

Can Hostility Interfere with the Health Benefits of Giving and Receiving Social Support? The Impact of Cynical Hostility on Cardiovascular Reactivity During Social Support Interactions Among Friends

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Abstract

Background Both social support and hostility have been reliably associated with important health outcomes including coronary heart disease (CHD). One potential pathway by which these variables may influence CHD is via their impact on cardiovascular reactivity (CVR). Although social support has been generally associated with beneficial effects on cardiovascular functioning, the cynicism and mistrust among hostile individuals may prevent them from benefiting from the support process during times of stress.

Purpose and Method The present study examined if level of hostility influenced CVR when discussing positive or negative personal experiences with a friend. To test this, healthy males and females and their same-sex friend were recruited ($N=216$) and randomly assigned to discuss either a positive or negative (stressful) personal experience while cardiovascular measures were recorded.

Results and Conclusions Results revealed the greatest systolic blood pressure and diastolic blood pressure reactivity among individuals high in hostility when discussing a negative experience. These results suggest that hostility may interfere with the benefits from support transactions during stress. Likewise, this association between hostility and reactivity was apparent for both support recipients and

support providers, suggesting that hostility could undermine the health benefits of both aspects of support transactions.

Keywords Hostility · Social support · Disclosure · Cardiovascular reactivity · Stress

Introduction

Both social support and hostility have been reliably associated with various causes of morbidity and mortality, including coronary heart disease (CHD), the number one cause of death for both men and women in the USA and most industrialized countries. Although social support has been generally associated with beneficial effects on cardiovascular functioning, the cynicism and mistrust among hostile individuals may prevent such individuals from benefiting from support during times of stress. Unfortunately, this possible interactive effect of social support and hostility has been examined in a preliminary manner with potentially important limitations. For example, most prior research has primarily examined hostility only among males and/or manipulated social support using strangers rather than existing relationships. There is also limited research examining the influence of hostility on social support interactions involving both the seeker/receiver and provider of support. Therefore, the present study examined if level of hostility, among males and females, influenced cardiovascular reactivity when discussing positive or negative (stressful) real-life experiences among friend pairs.

Background

Numerous studies have garnered support for the role that both hostility and social support play in physical health.

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Specifically, high hostility has been associated with coronary artery disease (CAD; [1]), hypertension [2], and overall incidence of CHD [3–6]. Importantly, both hostility and social support have been shown to be independent risk factors for the development of CHD [7–9]. High hostility and social isolation have been implicated in not only increased morbidity but also increased risk for mortality [10–13].

One potential explanation for effect of hostility and social support on incidence of CHD is cardiovascular reactivity (CVR). Evidence suggests that exaggerated CVR to stressful situations may influence the development and/or expression of cardiovascular disease ([14]; for reviews see [15, 16]). Numerous studies have shown that high hostile individuals display greater CVR to stressors [17–22]). Hostile individuals display more frequent, pronounced, and prolonged increases in blood pressure and neuroendocrine levels in response to stress [23], and these responses subsequently increase risk for CAD and CHD [5, 6]. Conversely, both measured and experimentally manipulated social support are associated with reduced CVR to stressors ([24, 25], for reviews, [26, 27]), and this mechanism is thought to contribute to the beneficial effects of support on health [28–30].

If hostility is associated with earlier mortality through the mechanism of increased CVR, presumably this stress reactivity is common in the daily lives of hostile persons. In fact, research suggests that the association between hostility and CVR is particularly evident during interpersonal stress, and hostility is associated with ambulatory assessments of blood pressure [9]. It is unclear, however, if hostile individuals can benefit from social support. In the first study of this issue, Lepore [25] found that unlike non-hostile persons, hostile individuals did not benefit from enacted support; however, this support was provided by an experimenter. It may not be surprising that someone characterized by cynicism may not trust the intensions of a stranger. However, it is unclear whether support from a friend might have a different effect, given that such relationships have a familiar and perhaps reassuring history.

It is also unclear whether hostile individuals would display generally heightened levels of stress across interpersonal situations. There is some evidence that CVR among hostile individuals may be attenuated by situational factors. High hostile males tend to show a greater CVR when required to self disclose or when attempting to exert influence over their partners than low hostile males [20, 31, 32]. Whereas, evidence has shown that high hostile women have exhibited the greatest CVR in situations of direct provocation and harassment [33, 22]. However, it is presently not determined if interpersonal transactions that are positive, such as disclosing positive information or offering support to someone in need, are seen as less

threatening and therefore less likely to evoke CVR among hostile persons.

The Nature of Hostility May Influence Interpersonal Transactions

Hostility consists of interrelated emotional, behavioral, and cognitive constructs consisting of anger; verbal and physical aggressive acts, involving harmful intent; and negative attitudes and beliefs about others, such as cynicism and mistrust [34]. Thus, hostile persons may be cynical about the intent or genuineness of friendly and supportive actions. As noted previously, Lepore [25] found that low hostile individuals responded to supportive comments from a confederate with reduced CVR, but hostile persons did not. Therefore, failure to benefit from supportive social interactions may be one potential pathway in which hostility may be associated with poorer health.

Prior research has examined social support and hostility as separate risk factors—noting their independent contributions, even though several studies have shown that individual differences in hostile personality traits are inversely related to levels of social support [10, 35, 36]. The separation of these risk factors in prior research is likely due to the conceptualization of hostility as a personality factor, while social support is viewed as a characteristic of the social environment. However, research is beginning to conceptualize hostility and social support as being interrelated [32]. The recent emergence of an interpersonal perspective on the study of personality and health suggests that characteristics of people are best viewed within an *interpersonal* or *transactional cycle* [9]. According to this perspective, people tend to influence the experience and responses of others in their social environment in ways that are consistent with their personality traits. Thus, a friendly disposition is more likely to evoke warmth and friendliness in others, while a hostile disposition is likely to illicit cold and hostile reactions from others. It is hypothesized that such transactions are self-sustaining and over time for hostile persons lead to cumulative exposure to unhealthy social situations [9].

Few studies have examined hostility and social support transactions, and to date no study has examined the role of hostility in terms of social support transactions that influence both the seeker/receiver and provider. As noted above, there is some evidence that hostile people report having less social support [36–39]. Hostile people may also provide less support [40], suggesting that even the process of providing it may be stressful. Recent evidence suggests that higher levels of providing support may reduce subsequent health risks, and that these benefits of support provision could even account for the correlated benefits of receiving support [41]. That is, the receipt and provision of support are likely

to be correlated over time, consistent with interpersonal theory [9, 41]. Further, these two facets of support transactions may be correlated health risk or protective factors. Therefore, it is important to understand both whether hostile people find being the recipient of support stressful and whether the greater stress of providing support is another way in which hostile people may be at risk.

The Present Study

The current study was guided by the general question, “Can hostile individuals benefit from receiving or providing social support?” More specifically, we tested the hypothesis that hostility would be associated with enhanced CVR to both the receipt and provision of support during the discussion of negative, but not positive personal events. Although hostile persons do not appear to benefit from receiving support from strangers [25], it is possible that support delivered by friends is effective. However, the greater social conflict and reduced social support evident in personal relationships of hostile persons [42–44] suggests they will not show physiological benefits of support even from friends.

Because interpersonal stress can occur in a broad array of situations, we were also interested in the effect of the interpersonal context. Do hostile people respond differently to positive and negative interpersonal exchanges? If hostility is associated with generalized interpersonal stress, we would expect increased reactivity when individuals are discussing both positive and negative experiences with their friend. However, if a hostile disposition would specifically interfere with support during times of stress then we should see increased reactivity primarily when participants are discussing negative experiences with their friend.

We were also interested in whether it is equally stressful being the recipient of support as being a support provider among hostile persons. If the role of support seeker/receiver is more stressful than the role of support provider, we should see a moderating effect of role on cardiovascular reactivity. Further, given that hostility is associated with lower perceptions of social support from one’s network and that such individual differences in social support are themselves associated with CVR [27], we also examined the association of hostility with CVR during support transactions while examining this related risk factor.

These questions were tested by examining the impact of hostility during interpersonal exchange on cardiovascular reactivity. To manipulate social support, participants brought a same-sex close friend to the laboratory and were randomly assigned to discuss either a positive or negative life experience with their friend. The hostility subscale of the Aggression Questionnaire [45] was used to determine level of hostility.

Method

Participants

Fifty-six women and 51 men and their same-sex friends ($N=214$) were recruited to participate in this study.¹ Participants were recruited from introductory psychology courses and offered extra credit or monetary compensation for their participation. The participants had known their friend an average of 6.5 years and had contact an average of 4.2 days per week. Consistent with prior research (e.g., [47]), the following self-reported inclusion criteria was used to select healthy participants: no existing hypertension, no cardiovascular prescription medication use, no past history of chronic disease with a cardiovascular component (e.g., diabetes), and no recent history of psychological disorder (e.g., major depressive disorder).

Procedures

Same-sex friend pairs were asked to come to our laboratory to complete the research protocol. Participants recruited by the experimenter were designated as the support recipient (the one asked to disclose as part of the study), and the friend they brought to the experiment was designated as the support provider (the one asked to simply respond). Upon arrival, after informed consent was obtained, each member of the pair completed a packet of questionnaires in separate rooms within the lab. Following this adaptation period of approximately 20 min, the friends were reunited and seated next to one another. The protocol consisted of a 12-min resting baseline period, a 4-min neutral discussion (i.e., what they do during a typical weekday), a second rest period lasting 7 min, and then a 6-min discussion (i.e., positive or negative experience) task. Throughout the protocol, participants were seated next to one another. A hospital-type curtain was drawn between them during resting periods. Cardiovascular assessments of systolic blood pressure (SBP), diastolic blood pressure (DBP), and heart rate (HR) were obtained once every 90 s from both members of the friend pairs during rest periods and once every minute during the discussion tasks. Each individual completed ratings of anxiety at the end of every aspect of the protocol, and perceptions of friends’ friendliness and dominance during discussions at the end of each discussion task, with the curtain drawn between them. The experimenter was in a separate room during both the rest and discussion portions of the protocol, communicating via

¹ Further information on this sample was reported in Holt-Lunstad et al. [46].

intercom to provide necessary instructions and viewing participants via a video monitor. The experimental protocol was video recorded for later analyses.

Before the discussion task began, participants designated as support recipients were asked to list and rate up to five past experiences that were particularly negative/positive (depending on random assignment) that they were willing to discuss as part of our experiment. Based on ratings (scale 1 to 5) of importance, positivity, and negativity, in comparison to all possible negative/positive events in their life, the experimenter selected an experience that was rated as moderately high to control for intensity across conditions. Participants designated as support recipients were asked to discuss three aspects of the selected experience—a description, their thoughts and feelings, and how they handled the situation and/or how they might have changed anything the selected experience. The friend (i.e., support provider) was told to simply respond as they would naturally. This format was intended to provide a reasonable level of experimental control, but also evoke interactions that would approximate representations of friends sharing and discussing various aspects of either a negative or positive experience, as would be typical in support transactions within personal relationships.

Measures

The Buss and Perry Aggression Questionnaire (AQ)

Level of hostility among our participants was assessed using the AQ. The AQ consists of 29, 5-point Likert scale items assessing trait anger, hostility, verbal aggression, and physical aggression. The hostility subscale consists of eight items and has an internal consistency of $\alpha=0.77$, and a 9-week retest reliability of 0.72 [45]. Items include statements such as “When people are especially nice, I wonder what they want”, “I am suspicious of overly friendly strangers” and “I am sometimes eaten up with jealousy”. It correlates highly with other measures of hostility, including scales found to predict subsequent health (i.e., [48]), and correlates less strongly with measures of conceptually less closely related constructs [49–51]. The internal consistency within this sample was also high for both the entire measure ($\alpha=0.89$) and the hostility subscale ($\alpha=0.80$). While the AQ has been used less frequently in research involving cardiovascular disease endpoints, it is associated with better psychometric properties than more frequently used measures (e.g., the Cook–Medley).

Impact Message Inventory, Form II (IMI)

The IMI [52] is a circumplex-based inventory designed to assess perceptions of another’s interpersonal behavior, along the dimensions of friendliness versus hostility and dominance versus submissiveness. This assessment con-

tains 32 items with four items per octant. Each member of the dyad rated their interaction with their friend on this instrument after each discussion (i.e., twice). Kiesler et al. [53] provide evidence supporting the circumplex structure of the IMI and demonstrate its adequate psychometric properties, and it has been found to be sensitive to similar interpersonal manipulations in prior research [54]. It was expected that the dimensions of friendliness and dominance as measured on the IMI would differ as a function of discussion (neutral, positive, or negative) and hostility. The use of circumplex-based measures is useful for documenting the impact of interpersonal manipulations in psychophysiological studies [55] and is quite relevant to the present procedure given the application of circumplex models to the study of social support transactions [56]. The IMI had an internal consistency of $\alpha=0.72$ in this study.

State Anxiety Scale

A short form of the Spielberger State-Trait Anxiety Scale was administered to participants prior to and following each discussion [57]. Prior work has found the internal consistency of the scale to be high (Cronbach’s alpha of 0.78 to 0.80) and was also high in this sample ($\alpha=0.82$)

Interpersonal Support Evaluation List (ISEL)

The ISEL was used to assess total social support among our participants. The ISEL includes 40 questions that assess the specific dimensions of appraisal, self-esteem, belonging, and tangible support. In a prior work, the internal consistencies of the scales range from 0.60 to 0.92; with a 4-week test/retest reliability of 0.87 for the total scale [58]. The ISEL was also associated with high internal consistency in this sample ($\alpha=0.90$). The reliability of the ISEL has been established over a 6-month period [58].

Additional Manipulation Checks

To ensure that manipulations were having their intended effect, a short questionnaire was devised that we refer to as the post-discussion rating. This includes items such as how stressful, difficult, effortful was the task, as well as items addressing how helpful/upsetting was this person during the task and when going to this person in the past. Participants were asked to rate their current feelings on a 1 (not at all) to 6 (extremely) point scale. For items 15 and 16, 1 = never, 6 = at great lengths.

Cardiovascular Response

A Dinamap Model 8100 monitor (Critikon Corporation, Tampa, FL, USA) was used to measure SBP, DBP, and HR. The Dinamap uses the oscillometric method to estimate

blood pressure. Blood pressure assessments were obtained via a properly sized occluding cuff positioned on the upper left arm of the participant according to the manufacturer's specifications.

Observational Behavioral Data

We had two independent raters code the videotaped interactions using *The Check List of Interpersonal Transactions—Revised (CLOIT-R; [59])*. The CLOIT-R is an observational rating method based on the interpersonal circumplex models of behavior. The CLOIT is made up of 16 subscales. Prior research has modified it to make it more applicable to dyadic interactions and has demonstrated that behaviorally coded dominance and hostility to be significantly and independently correlated with cardiovascular reactivity [60]. The present study focused on eight of the subscales (Dominance, Submissive, Friendly, Hostility, Cold, Warm, Assured, Unassured) in an effort to capture each of the four poles of the circumplex. Each subscale was assessed by two descriptors. Each of the three 1-min response segments was coded (1 = yes, 0 = no) as to whether the descriptor described the support provider and summed for each subscale. Due to various problems (malfunctioning VCR, no volume, and one dyad did not speak English) we lost data for 32 dyads. Thus, we had video data for 80 dyads. Sufficient inter-rater reliability was established across the behavioral ratings of the dimensions dominant/submissive ($r=0.81$; $p<0.0001$), friendly/hostile ($r=0.70$; $p<0.001$), warm/cold ($r=0.82$; $p<0.0001$), or unassured/assured ($r=0.62$; $p<0.001$).

We were also interested in examining the extent to which the structured (alternating minute) speaking protocol may have differentially impacted the flow of conversations. Thus, raters also checked (1 = yes, 0 = no) for the following five items: (1) there were awkward pauses; (2) the *support provider* had difficulty speaking for the entire minute; (3) the *support recipient* had difficulty speaking for the entire minute; (4) the *support provider* seemed to feel uncomfortable/awkward/uneasy responding to the friend; and (5) the *support recipient* seemed to feel uncomfortable/awkward/uneasy speaking about the experience. The means of the scores are as follows: (1) $m=0.58$; (2) $m=0.66$; (3) $m=0.12$; (4) $m=0.60$; (5) $m=0.20$. There was no significant effect of hostility or interaction with valence of discussion on any of these items ($p's>0.05$); thus, it appears that the structured nature of the conversation did not differentially impact the flow of conversation.

Data Analysis

We used Proc Mixed (SAS Institute; [61]) to estimate random intercept models with random effects for friend pairs. As

such, analyses controlled for the non-independence of observations of friend pairs. In our analyses, gender, discussion condition, and hostility were first centered at their grand mean before inclusion into the model [62]. Hostility was treated as a continuous variable. These data are reported in unstandardized regression coefficients. Results reported are all actor effects; thus, irrespective of support role (support provider or support recipient), the findings represent how the subject's own hostility level and condition (not their partner's hostility level) influenced our dependent measures.

Results

Manipulation Checks and Self-Report Measures

Since our participants were randomly assigned to discuss a positive or negative experience with their friend, before examining the physiological effects associated with these discussions, we first examined whether they were of comparable psychological intensity. Ratings of topic intensity indicated no significant group differences ($m=2.9$; 3 = moderate) suggesting that the topic selection procedure was effective and any differences between conditions could not be simply explained in terms of the psychological intensity of the positive and negative experiences.

We also examined if friendship characteristics varied systematically according to level of hostility. Ratings indicate there was no significant effect of hostility on the length of time they have known their friend or the amount of contact with the friend. There was also no significant effect of level of hostility on how important the friendship was perceived. Therefore, the level of friendship is fairly equivalent across the range of hostility.

A number of other items intended to be manipulation checks were also included in our Post-Discussion Rating Scale that was completed following the discussion (i.e., positive or negative). Although based on single items, there were several significant effects of hostility (see Table 1). Results revealed a significant effect of hostility for items 1 and 2 ($p's<0.05$), such that those higher in hostility were less open and felt less comfortable during the discussion with their friend. Hostility was also associated with items 4, 5, 6, 8, 9, and 14 ($p's<0.05$), such that those higher in hostility found the discussion to be more challenging, upsetting, threatening, and difficult. They felt more mixed and conflicted towards their friend and rated that it was more upsetting when discussing this event with their friend in the past. We next entered discussion valence into the equation to determine if these findings were consistent across both positive and negative discussions (i.e., testing for interaction effects). We found a significant interaction between hostility and discussion valence for

Table 1 Item means and association with hostility reported in unstandardized betas

Post-discussion ratings	Mean	B
How <i>open</i> were you to disclosing this event with your friend?	5.20	−0.36****
How <i>comfortable</i> did you feel discussing this event with your friend?	4.97	−0.35***
How <i>helpful</i> was your friend during the discussion?	3.81	−0.11
How <i>challenging</i> was the event discussion task?	2.86	0.36**
How <i>upsetting</i> was your friend during the discussion?	1.48	0.21*
How <i>mixed and conflicted</i> were your thoughts and feelings toward your friend during the discussion?	1.42	0.26****
How <i>effortful</i> was it to do the discussion task?	2.88	0.07
How <i>threatening</i> was the event discussion task?	1.45	0.25***
How <i>difficult</i> did you find the discussion task?	2.30	0.31**
How <i>natural</i> was this discussion compared to normal discussions with this friend?	3.07	−0.08
To what extent did your friend respond as <i>normally</i> as he or she would outside this experiment?	4.06	−0.16
How <i>familiar</i> was your friend with the event that you discussed?	3.79	−0.04
When discussing this event with this person in the past, how <i>helpful</i> has your friend been?	3.76	−0.24
When discussing this event with this person in the past, how <i>upsetting</i> has your friend been?	1.57	0.25**
To what extent have you discussed this event with <i>this friend</i> before?	2.45	0.18
To what extent have you discussed this event with <i>anyone</i> before?	2.73	−0.04

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; **** $p < 0.0001$

Means represented above were scaled according to 1=not at all, 6=extremely; for the final two items, 1=never, 6=at great lengths

item 1 ($b = 0.48$; $p < 0.01$); however, there were no other significant interactions. When blocking on discussion valence, we find that the effect remains significant for discussions of positive ($b = -0.60$; $p < 0.0001$) but not negative discussions ($b = -0.12$; $p = 0.32$). Thus, it appears that hostile persons were less open primarily during discussions of positive experiences.

Ratings of Friend's Friendliness and Dominance

We again used the Proc Mixed procedure in SAS to analyze these data. During the neutral discussion, there was no significant effect of trait hostility, gender, or their interaction (p 's > 0.05) on ratings of partners' dominance; however, ratings of partner's friendliness was significantly associated with trait hostility ($b = -0.52$, $p < 0.0001$), gender ($b = -0.22$, $p = 0.01$), and their interaction ($b = -0.29$, $p = 0.01$). Those higher in hostility perceived their friend to be less friendly, and female friends were perceived as friendlier than male friends. Plots of the trait hostility by gender interaction reveal that males high in hostility perceived their friend as having the lowest levels of friendliness/warmth.

During the discussion of positive or negative experiences, data revealed a significant association between IMI ratings of the partner's dominance and gender ($b = 0.14$, $p < 0.05$) such that males were rated as significantly more dominant/controlling than females; however, there was no significant association or interaction with trait hostility ($p > 0.05$). When examining ratings of partner's friendliness, we found a significant main effect for hostility ($b = -0.59$, $p < 0.0001$) and gender ($b = -0.22$, $p = 0.02$), such that higher hostility was associated with lower ratings of partner's friendliness, and friendliness was higher among female than male friend

pairs. We also found a three-way interaction between hostility, gender, and valence of discussion ($b = 0.39$, $p = 0.004$). In follow-up analyses blocking on condition, we find that among friends discussing a negative experience, we have a significant hostility ($b = -0.52$, $p = 0.004$) and gender main effect ($b = -0.38$, $p = 0.004$), and the hostility by gender interaction ($b = -0.62$, $p < 0.001$). When discussing a negative experience, those greater in trait hostility viewed their friend as less friendly and males viewed their friends as less friendly. Among friends discussing positive events, we see only a trait hostility main effect ($b = -0.66$, $p = 0.001$). In sum, across conditions, hostile individuals rated their friend as no more or less dominant/controlling; however, trait hostility was consistently associated with perceptions of reduced friendliness.

Observer Ratings of Friend's Behavior

We next examined the potential that the support provider may have behaved differentially as a function of the friend's (support recipient) level of hostility. Results revealed no significant effect of hostility on behavioral ratings of the dimensions dominant/submissive, friendly/hostile, warm/cold, or unassured/assured. Thus, despite differential perceptions of the friendliness of the friend (support provider), there were no behavioral differences as rated by independent observers.

Anxiety

In analyses using Proc Mixed, we found a significant main effect for hostility across all epochs. Higher hostility was associated with higher anxiety during the first baseline ($b = 0.17$, $p < 0.0001$), neutral discussion ($b = 0.15$, $p < 0.0001$),

second baseline ($b=0.15$, $p<0.0001$), and discussion task ($b=0.17$, $p=0.0005$). When we looked at change in anxiety from the baseline to discussion task, there was no significant effect of hostility ($p>0.05$). There was no significant interaction with the discussion condition (positive or negative) for either level of anxiety or change in anxiety (p 's >0.05).

Primary Analyses

We used the Proc Mixed procedure in SAS to analyze these data. The physiological dependent measures were SBP, DBP, and HR. An average baseline value was calculated for each of our physiological variables to increase the reliability of these assessments [63]. During the neutral and event discussions, the participant and friend alternated speaking for 1 min each so that we had an index of speaking versus listening. Since there were no differential patterns of our manipulations as a function of speaking and listening on SBP, DBP, or HR, an average for the neutral and an average for the positive/negative discussion were calculated for each of our physiological variables to increase the reliability of these assessments [63]. Change scores were then computed as an index of reactivity [64]. Because basal level can affect reactivity scores [65], baseline measures of physiological functioning were entered into all of the reactivity analyses as a covariate.

Baseline and Reactivity During the Neutral Task

When examining baseline assessments, there was no main effect of trait hostility for SBP, DBP, or HR; however, there was a gender by hostility interaction for SBP ($b=-1.69$; $p=0.04$). When blocking on gender, we find that hostility significantly predicts higher baseline SBP among women ($p=0.05$) but not men ($p=0.38$). When examining reactivity while discussing a neutral topic with their friend, we also found no significant results for hostility for SBP, DBP, or HR reactivity. When examining the second baseline assessments, there was no main effect for hostility for SBP or DBP; however, HR varied significantly by level of hostility ($b=1.85$; $p=0.04$). These results suggest that cardiovascular responses for hostile individuals are not consistently high across situations.

Reactivity to Discussing a Positive or Negative Experience

To examine the effects of hostility within each discussion condition (positive, negative) on cardiovascular reactivity,

² We initially included gender in the model to test for any gender and hostility interactions, although there are documented sex differences in cardiovascular functioning, because not much has been done examining hostility among both sexes. However, because there were no significant gender effects (main effects or interactions with hostility), to simplify the model we entered gender in as a covariate in all subsequent analyses.

we again used Proc Mixed. Gender, measures of physiological functioning during the second baseline, and reactivity during the neutral discussion were entered into all of the reactivity analyses as covariates.² Results revealed that hostility significantly predicted SBP reactivity ($b=-5.34$; $p<0.01$). Hostility also had a marginal effect on DBP ($b=-3.06$; $p=0.06$), but no significant effect for HR reactivity. In addition, the valence of the discussion significantly predicted SBP reactivity ($b=2.15$; $p=0.01$) such that reactivity was greater when discussing negative experiences; however, there was no significant effect on DBP or HR reactivity.

We next evaluated our hypotheses about the context in which hostility may be detrimental. A significant interaction emerged between trait hostility and discussion valence for SBP ($b=3.21$; $p<0.01$) and DBP ($b=2.28$; $p=0.02$) reactivity.³ In follow-up analyses blocking on hostility (e.g., one SD above and below the mean) for SBP reactivity, we find significantly greater reactivity in the negative than positive discussion condition for those high in hostility ($b=7.01$; $p<0.005$), but there is no significant difference for those low in hostility ($b=-3.23$; $p=0.22$). When blocking on condition, we find a significant effect of hostility in the positive condition ($b=-6.58$; $p<0.05$) and the negative condition ($b=4.15$; $p<0.05$). Plots of the interaction for SBP indicated the greatest levels of SBP reactivity among high hostile individuals disclosing a negative event whereas the lowest level of reactivity was among high hostile individuals disclosing positive events (see Fig. 1). We also performed similar follow-up analyses blocking on hostility (e.g., one SD above and below the mean) for DBP reactivity. We found no significant condition effect (i.e., negative versus positive discussion) for those high in hostility ($b=8.03$; $p<0.14$) nor for those low in hostility ($b=-17.05$; $p=0.31$) for DBP reactivity. When blocking on condition, however, we find a significant effect of hostility in the negative condition ($b=1.47$; $p=0.05$) but not in the positive condition ($b=-0.63$; $p=0.37$). When we plot the interaction for DBP, we again see the greatest levels of reactivity among high hostile individuals disclosing a negative event (see Fig. 2). There was no significant interaction effect for HR ($p>0.05$).

The Role of Support Provider Versus Recipient

We next examined whether responses differed according to one's role in the support process and whether support role

³ A previous report using this data examined the quality of the friends' relationship (i.e., ambivalent versus positive) as a moderator of the effects of experimentally manipulated social support [46]. When statistically controlling for the quality of the relationship, none of our primary findings were changed. Therefore, the effects of hostility reported here are independent of those reported elsewhere.

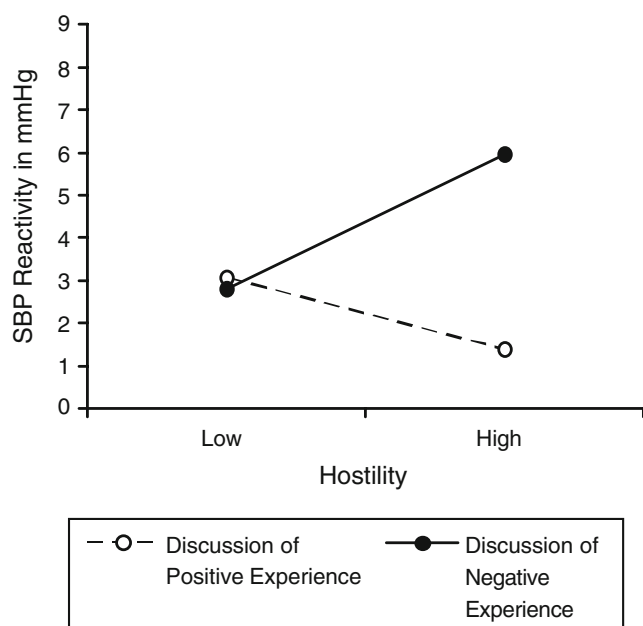


Fig. 1 SBP levels during social interactions as a function of hostility and discussion type

moderated the impact of hostility during positive and negative interpersonal exchanges. We entered in to the equation a new variable: support role (i.e., the participant who disclosed the experience and the friend who was asked to respond). With the inclusion of this new variable, we found no significant main effect of support role for SBP, DBP, or HR (p 's > 0.05). However, we did find a significant interaction between support role and the valence of the discussion (positive or negative) for SBP ($b = 3.72$; $p = 0.01$). When examining the simple effect of support role by discussion, we find that there was no effect of valence of discussion for those providing support, but there was an effect for those seeking/receiving support ($b = 4.02$; $p < 0.001$). Thus, regardless of hostility level, among persons seeking/receiving support, discussing negative events was associated with higher SBP reactivity than discussing positive experiences. There were no other significant interactions with the valence of the discussion for DBP or HR. Likewise, there was no significant support role \times hostility interaction or three-way interaction for SBP, DBP, or HR (p 's > 0.05). Importantly, the hostility \times condition effect for SBP reactivity continued to be significant when examining support receipt ($b = 2.90$; $p < 0.05$) and support provision ($b = 3.60$; $p < 0.05$) separately. Thus, it appears that among hostile individuals both receiving and providing support are experienced similarly physiologically.

We also examined the impact of role of support provider versus recipient on our psychological variables. Given that these roles were only applied during the discussion task, all analyses are based on measures relevant to this aspect of the protocol. Results revealed no significant main effect of

support role for perceptions of dominance or friendliness on the IMI, nor was there an interaction with the valence of the discussion (positive or negative), hostility, or their three-way interaction (p 's > 0.05). Thus, our finding that hostility was associated with lower perceptions of friendliness of their friend was not moderated by their role in the support processes. When we examined anxiety during the discussion task, we find a significant main effect of support role ($b = 0.07$; $p = 0.05$) such that those asked to disclose (i.e., support seeker/recipient) were higher in anxiety than those asked to respond (i.e., support provider). We also found a support role by hostility interaction ($b = -0.10$; $p < 0.05$). Interestingly, when we block on support role we find among those asked to disclose, there is no longer a hostility effect ($p = 0.36$); however, there is a hostility effect among those asked to respond ($b = 0.29$; $p < 0.0001$). Thus, hostile individuals are more anxious when expected to provide support than when seeking/receiving it.

Hostility and Network Social Support

Consistent with prior literature (e.g., [66, 37]), we examined whether hostility was associated with lowered perceptions of social support from their network and their interactive effects. Consistent with Chen and colleagues [66], social support was determined by one's score on the appraisal subscale of ISEL. We found a significant main effect of trait hostility for social support ($b = -0.12$; $p < 0.001$). Thus, higher hostility was associated with lower appraisal of social support. We next examined whether or not the level of network support interacted with hostility to

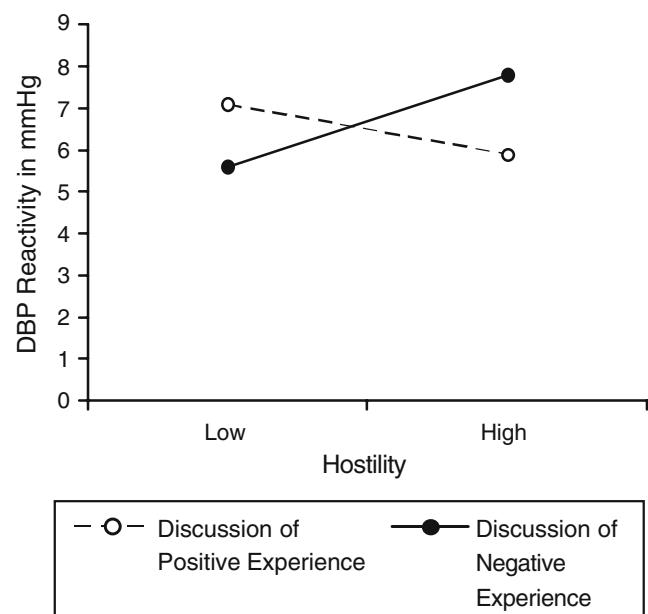


Fig. 2 DBP levels during social interactions as a function of hostility and discussion type

predict CVR. We found no support main effect or hostility by social support interaction for SBP, DBP, or HR reactivity (p 's>0.05). In sum, we found evidence that hostility is associated with lower social support; however, we did not find any significant interaction between hostility and social support nor any evidence that the level of network support accounted for the relationship between hostility and CVR.

Discussion

The present study examined the association between hostility, social support, and CVR. Specifically, our first aim was to examine whether hostility would be associated with CVR during discussions of positive and negative events with friends. High hostility was associated with heightened SBP and DBP reactivity during discussion of negative events, but not during discussions of positive events. These results, in combination with the finding that those high in hostility perceived their friend to be less friendly despite no actual behavioral difference, suggest that hostile individuals may have a perceptual bias that may impede benefiting from social support received from friends during stressful times. The second aim of this study was to determine whether any association between trait hostility and CVR varied across the roles of recipient versus provider of support. These results suggest that during social support interactions individuals high in hostility are more anxious when expected to provide support. However, trait hostility was significantly associated with increased CVR regardless of role in the support transaction (i.e., seeking/receiving support or providing support). Finally, we were interested in whether low perceptions of social support from one's network would provide further clarification of the association of hostility and CVR. As predicted hostility was associated with lower overall social support, however, there was no evidence of moderation or mediation.

This study is consistent with and extends prior research. Specifically, this research replicates Christensen and Smith's data [31] such that we also find that greater cardiovascular reactivity during self-disclosure of personally stressful events is positively associated with hostility. Importantly, this study extended those previous findings in a number of ways. First, we included in our sample both men and women. More importantly, we found that this reactivity associated with self-disclosure is not generalized to all types of disclosure but rather appears to be most pronounced when disclosing negative events—disclosure most associated with support seeking and vulnerability. This study also extends Lepore's [25], as the support is from an actual friend rather than a stranger. Most importantly, because this study utilized an existing friendship rather than a stranger, these data suggest that hostile persons have

a more generalized mistrust in others and not merely mistrust of strangers. This is also the first study to date that has examined this from an interpersonal perspective—examining the impact of role of both recipient and provider of support.

There are qualifications, however, that warrant attention. The first concerns the generalizability of the sample. Our sample was primarily young (college-aged), healthy, and Caucasian. The extent to which these findings can be generalized to other ages, SES, health status, and ethnicities cannot be determined. Replication using more diverse samples is needed. In addition, all participants were required to bring in a same-sex friend. It is possible that participants may have reacted differently if they were interacting with an opposite sex individual and/or someone of a different relationship type (e.g., romantic partner, sibling, coworker). Likewise, our protocol was structured such that each member of the friend pair was in either the support recipient or provider role, but not both. Future research using a within-subjects design may be a stronger test. It is also unclear why our findings would be significant for BP but not HR. Future studies utilizing methods that may shed light on the underlying determinants and benefit from the increased reliability of continuous measurement are encouraged.

Another potential limitation of this study is the ecological validity of our procedures relative to naturally occurring social support or disclosure processes. The first step in the support process is whether one chooses to actively seek out support. It is possible that hostile people may not actually choose to seek out their friend when they need support. In fact, hostile characteristics such as cynicism may lead such individuals to not expect much support from others. If little support is anticipated, it may be possible they would be less likely to seek it out. Because we asked each member of the dyad to rate their friend on how likely they were to go to that person when under stress (“when you need support, such as advise, understanding, or a favor”), when they were “happy, excited, or proud of something” (i.e., happy times), or “during routine daily interactions, conversations or activities” (i.e., neutral situations), we were able to examine this. Surprisingly, we found that hostility did not significantly predict the likelihood that they would go to their friend during stressful times ($p=0.40$); however, hostility did predict likelihood to seek out their friend during happy times ($b=-0.21$, $p=0.05$) and neutral situations ($b=-0.26$, $p=0.01$). Thus, as hostility increases, our participants were less likely to go to their friend to share positive news or go to their friend more generally. Future studies that directly test these issues are needed.

It is also possible that the structured (alternating minutes) conversation reduced the naturalism of discussions between friends. Support interactions, especially

emotional support situations, often entail unequal exchange by support recipient and provider. Consistent with this idea, observational data revealed more awkwardness and difficulty speaking for the entire minute among support providers than recipients. At times, successful support provision may entail primarily being a good listener; thus, non-verbal communication may supersede any verbal exchange. For instance, research supports that invisible support may be more beneficial in some circumstances than explicit support provision [67]. Thus, it is possible that reactions may be more a result of an artificial situation for which one has no normative script, or increased evaluative threat for support recipients, than support transactions per se. However, potentially embarrassing or threatening self-disclosure is an inherent aspect of support transactions that are not invisible (i.e., actual interactions). Likewise, while it is difficult to determine precisely the extent to which the naturalism was compromised, our behavioral data suggest that any effect the structured nature of the discussion may have had was equivalent across the range of hostility. Given that the positive discussions did not yield the same results, these and our behavioral data provide some attenuation of this potential limitation.

Despite these limitations, this study has a number of strengths. First, the use of existing friendships is an important step in increased ecological validity. Much of the prior literature has been limited, as many laboratory studies examining both hostility and social support have often used strangers, confederates, or the experimenter to operationalize support [68] and/or induce anger or irritation. Although these studies provide insight on processes associated with hostility and social support, they may be limited in capturing sophisticated nuances associated with existing relationships (i.e., one's history with that person). An additional strength of this study is the inclusion of both men and women. Although we did not find any interactions between hostility and gender for CVR, hostility has been inadequately examined among women in prior research. Finally, there may be epidemiologic implications of this line of research. Most of the literature involving morbidity and mortality outcomes has examined either trait hostility or social support, but not both. It is possible that physiological evidence indicating interactions between these two psychosocial factors may suggest that the epidemiologic literature underestimates their association with cardiovascular endpoints.

Overall, this research may help clarify the health-related consequences of interpersonal interactions of hostile individuals. It appears that not only might hostile persons fail to benefit from support during times of stress, but the role of giving support may be emotionally stressful and physiologically taxing for hostile persons as well. This is consistent with the hypothesis that hostility is characterized

by both greater exposure and reactivity to social stressors. However, these findings also suggest that positive social interactions (i.e., discussing positive events) may not confer the same vulnerability as stressful or negative processes for hostile persons. Further research is needed, however, to elucidate the interpersonal perspective on hostility and its impact on health. Given both CHD and hostility are thought to begin developing in childhood and continue to evolve over many decades, a developmental perspective may be critical in understanding and modifying the adverse effects of hostility on health. The present results suggest that the interconnected health benefits of both giving and receiving social support [41] are less available to hostile persons. Less frequent experience of such interactions and less physiological benefit from them across the life course [70] could contribute to the adverse health effects of hostility, perhaps suggesting useful targets for prevention efforts.

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