and social ties as two of the more promising topics of study (1). Hostile attributes, including cognitive, experiential, and expressive elements, appear to be associated with elevated risk for the development of coronary disease and for cardiac events in individuals with CHD (2). Similarly, individuals who are not well integrated within a network of social ties, or who perceive low levels of social support, are more likely to experience negative CHD outcomes (3,4). Although hostility and social support typically have been examined separately in epidemiologic research, some findings suggest that when considered in combination they account for cardiovascular outcomes above and beyond their separate main effects (5,6).

One mechanism through which both hostility and social isolation may influence the development and/or course of CHD involves cardiovascular reactivity (CVR) to psychological stressors. Behaviorally evoked elevations in blood pressure, heart rate (HR), and other hemodynamic parameters may reflect processes involved in the development of CHD and other cardiovascular conditions such as essential hypertension (7). Both trait hostility (8) and social isolation (9) appear to be associated with heightened CVR to psychological stressors. As with epidemiologic research, few psychophysiological studies have examined hostility and social support simultaneously to determine their independent and conjoint relations with CVR.

Three interrelated theoretical models constitute a broad, interpersonal perspective to guide an integrated examination of trait hostility and social support (10). In his transactional model, Smith (11) hypothesized processes of interplay between hostility and a form of psychosocial vulnerability that arises from high levels of interpersonal stress and low levels of social support. The interpersonal circumplex model of social behavior (12,13), a two-dimensional framework for describing positive and negative aspects of both personality traits and the social environment, has been used to conceptualize health-related social exchanges (14,15). An interpersonal development perspective describes the role of parental influences and other interpersonal determinants of personality and social behavior patterns (16–18).

The interpersonal perspective leads to several hypotheses regarding the role of trait hostility and perceived social support as determinants of CVR. One set of hypotheses, pertaining to main effects of hostility and support on CVR, concern the basic premise that hostile traits such as cynicism and anger-proneness are accompanied by the sense that one cannot expect a high level of support from friends and family members. Given this combination of characteristics, hostile individuals may be more physiologically responsive to psychosocial stressors, in part, because they anticipate relatively little support from members of their social network. This suggests a statistical mediation hypothesis in which low levels of social support partially account for the main effect of hostility on CVR. This phenomenon would most likely be evident in stressful situations involving actual offers of support from social network members, or in which variations in the perceived availability of support might affect physiological reactivity through appraisal processes without support actually being offered or drawn on.

A set of alternative main-effect hypotheses would be somewhat less supportive of the general interpersonal perspective. In one, the mediational pattern would be reversed, and variations

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Yung Chen is now at Duke University Medical Center. Suzanne Gilligan is now at the Consortium for Advanced Psychological Training, Michigan State University. Elliot Coups is now at Memorial Sloan-Kettering Cancer Center, Department of Psychiatry and Behavioral Sciences.

Reprint Address: R. J. Contrada, Ph.D., Department of Psychology, Rutgers University, Tillett Hall, 53 Avenue E, Piscataway, NJ 08854–8040. E-mail: contrada@rci.rutgers.edu

in trait hostility would account for the association between low perceived social support and heightened CVR. This set of results would not be directly at odds with the interpersonal framework. But it might be construed as more compatible with a trait-focused model in that personality hostility would be directly related to reactivity, whereas its connection to a relative lack of social support would be operating at a point more distal to health-damaging physiological processes. Similarly, independent, nonoverlapping main effects of hostility, support, or both would suggest more parsimonious explanations that lend no special significance to links between personality hostility and aspects of interpersonal relationships. In studies conducted thus far to examine trait hostility and social support jointly as predictors of CVR, some have reported main effects for hostility but not for support (19–23), at least one has reported a main effect for support but not for hostility (24), and at least one has reported main effects for both hostility and support (22). These inconsistencies are difficult to reconcile because the studies vary with respect to a number of methodological factors, including whether support was operationalized using a perceived social support scale or as an experimental manipulation. To our knowledge, the issue of mediational effects has not been addressed in this work.

The general interpersonal perspective also leads to hypotheses regarding interactive effects of trait hostility and perceived social support. At least two different interaction patterns might be anticipated. One possibility is that trait hostility is more strongly related to CVR under conditions of low compared with high social support. The perception of low levels of social support may exacerbate the effects of stress especially among high-hostile individuals because it confirms their cynicism and distrust in addition to leaving them without a needed coping resource. On the other hand, it may be argued that trait hostility should be more strongly related to CVR under conditions of high compared with low social support. Hostile individuals may become ambivalent when they perceive a high level of social support. They may resent actual or anticipated offers of support because their cynicism leads them to suspect the motives of actual/potential providers of support, or because the felt obligation to reciprocate may be perceived as excessively burdensome to individuals not predisposed to be helpful to others. There have been several reported statistical interactions between hostility and support in CVR research, but the form of the interaction has varied (21,22,24,25). As with reported main effects discussed above, methodological variations make cross-study comparisons difficult.

The purpose of this study was to test the foregoing hypotheses regarding the interplay of personality hostility and social support in a laboratory setting in which healthy male and female undergraduates were subjected to two standardized psychological stressors. The two stressors were selected as a means of creating variation in social threat and personal relevance, factors that should influence the degree to which hostility and support affect CVR. In a speech task, participants spoke aloud about their most stressful ongoing problem. This task was administered in a manner designed to heighten social threat and personal relevance, features that appear to increase the likelihood of detecting associations between hostility and CVR (8). In addition, it was expected that stress associated with reexperiencing and discussing an actual personal problem would be responsive to effects of perceived support even absent the possibility that support would be offered or drawn on in the experimental session. Calling to mind a personal problem presumably primes thoughts regarding anticipated sources of support. In a mental arithmetic task, participants solved arithmetic problems under time pressure. As a performance challenge confronted in isolation, whose social and personal elements are less salient, this task was not expected to be as effective as the speech task in potentiating CVR in hostile participants, and it was expected to be less responsive to effects of perceived support from network members.

Trait hostility and perceived social support were measured with a questionnaire packet administered following task performance. Multiple-regression analysis was used to examine the hypotheses, outlined previously, that were derived from the general interpersonal model. More specifically, we estimated main effects models as the initial step in determining whether the data supported the hypothesized mediational pattern in which variation in perceived social support accounted for greater CVR among high-hostile compared with low-hostile participants. After examining this hypothesis and its alternatives, interaction terms were added to the main effects model to determine whether the data supported either of the two hypothesized patterns in which perceived social support moderates the effects of trait hostility on CVR, and whether the effects of hostility and support were potentiated by the task variation.

METHOD

Participants

Participants were 110 college students who completed the study in return for course credit for an introductory psychology class. Data for two participants were excluded from all analyses: One smoked cigarettes and the other consumed caffeinated beverages, both within 90 min prior to the session. The final sample consisted of 53 men and 55 women. Their average age was 19.6 (SD = 2.5). Participants indicated their ethnic or racial group membership as follows: White/Caucasian, 43.5%; Asian/Pacific Islander, 36.1%; Black/African American, 8.3%; Hispanic/Latino, 7.4%; Other, 4.6%.

Procedure

Participants were instructed not to smoke, consume caffeinated beverages, or exercise for at least 90 min before their scheduled sessions. On arrival, a brief introduction to the study was presented, and informed consent was obtained. The participant then sat alone in one room, with the blood pressure cuff and microphone placed on the nondominant arm. A 5-min resting baseline period then ensued to permit cardiovascular activity to stabilize. Participants then received instructions for and performed the speech and arithmetic tasks, with a short break in between the two. Sequence of task administration was counterbalanced.

Speech task. For the public speaking task, participants were instructed to make a 3-min speech about an ongoing stressful problem. They were told that the nature of the problem must fall into one of the following categories: romantic, family, academic, or roommate related. A video camera was positioned in front of the participants both to record the speech task and to heighten social threat. Participants were informed that their speech would be taped for later evaluation. Then, participants were given 3 min to prepare the speech. As an additional means of increasing social threat, the experimenter implied the presence of multiple observers by speaking through the intercom, saying "Is everybody ready to begin back there?" After the preparation period, participants delivered their speech. If participants stopped before 3 min had elapsed, they were prompted to provide more information about the stressful event.

Mental arithmetic task. For the mental arithmetic task, participants engaged in a 5-min addition and subtraction exercise. They were required, under time pressure, to attempt a series of problems that involved adding together two numbers displayed on a computer screen and then adding or subtracting another displayed number. They were instructed to try their best and told they would receive a prize if they performed well. Once they completed the task performance phase of the study, participants were escorted to a different room and given a questionnaire packet containing the psychosocial measures. All participants were given a candy bar at the end of the session, regardless of their task performance.

Measures

Cardiovascular activity. Systolic blood pressure (SBP), diastolic blood pressure (DBP), and HR were measured using a Spacelabs model 2600B (version 5.0; Spacelabs Medical, Issaquah, WA) automated blood pressure and HR monitor. An occluding cuff was placed around the participant's nondominant arm, with a microphone positioned over the brachial artery to detect Korotkoff sounds. SBP and DBP were measured in millimeters of mercury (mmHg), and HR was measured in beats per minute (bpm). Blood pressure readings were obtained at Minutes 1, 3, and 5 of the baseline and mental arithmetic periods, and Minutes 1 and 3 of the speech task. HR also was measured by the Spacelabs unit, based on the detection of pulses during cuff inflation. Baseline cardiovascular measures (SBP, DBP, HR) were computed as the mean of the Minutes 3 and 5 readings. CVR for each task was calculated by subtracting baseline measures from the mean of the readings for each task.

Perceived social support. Perceived social support was measured using the 12-item Appraisal subscale of the college student version of the Interpersonal Support Evaluation List (ISEL [26]). This scale operationalizes appraisal support as the perceived availability of someone with whom one can comfortably discuss problems and difficulties. It was selected because it is brief and assesses a major function of supportive social networks that appears particularly relevant to hypotheses regarding the interplay between hostility and social support. Appraisal support has been linked to stress-related physiological activity in previous research (e.g., 25,27). In this sample, Cronbach's alpha was .80 for the ISEL Appraisal scale.

Trait hostility. Trait hostility was measured using the 50-item Cook–Medley Hostility Scale, or Ho (28). Instead of the original, true–false response format, a 6-point agree/disagree scale was used in this study, a format that has been successfully employed in previous psychophysiological research (29,30). For the Ho in this sample, Cronbach's alpha was .89.

Other measures. The questionnaire packet also included items on demographics, such as age, gender, and ethnic or racial background.

RESULTS

Associations Among Psychosocial Factors

The mean Ho score was 176.91 (*SD* = 27.96), and the mean ISEL Appraisal score was 9.42 (*SD* = 2.68). The two measures showed the expected inverse correlation ($r = -.45$, $p < .01$).

Baseline Cardiovascular Measures

Mean baseline values were 117.0 mm/Hg (*SD* = 13.0) for SBP, 66.2 mmHg (*SD* = 10.2) for DBP, and 74.3 BPM (*SD* = 9.9) for HR. Multiple-regression analyses examined relations between the predictors and each of the baseline cardiovascular measures. Men had significantly higher baseline SBP than women (*M*s = 123.0 mmHg and 111.2 mmHg, $\beta = -11.11$, $p < .001$). There were no gender differences for baseline DBP or HR (*p*s > .10), and no significant main effects or interactions linking hostility or support or both to any baseline cardiovascular measure (*p*s > .70).

Speech Topic Categories

A series of one-way analyses of variance (ANOVAs) were conducted to determine whether participants who chose different speech topics (i.e., romantic, family, academic, roommate related) differed with regard to the main study variables. No differences were found for hostility ($p > .44$) or perceived social support ($p > .68$). Similarly, a chi-square analysis indicated no difference between men and women in choice of topic ($p > .80$).

CVR

Before conducting the main analyses, the level of reactivity produced by the two tasks was compared using repeated measures ANOVA. Results indicated significant task effects for all three measures, Fs(1, 107) ≥ 13.40, ps < .001. The speech task generated greater elevations than did the arithmetic task (SBP: *M*s in mmHg = 17.35 and 12.44; DBP: *M*s in mmHg = 19.91 and 14.38; HR: *M*s in BPM = 12.22 and 8.07).

Main effects analysis. Effects of main study variables were then examined using hierarchical, mixed-model multiple-regression analysis. In the first step, a simultaneous main effects model included hostility and support as continuous, between-subject

factors, controlling for gender and baseline cardiovascular measures. The model for SBP accounted for a statistically significant but modest portion of the variance ($R^2 = .24$, $p < .001$). Main effects models for DBP ($R^2 = .13$, $p < .01$) and HR ($R^2 = .10$, $p < .04$) also were significant but accounted for smaller proportions of the variance. Baseline cardiovascular values were significantly related to reactivity measures, with higher baselines associated with smaller change-scores for all three measures of CVR (ps < .008). There were no main effects of gender, hostility, or perceived social support for SBP (ps > .24), DBP (ps > .43), or HR (ps > .24). Further analysis involving hierarchical entry of the predictors indicated that main effects described previously were unaltered by the sequence in which they were entered into the model. The absence of main effects rules out mediational hypotheses regarding hostility and support in which either of these factors influences reactivity through its association with the other (31,32).

Moderation analyses. Next we added the Hostility × Support interaction (Step 2), and then terms reflecting task-related interactions (Step 3) to the main effects model for each cardiovascular measure. For SBP, Step 2 significantly improved the main effects model, $F(1, 101) = 5.05$, $\Delta R^2 = .04$, $p < .03$, reflecting a significant Hostility × Support interaction, $\beta = 1.14$, $SE = .01$, $p < .03$. As shown in Figure 1, the two-way interaction occurred because, averaging across tasks, higher hostility scores were associated with greater SBP reactivity only for those who were high in perceived social support. For those with low social support scores, greater hostility was associated with somewhat less SBP reactivity. In Step 3 of the SBP analysis, no significant interactions were found between task and either hostility or support (ps > .11), and the Hostility × Support × Task interaction was nonsignificant as well ($p > .36$).

In Step 2 of the DBP analysis, addition of the Hostility × Support interaction fell short of significantly improving the main effects model, $F(1, 101) = 3.52$, $\Delta R^2 = .03$, $p < .07$. In Step 3, adding interactions involving the task variable significantly improved the model, $F(3, 98) = 5.93$, $\Delta R^2 = .05$, $p < .02$. There were no two-way interactions between task and either hostility or support (ps > .57), but the Hostility × Support × Task interaction was significant, $\beta = 1.38$, $SE = .01$, $p < .02$. A plot of the interaction, presented in Figure 2, shows a pattern for the speech task that is highly similar to that obtained across tasks for SBP reactivity: Higher hostility was associated with greater reactivity only for those who were high in perceived social support. Among those who scored low in social support, greater hostility was associated with somewhat less DBP reactivity. For mental arithmetic, by contrast, there was little indication of an association between either hostility or social support and DBP reactivity. When data for the two tasks were analyzed separately, the Hostility × Support interaction was significant for the speech task, $\beta = 1.58$, $SE = .01$, $p < .006$, but not for the math task ($p > .76$).

For HR, addition of the Hostility × Support interaction in Step 2 did not significantly improve the main effects model ($p > .85$). Similarly, addition of task-related interactions in Step 3 revealed no significant interactions between task and either hostility or support ($p > .23$), and the Hostility × Support × Task interaction did not approach significance ($p > .92$).

Further analysis indicated that there were no two-, three-, or four-way interactions of gender with the hostility, support, or task variables for any of the CVR variables (ps > .13).

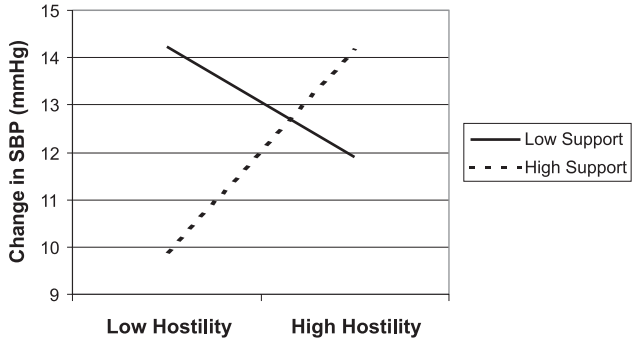
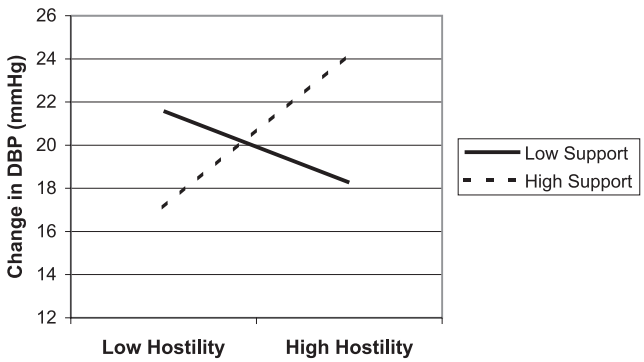
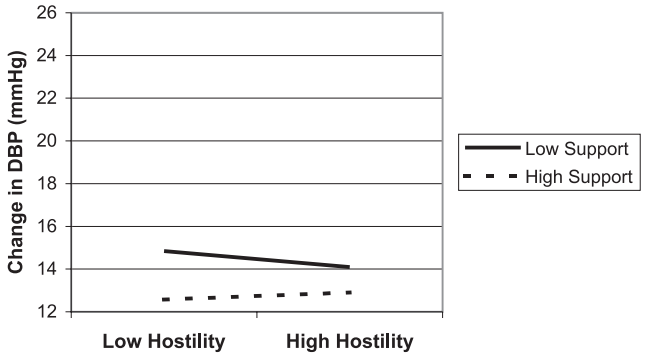


FIGURE 1 Interactive effect of hostility and perceived social support on changes (from baseline) in SBP in mmHg, averaging across both speech and math tasks. Predicted values of change in SBP are plotted 1 *SD* above and below the mean for hostility and perceived social support.



A



B

FIGURE 2 Interactive effect of hostility and perceived social support on changes (from baseline) in DBP in mmHg, for speech (A) and math (B) tasks. Predicted values of change in DBP are plotted 1 *SD* above and below the mean for hostility and perceived social support.

DISCUSSION

This psychophysiological study examined several hypotheses derived from a general interpersonal perspective that emphasizes the interplay between hostile personality attributes and aspects of social relationships. Trait hostility and perceived social support interacted in predicting CVR to acute laboratory stressors. Higher hostility scores were associated with greater SBP and DBP reactivity only among participants who reported higher levels of social support. For DBP, this moderating effect of social support on hostility was significantly more pronounced for a public speech task than for a mental arithmetic task. Thus, the results point to interaction effects in which perceived social support moderates effects of hostility on CVR, whereas there was no evidence of mediational effects or independent main effects. These findings have implications for conceptualizing the role of hostility and social support in influencing CVR.

Hostility and Social Support in CVR

This study provides evidence of interdependence in the effects of trait hostility and perceived social support on CVR. Neither hostility nor social support exerted a main effect on CVR. However, comparison of the findings for SBP and DBP (see Figures 1 and 2) reveals a consistent pattern in which the expected positive association between hostility and CVR is evident only among participants who reported high levels of social support. The more social nature and greater personal relevance of the speech task appear to have contributed to the production of this effect for DBP (compare Panels A and B in Figure 2) but not for SBP. As a general matter, the presence of an interaction effect agrees with at least four previous psychophysiological studies of hostility and social support (21,22,24,25). As noted earlier, however, the reported interaction patterns have differed. Our findings most closely agree with those of Lepore (24). Lepore found that cynicism (a major facet of trait hostility) was most strongly positively associated with SBP and DBP reactivity in an experimental condition designed to create the perception of social support, and showed a smaller, inverse association with SBP and DBP in a no-support condition. This pattern closely corresponds to data from the present study that were obtained using a measure of naturally occurring social support. Both similarities and differences across the small number of studies in this area should be viewed guardedly given methodological variations. Nonetheless, there is a striking convergence between our findings for measured support and those of Lepore reflecting manipulated support.

The Hostility × Social Support interactions may be viewed as consistent with Smith's (11) transactional model insofar as that model calls attention to the interplay of personal attributes and situation factors in accounting for elevated cardiac risk in individuals with high scores on trait hostility measures. By contrast, mediational effects that also would have been consistent with the transactional model were not observed in this study. That is, despite the expected inverse correlation between hostility and social support, there was no evidence that low social support mediated main effects of hostility on cardiovascular measures. This might be taken as a failure to support the suggestion that low social support, a psychosocial vulnerability associated with trait hostility, accounts, in part, for the relation between hostility and pathophysiological responses to stressors that are reflected in CVR. However, it is possible that the present study did not provide an adequate test of this hypothesis because of its cross-sectional design. Mediational pathways implied by the transactional model of hostility might better be detected using a longitudinal design that would permit changes in hostility and social support to influence each other over time and, in turn, produce changes in CVR.

Although congruent with basic premises of Smith's (11) transactional model, the question remains as to precisely how to interpret the Hostility × Social Support interactions. One possibility makes use of reasoning based on circumplex models of interpersonal relationships that highlight the importance of ambivalence. Research guided by such models that did not explicitly address trait hostility has shown that interpersonal relationships or exchanges characterized by both positive and negative feelings may be more health-damaging than simple negativity (14,33,34). In this study, trait hostility may have operated as a marker for interpersonal negativity that creates the opportunity for interpersonal ambivalence. Previous research supports the notion that individuals high in trait hostility are negative in their mental representations of others (35) and in interpersonal behaviors (36), including those involving social network members with whom they otherwise express closeness and positive feelings.

The attitudinal negativity of hostile individuals—characterized by cynicism, mistrust, and resentment—may create interpersonal ambivalence when it interacts with positive input from participants' social network members, such as that implied by high levels of perceived social support. When offers of support from a friend or family member are made, or even just expected, ambivalence might be aroused: Gratitude and anticipated benefits of anticipated support are accompanied by concerns about being emotionally dependent, having one's vulnerability taken advantage of, or being negatively evaluated. Interpersonal ambivalence may provoke exaggerated CVR responses, such as were observed among high-hostile, high-support participants in this study.

It is interesting to note similarities between the high-hostile, high social support participants in this study and that of a subgroup of hostile individuals described by Gallo and Smith (10). The latter research participants, identified using statistical clustering techniques, were characterized by markers for interpersonal negativity, such as trait hostility, disagreeableness, and social conflict, as well as by markers for interpersonal positivity, such as high perceived social support, an affiliative orientation toward parents, and a secure attachment style. They were distinguished from a high hostility group that showed less ambivalence in that they reported low levels of social support, as well as from a group low in both hostility and support. The apparent convergence in results generated by our multiple-regression analysis and Gallo and Smith's clustering procedures supports our suggestion that an ambivalent interpersonal orientation underlies the Hostility × Social Support interaction ef-

fects for CVR. This line of thought is speculative, however, and does not account for the smaller, inverse association between hostility and CVR among participants who were low in social support. Nonetheless, it may provide a useful avenue for further conceptual analysis.

Limitations

Several factors argue for caution in drawing conclusions from this study. As already discussed, inferences about theoretical models such as Smith's (11) transactional model of hostility and interpersonal theories based on the circumplex model (e.g., 10) must be qualified by the cross-sectional design and the absence of direct measures of the structure and quality of participants' social relationships. This study did not capture the dynamics of actual person–environment exchanges, and both trait hostility and social support were measured on only a single occasion using self-report measures. Thus it is not clear whether and to what extent the findings reflect the actual quality of participants' social relationships as opposed to intrapersonal, social cognitive representations of those relationships. Research making use of subjective and objective measures (e.g., 37) or manipulations (e.g., 19) of participants' social relationships is required to identify the processes that underlie statistical interactions between trait hostility and perceived social support in predicting CVR.

The data patterns we obtained, although showing some consistency across SBP and DBP in the case of the Hostility × Social Support interaction, did not extend to HR, for which no significant psychosocial predictors were identified. The lack of HR effects may have been due to the use of a blood pressure device whose determination of HR is based on a small sample of vascular pulsations rather than continuous EKG recording. The task variation that also qualified the findings did so in a manner that accorded with expectations only in some respects. The task main effects, and the fact that the Hostility × Social Support effect for DBP was in evidence only during the speech task, supported our assumption regarding that task's social quality and greater degree of personal and emotional involvement. However, the task manipulation did not generate the expected interaction for SBP. Finally, as mentioned earlier, variations in other aspects of methodology, such as the investigation of measured versus experimentally manipulated social support, may contribute to inconsistencies across studies. Replication of these findings is required in studies varying along this and other dimensions of research strategy.

CONCLUSIONS

Trait hostility and social isolation, both suspected risk factors for CHD, have typically been studied in isolation from each other in epidemiological work and in research examining potential explanatory mechanisms. Results of this study accord with an emerging interpersonal perspective and accumulating empirical findings that draw attention to the interdependence between personality-related and social–environmental risk factors. They also support recent indications pointing to possible health-damaging effects of interpersonal ambivalence. Replications of these results, and extensions that involve explicit measurement of network structure and quality, may provide greater insight into the contributions of personality and social relationships to CHD than will research examining these factors separately.

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