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Hostile Mood and Social Strain during Daily Life: A Test of the Transactional Model

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## Abstract

**Background:** Hostility is a multidimensional construct related to cardiovascular (CV) disease risk. Daily hostile mood and social interactions may precipitate stress-related CV responses in hostile individuals. **Purpose:** Determine whether trait cognitive hostility best predicts daily hostile mood and social interactions relative to other trait hostility factors and explore the temporal links between these daily measures. **Methods:** 171 participants completed assessments of 4 trait hostility scales. Participants completed an electronic diary across 3 days, assessing current hostile mood and social interaction quality. **Results:** Multiple regression analyses revealed both affective and cognitive hostility to be significant predictors of daily hostile mood, and cognitive hostility alone to predict daily social strain. Additional analyses revealed previous social strain to predict elevated subsequent hostile mood. **Conclusions:** Episodes of social strain may give rise to elevated hostile mood. Trait cognitive hostility may be an important factor in predicting daily social strain.

*Keywords:* hostility, hostile mood, social strain, and transactional model.

### Hostile Mood and Social Strain during Daily Life: A Test of the Transactional Model

A substantial literature has shown dispositional hostility to be a significant predictor of cardiovascular (CV) disease morbidity and mortality (e.g., 1-3). Further, evidence suggests hostility to be linked to a host of risk factors for the development of CV disease, including metabolic syndrome, excessive alcohol consumption, smoking, low socio-economic status, social isolation, and high rates of depression (e.g., 4-5). Hostility has been defined as a general and enduring personality trait, characterized by a tendency to experience anger frequently and intensely; a cynical mistrust and devaluation in the worth and motives of others; an expectation of others as a likely source of wrongdoing; a relational view of being opposed to others; and a desire to inflict harm or to see others harmed (6-7). Thus, the hostility construct is recognized as multidimensional, including affective (e.g., anger), behavioral (e.g., aggression), and cognitive (e.g., cynicism) components (8).

The hostility construct has been characterized by elevated exposure and reactivity to unhealthy psychosocial contexts (e.g., 9). Interpersonal models designed to explain the relationship between hostility and CV disease risk have noted the interrelationships between hostility and adverse social environments, suggesting that daily bouts of interpersonal strain may set the stage for disease promoting CV responses among hostile individuals (e.g., 10). Rooted in interpersonal theory, the transactional model of hostility characterizes the cynical mistrust and hyper-vigilance to threat inherent to the hostile disposition (i.e., cognitive hostility) as instrumental in creating a social environment conducive to antagonistic interactions that facilitate and prolong the experience of anger (9). The basic model stipulates that the covert attributes of the hostile disposition foster disagreeable social encounters while simultaneously undermining offers of social support, both advocating social antagonism and decreasing the likelihood of

agreeable social interactions (see Figure 1). Under this model, the covert attributes of cynicism and relation view of opposition are thought to transact upon the social environment in a manner ill-suited for agreeable interactions and social support. An important feature of the transactional model concerns the notion of cognitive hostility promoting a high frequency of provocation in their daily interactions: the cynical expectation of others as a source of wrongdoing may put people on the defensive and increase the probability of disagreeable encounters. Therefore, the cognitive attributes of the hostile persona are believed to promote antagonistic behaviors towards interpersonal targets, thereby reinforcing complementary behaviors from others which confirm the initiating cynical orientation.

Although the transactional model may be appealing as a means of conceptualizing the relationship between hostility and CV disease, it is a difficult model to test directly, requiring a design that would permit examining actual social interactions in the lives of hostile individuals. Ecological momentary assessment (EMA) methods, characterized by repeated assessments of subjects' momentary states in their natural environments (12), can be used to capture mood and social interactions as they unfold in real time. In addition, in this report we have the capacity to pit the factors that underlie the multidimensional hostility construct against one another, allowing us to examine the extent to which cognitive hostility, specifically, is the best predictor of social strain during daily life.

Previous research examining hostility in natural settings is limited relative to the number of laboratory studies examining hostility and social strain. Nonetheless, evidence through EMA methods suggests that various measures of hostility may be related to hostile mood and social interactions. For example, individuals rating high on the Buss-Durkee Hostility Inventory have been found to exhibit more negative affect during their daily activities than those rating low on

this measure (13). Other research has revealed potential for hostility scores from the Type A Behavior Pattern structured interview to be linked to high negative affect across 3 days of recording (14). Subjects scoring in the highest quartile on the Cook-Medley Hostility Scale (15), a commonly used inventory believed to largely tap into the cognitive component of the hostility construct, have been found to report greater daily interpersonal stress than subjects scoring in the lowest quartile on the Cook-Medley Hostility Scale (16).

Scores from the Cook-Medley Hostility Scale have been found to be positively associated with the frequency and intensity of negative social interactions (17). This study also revealed hostility levels to interact with daily measures of social strain to predict increases in ambulatory diastolic blood pressure, such that increases in the intensity of negative interactions were linked to elevations in ambulatory diastolic blood pressure for high, but not low, hostile subjects. These findings provide support for the notion that the pathogenic effects of hostility may be mediated in part by responses to social interactions.

Whereas significant positive associations have been found between trait hostility and social strain, an opposite pattern has emerged in the literature indicating significant inverse associations between trait hostility and social interactions characterized as agreeable or supportive. Field investigations have noted Cook-Medley Hostility Scale scores to predict lower levels of perceived social support (16) and less frequent and intense agreeable social interactions (17-18). A variety of lab based studies have found trait hostility to inversely predict levels of social support from the interpersonal social evaluation list, a commonly used inventory to assess perceived social support (19-21).

In addition to studying the predictive utility of dispositional measures of hostility on the quality of social interactions, researchers have investigated the role of hostile mood in predicting

subsequent episodes of interpersonal stress. One study showed that morning levels of hostile mood predicted elevated evening reports of daily negative life events among a sample of 127 undergraduate participants, based upon a 19 item inventory that included assessments of social strain (22). This work suggests that while cognitive hostility may generally elevate risk for social strain, discrete episodes of hostile affect may also contribute to disagreeable social interactions. However, the directionality of these effects was not explored in this study, nor was the role of trait cognitive hostility in contributing to, or moderating these effects.

Research to date demonstrates that a variety of measures for trait hostility are meaningfully related to daily reports of hostile mood and social interactions. However, it remains unknown which facets of hostility best predict these daily reports of hostile mood and social interactions believed to be an instrumental component to the relationship between hostility and CV disease. Studies investigating the link between hostility and CV disease have rarely incorporated assessments that tap into all the factors comprising the hostility construct (23). Previous factor analyses of the hostility construct have reported 3 factor solutions of cognitive, behavioral, and affective components (e.g., 8, 24-25), although some analyses have supported a 2 factor result (e.g., 26), perhaps due to variation in representation of cognitive items within the pool of scales. Evidence that an individual factor of the hostility construct is more predictive of these social interactions relative to others may facilitate a stronger understanding of the hostility-CV disease link. EMA methods may be used to determine which aspects of hostility are most predictive of daily assessments related to hostile mood and social interactions. For example, the transactional model of hostility has been used to argue that cynical hostility may predict subsequent bouts of antagonistic social interactions (27); evidence that the cognitive factor of the



hostility construct predicts most of the variance associated with daily reports of hostile mood and social strain relative to other trait hostility factors would be supportive of this model.

The purpose of the current report was to use EMA methods to determine the strength and direction of relationships for commonly used hostility scales in predicting daily reports of hostile mood and social interaction variables. An exploratory factor structure of the hostility construct was used to assess predictors of daily reports of hostile mood and social interactions in simple and multiple regression analyses. The various hostility factors were expected to predict these daily reports of hostile mood and social interactions under simple linear regression analyses, with inverse associations predicted for social support and agreeable social interactions, and positive associations predicted for hostile mood and social strain. In accord with the transactional model, the cognitive component of the hostility construct was expected to predict the most variance in daily reports of hostile mood and social interactions when pitted against the other hostility factors in multiple regression analyses. Additional analyses were undertaken using hierarchical linear modeling (HLM) to determine whether previous experiences of hostile mood predict subsequent levels of social strain in accord with previous research (22). Further, HLM was used to test whether previous social strain predicts subsequent levels of hostile mood. Finally, for each set of HLM models, exploratory analyses tested whether dispositional hostility factors moderated the observed effects on hostile mood and social strain, respectively.

## Method

### *Participants*

We studied 171 healthy adults (77 men, 94 women;  $M = 40.89$  years,  $SD = 5.76$ ) from the Stress Treatment and Health Response study, a randomized, double blind clinical trial designed to ascertain the effects of pharmacologic serotonergic augmentation on hostility levels

and risk factors for CV disease. This study received approval from the Institutional Review Board at the University of Pittsburgh. Recruitment involved targeted mailings with self-addressed return postcards to residents in the local metropolitan area (Allegheny County, Pennsylvania). It should be noted that participants underwent a number of assessments not described in this report (see 28).

Inclusion criteria included age (30-50 yrs) and elevated scores on a screening inventory that included items from the Cook-Medley Hostility Scale and Buss-Durkee Hostility Inventory (29-30). Participants were selected for participation in the current study if scoring in the top tertile on this screening inventory, based upon a normative sample (see 28). Exclusionary criteria included the following: history of CV disease or other chronic medical conditions (e.g., diabetes); current Axis I DSM-IV diagnosis; excessive alcohol consumption ( $> 14$  drinks/week or  $> 2$  binges/week); current use of street drugs by self report; or positive urine drug screen. Because of the focus on the impact of serotonergic drug treatment on CV disease risk factors (not reported here), participants were also excluded for use of psychotropic medications, or medications prescribed for cholesterol or high blood pressure. To reduce any potential teratogenic effects, pregnant women (positive pregnancy test), those planning to become pregnant, and premenopausal women unwilling to commit to use of double barrier contraceptive method during the course of the study were excluded from participation. Individuals with blood glucose over 140 or resting blood pressure  $> 160/100$  mmHg were also excluded and were referred immediately for treatment.

Individuals who called or returned postcards expressing interest in the study ( $n = 5,080$ ) were contacted by telephone to schedule an initial screening appointment. Five hundred eighty-four (12%) of these individuals were invited to the laboratory for further assessment. From this

initial sample, 229 (39%) individuals met all of the above criteria and agreed to be enrolled in the study. Fifty-five (24%) of these individuals dropped out/withdrew from the study during the baseline period prior to completion of the electronic diary assessments of daily mood and social interactions (see below). Independent samples t-tests confirmed that the participants who dropped out/withdrew from the study during the baseline period did not differ from the participants who completed the electronic diary assessments for the current report in terms of initial screening hostility scores or participant age ( $p$ 's > .2). Chi square analyses also indicated non-significant differences between these groups in terms of sex and race ( $p$ 's > .1). Three participants were excluded from the current report due to incomplete data on the psychosocial questionnaires for trait hostility assessment. Out of the remaining sample ( $n = 171$ ), 81% were Caucasian and 14% were African American, with 15% of the sample reporting no more than a high school education and 41% reporting a bachelor's degree or higher. The participants from the current report represent the sample of individuals participating in the Stress Treatment and Health Response study at the baseline period, prior to drug treatment randomization.

### *Procedures*

Telephone screening interviews were conducted with potential participants who had expressed participation interest via phone or postcard; with the exception of past and current psychiatric status, these interviews were designed to target the major criteria described above. A more extensive description of telephone screening procedures is available in a previous publication (28).

Interested individuals passing the telephone screening were invited to the laboratory for an initial visit, during which time they were administered a written informed consent followed by a more extensive medical history interview, a portion of the Structured Clinical Interview for

DSM-IV to rule out current Axis I diagnosis, a clinic blood pressure screening and finger stick for blood glucose, a pregnancy test if female, and a urine drug screen. A demographics questionnaire was also administered at this point, which assessed age, gender, race, and education level. Race was coded as a binary (dummy) variable (0 = Caucasian, 1 = minority), since the prevalence of non-African American ethnic minorities in the sample ( $n = 8$ ) was too small to examine these groups separately. For education level, participants were classified into 4 categories (1 = *high school or less*, 2 = *some college or technical school*, 3 = *bachelor's degree*, and 4 = *graduate degree*). Participants who were interested and eligible after this initial visit attended 5 additional pretesting visits over a 1-1/2 month period (range of 17-108 days). Additional risk factor information was assessed during the second visit, a series of laboratory stressors were administered during the third visit (not reported here), and the remaining 3 visits involved training and feedback on self report field diary assessments and the administration of psychosocial questionnaires on a laboratory computer (see below).

#### *Electronic Diary*

A 47 item self report scale was developed for the purposes of repeated assessment of participant mood and social interaction quality across 3 days, using many of the items included in the Diary of Ambulatory Behavioral states (see 31). The electronic diary used in the current study was presented on a palmtop computer (Palm Pilot Professional, Palm, Santa Clara, California) programmed specifically for this project. An auditory prompt was administered every 45 minutes during waking hours across the 3-day recording period to alert the participant to complete the electronic diary inventory. Multi-item Likert-type scales from the electronic diary measured within-person fluctuations in social interaction quality and mood, with intensity responses ranging from 0-100. Participants recorded their responses to these items using a stylus

on a *no* to *yes* sliding scale. One of the items on the electronic diary asked whether participants were currently or recently involved in a social interaction (*yes* or *no*), which was defined as “a give-and-take exchange with another, which may or may not involve conversation” (32).

The dependent variables for the current report included electronic diary derived measures of hostile mood, social strain and the positive social interaction variables of emotional support and agreeableness. Hostile mood was assessed by 3 items selected from the hostility sub-scale of the PANAS (33) to measure the degree to which participants rated feeling hostile, angry, and irritable at the time of assessment. Social strain was measured by the degree to which participants rated their social interactions with the following characteristics: “Someone treated you badly?”, “Someone interfered with your efforts?”, and “Someone was in conflict with you?”. Similarly, assessment of positive social interaction variables was based upon 3 item inventories, with sample items including “Pleasant interaction?” (agreeableness) and “Someone expressed care/concern for you?” (emotional support). These items were derived from previous literature investigating the quality of social interactions using EMA methods (31). For the variables of social strain and positive social interactions in the current report, observations were not included for analyses unless participants responded in the affirmative to being involved in a social interaction within the past 10 minutes. Observations were averaged within person for the first set of simple and multiple regression analyses pertaining to the relationship between trait hostility factors and dependent measures of daily hostile mood and social interaction variables. Because these averaged scores were time sampled, they were assumed to be representative of participants’ daily experience. We have previously shown that 3-day time-sampled average ratings of mood and social interactions are reasonably stable across a 4-month period (34). Internal reliabilities

for the 3 item electronic diary sub-scales were adequate in the current data set, based upon 6,173 diary entries made by 171 participants across a 3 day period (Chronbach's  $\alpha = .85-.94$ ).

Electronic diary use facilitates data entry and feedback that permits rapid downloads and display. Missing and out of range entries were precluded by the diary, and all entries were time stamped. Electronic diary software features enabled participants to "delay" diary entries when necessary (e.g., while driving or at church), but participants were discouraged from overusing this feature, which was recorded along with regular data entry responses (35).

### *Psychosocial Questionnaires*

*Cook-Medley Hostility Scale.* The 50 item true-false Cook-Medley Hostility Scale consists of items derived from the Minnesota Multiphasic Personality Inventory (36). Sample items include "Most people inwardly dislike putting themselves out to help others" and "It is safer to trust nobody". The scale has been demonstrated to exhibit high test-retest reliability ( $r > .8$  over periods of 1-4 yrs; 37-38) and high internal consistency (Chronbach's  $\alpha = .80-.82$ ; 39). The internal consistency for the total scale in the current sample was observed to be at a high level (Chronbach's  $\alpha = .86$ ).

*Buss-Durkee Hostility Inventory.* One of the more comprehensive instruments to measure hostility, the Buss-Durkee Hostility Inventory is comprised of 75 true-false items to assess 8 rationally derived subscales: Assault, Indirect Hostility, Irritability, Negativism, Resentment, Suspicion, Verbal Hostility, and Guilt (30). The scale has demonstrated adequate test retest reliability ( $r = .82$ ) across a two week period (40). The internal consistencies pertaining to the Buss-Durkee Hostility Inventory sub-scales in the current sample were variable in the low-moderate range (Chronbach's  $\alpha = .40-.72$ ).

*Buss-Perry Aggression Questionnaire.* This scale represents a revised version of the Buss-Durkee Hostility Inventory, with 29 items designed to measure 4 sub-scales using a 5 point Likert-type scale: Physical Aggression, Verbal Aggression, Hostility, and Anger; adequate internal and retest reliability has been demonstrated for the inventory (41). The internal consistencies for the four subscales of the Buss-Perry Aggression Questionnaire were observed to be adequate in the current sample (Chronbach's  $\alpha = .73-.84$ ).

*Spielberger State-Trait Anger Expression Inventory (STAXI).* Three sub-scales from this inventory were used in the current study: Trait Anger (10 items), Anger-In and Anger Control (8 items each). These scales were administered using a 4 point Likert-type format and have been demonstrated to be internally consistent (42). The sub-scale internal consistencies were observed to be adequate in the current sample (Chronbach's  $\alpha = .79-.83$ ).

*Structured Interview for the Type A Behavior Pattern (SI-TABP).* This tool represents a 15 minute interview assessment of the various components comprising the Type A behavior pattern (43), such as hostility, impatience, and pressured speech. The Hostility Facet Scoring System (44) was used to rate interview responses using a 5 pt scale in terms of overall Potential for Hostility, Hostile Intensity, Hostile Content, and Hostile Style.

#### *Hostility Measures Data Reduction*

The hostility subscale scores were subjected to data reduction as a means of deriving a theoretically meaningful smaller subset of variables, as reported previously from the subset of the sample which was subsequently randomized into the treatment study (see 28). The internal reliabilities of the hostility subscales were adequate, with the exception of those corresponding to the original Buss-Durkee Hostility Inventory (BDHI) subscales. Consequently, an initial principal components analysis (PCA) with an eigenvalue criterion of 1 on varimax rotation was

run on the 8 BDHI subscales, yielding a 3 factor solution with loadings above .50: BDHI Factor 1 (resentment, suspicion, and guilt); BDHI Factor 2 (assault, verbal, and negativism); and BDHI Factor 3 (indirect and irritability). The new BDHI factors (3 scores) were then included as input for an omnibus PCA along with the total Cook-Medley Hostility Scale (CMHS) score, the 4 Buss-Perry Aggression Questionnaire (BPAQ) subscale scores, and the 3 STAXI subscale scores. The omnibus PCA yielded another 3 factor solution with the first factor comprised of measures for Cognitive Hostility (BDHI Factor 1, BPAQ Hostility, STAXI Anger-In, and CMHS); the second factor including scales related to Hostile Behavior (BDHI Factor 2, BPAQ Physical, and BPAQ Verbal); and the third factor consisting of scales for Hostile Affect (BPAQ Anger, STAXI Anger Control, BDHI Factor 3, and STAXI Trait Anger). The STAXI Anger Control subscale displayed a negative loading in the Affective Hostility factor. The 3 factors explained 69% of the total variance, with the cognitive, behavioral, and affective factors accounting for 41%, 18%, and 10% of the variance explained, respectively. Table 1 displays the hostility factor scores corresponding to this PCA. The sum of the four hostility scores from the SI-TABP did not load  $> .5$  on any of the three factors in this data reduction procedure; consequently, the data from this inventory were withheld from analyses in the current report. Standard (z) scores linked with each of the highly loading component subscales were averaged to derived unit-weighted measures for each of these factors to be used as predictor variables in subsequent analyses.

### *Analytic Strategy*

A set of Pearson correlations (two tailed; SPSS, v. 19.0, 45) were evaluated to determine the strength and direction of the relationships between the PCA derived hostility factor scores and the frequency of social interactions, indexed by the proportion of diary entries in which



participants indicated being in a social interaction at present or within the past 10 minutes. A combination of simple linear regression and multiple regression analyses (SPSS, v. 19.0, 45) also tested the hostility factors as predictors of daily reports of hostile mood and the social interaction variables. To determine whether each factor was predictive of the dependent measures, simple linear regressions tested each hostility factor separately. Next, all 3 hostility factors were entered into a model simultaneously, to ascertain whether each factor was an independent predictor of the dependent measures.

Hierarchical linear modeling (PROC MIXED; SAS, v 9.2, 46) was used to test whether previous hostile mood predicts subsequent social strain and previous social strain predicts subsequent hostile mood. Maximum likelihood methods were used to obtain solutions for the models. Lag variables were created to serve as predictor variables of previous hostile mood and previous social strain, respectively, to permit the testing of the two models (e.g., hostile mood at the time of one diary entry predicting social strain at the time of the next diary entry). Age, sex, race, and education were included as fixed effects covariates in all HLM models in this report. Each model also controlled for the current level of the predictor variable (e.g., current hostile mood covariate in the model using previous mood to predict subsequent social strain). A second set of HLM analyses tested whether dispositional hostility factors moderate the relationships between previous hostile mood and subsequent social strain, as well as previous social strain and subsequent hostile mood. Statistical interactions were tested between lag variables and each of the hostility disposition factors separately.

## Results

### *Descriptive Statistics*

Average hostility scores were in the moderate to high range across the sample (see Table 2), as would be expected based upon Stress Treatment and Health Response inclusion criteria. Men scored higher than women on the following measures: Buss-Perry Aggression Questionnaire,  $t(169) = 2.142, p < .05$ ; Cook-Medley Hostility Scale,  $t(169) = 2.723, p < .01$ ; and Anger-In,  $t(169) = 2.551, p < .05$ . Buss-Durkee Hostility Inventory scores were also marginally higher among men compared to women,  $t(169) = 1.768, p = .079$ . Men were observed to score higher on the affective and cognitive hostility factors relative to women: affective hostility,  $t(169) = 2.82, p = .005$ ; and cognitive hostility,  $t(169) = 2.47, p = .014$ . An inverse correlation was observed between age and Trait Anger scores,  $r = -.164, p < .05$ .

Frequency and magnitude of the averaged daily reports of hostile mood, social strain, and agreeable social interactions did not vary as a function of age, gender, race, or education. However, a marginal effect was observed for magnitude of emotional support during social interactions as a function of race,  $t(169) = -1.76, p = .08$ , with higher values for minority participants ( $M = 52.2, SD = 17.7$ ) relative to Caucasian participants ( $M = 46.4, SD = 16.7$ ). Another marginal association indicated magnitude of emotional support during social interactions to vary as a function of education,  $F(3,167) = 2.59, p = .055$ ; Bonferroni post-hoc analyses indicated significantly higher emotional support among participants with a high school education or less ( $M = 54.5, SD = 3.9$ ) relative to those with at least a master's degree ( $M = 42.1, SD = 3.07$ ).

Sample characteristics and descriptive statistics associated with the hostility scales by gender and electronic diary subscales of hostile mood and social interaction quality are displayed in Table 2. As shown in this table, 68% of electronic diary entries took place within 10 minutes of a social interaction: 53.08 total electronic diary entries were completed by each participant

(SD = 11.06, range = 27-131), with 36.10 of these entries (SD = 13.19, range = 6-112) taking place within 10 minutes of a social interaction. Further, 44% of electronic diary entries rated above the grand median (sample median of participant means) for hostile mood ( $M = 23.27$ ,  $SD = 16.69$  entries; range = 0-62), whereas 25% of electronic diary entries rated above the grand median for social strain ( $M = 13.5$ ,  $SD = 12.7$  entries; range = 0-58). Likewise, 40% of electronic diary entries rated above the grand median for agreeable interactions ( $M = 21.01$ ,  $SD = 12.7$  entries; range 0-87), and 34% above the grand median for emotional support ( $M = 17.89$ ,  $SD = 11.85$  entries; range 0-87).

A significant inverse correlation was observed between proportion of overall social interactions by participant and cognitive hostility factor scores,  $r = -.198$ ,  $p < .01$ , whereas affective and behavioral hostility factor scores were unrelated to proportion of overall social interactions,  $p$ 's  $> .4$ . Magnitude of daily social strain was inversely correlated with magnitude of daily agreeable social interactions,  $r = -.49$ ,  $p < .001$ . Intercorrelations of hostility factor scores with the frequency and magnitude of social interaction quality and hostile mood are displayed in Table 3.

#### *Hostility Factors as Predictors of Hostile Mood and Social Interaction Variables*

*Hostile Mood.* Separate analyses indicated each factor to be a significant predictor of hostile mood: Affect ( $\beta = .361$ ,  $p < .001$ ;  $R^2 = .13$ ); Behavior ( $\beta = .207$ ,  $p = .006$ ;  $R^2 = .04$ ); and Cognition ( $\beta = .384$ ,  $p < .001$ ;  $R^2 = .15$ ). Inclusion of all 3 factors entered simultaneously into the same model resulted in a non-significant effect for the Hostile Behavior factor ( $\beta = .027$ ,  $p > .7$ ), whereas the effects for the Hostile Affect and Hostile Cognition factors remained significant: Affect ( $\beta = .217$ ,  $p = .012$ ) and Cognition ( $\beta = .269$ ,  $p = .001$ ).

*Social Strain.* Simple linear regression and multiple regression analyses evaluated significant differences in magnitude of social strain ratings for social interactions restricted to the past 10 minutes, including agreeable social interactions as a covariate. Again, separate regressions revealed significant effects for each factor as a predictor of social strain: Affect ( $\beta = .19, p = .005; \Delta R^2 = .04$ ); Behavior ( $\beta = .17, p = .013; \Delta R^2 = .03$ ); and Cognition ( $\beta = .23, p = .001; \Delta R^2 = .05$ ). Following simultaneous entry of all 3 factors into the same model, the Hostile Cognition factor remained significant ( $\beta = .17, p = .027$ ), whereas the effects for the other two factors became non-significant: Hostile Affect ( $\beta = .07, p > .3$ ) and Hostile Behavior ( $\beta = .08, p > .2$ ).

*Agreeableness.* Simple linear regression and multiple regression analyses evaluated significant differences in magnitude of agreeableness ratings for social interactions restricted to the past 10 minutes, including social strain ratings as a covariate. Simple linear regressions revealed the individual hostility factors as unrelated to the magnitude of daily agreeable social interactions ( $p$ 's  $> .5$ ). However, simple linear regressions not including social strain as a covariate indicated Hostile Affect as inversely predictive of agreeable social interactions ( $\beta = -.153, p = .046; R^2 = .023$ ), with a marginal association for Hostile Cognition ( $\beta = -.132, p = .086; R^2 = .017$ ), whereas Hostile Behavior was unrelated to the magnitude of agreeable social interactions ( $\beta = -.06, p > .4$ ), thereby suggesting that these predictive associations of Hostile Affect and Cognition to agreeable interactions are secondary to the more prominent relationship of social strain. The individual factors were unrelated to agreeableness social interaction magnitude in the combined model ( $p$ 's  $> .4$ ).

*Emotional Support.* Simple linear regression and multiple regression analyses evaluated significant differences in magnitude of emotional support ratings for social interactions restricted

to the past 10 minutes, including education and race as covariates. None of the hostility factors were significant predictors of emotional support magnitude ratings in simple linear regressions ( $p$ 's > .3). Likewise, individual hostility factor predictors were unrelated to the magnitude of emotional support ratings in the combined model ( $p$ 's > .5).

#### *HLM Models Predicting Hostile Mood and Social Strain*

HLM evaluated the predictive association of previous hostile mood on subsequent social strain with age, sex, race, education, and current hostile mood used as covariates. The social strain variable was restricted to social interactions taking place within 10 minutes of a given diary entry. A non-significant inverse association was observed between previous hostile mood and subsequent social strain ( $B = -.014$ ,  $SE = .012$ ),  $t(170) = -1.22$ ,  $p = .23$ . Interestingly, previous hostile mood did predict elevated subsequent social strain when not including current hostile mood as a covariate ( $B = .085$ ,  $SE = .012$ ),  $t(170) = 6.94$ ,  $p < .001$ , suggesting that although previous hostile mood predicts subsequent social strain, this relationship is diminished by the variance pertaining to the more prominent influence of current hostile mood. Cognitive, affective, and behavioral dispositional factors were not found to moderate the relationship between previous hostile mood and subsequent social strain ( $p$ 's > .4).

HLM also tested the predictive relationship of previous social strain on subsequent hostile mood with age, sex, race, education, and current social strain used as covariates. A significant positive association was observed between previous social strain and subsequent hostile mood ( $B = .111$ ,  $SE = .023$ ),  $t(164) = 5.38$ ,  $p < .001$ , indicating that elevated social strain levels predicted higher subsequent hostile mood. Again, dispositional hostility factors were not found to interact with previous social strain to predict subsequent hostile mood ( $p$ 's > .3).

#### Discussion

The PCA derived hostility factors from the current report, and reported previously (see 28), supports the multidimensionality of the hostility construct, and resonates with the ‘ABC’ Model of hostility as comprised of affective, behavioral, and cognitive components (8). The primary aim of the current report was to use EMA methods to ascertain which factors of the multidimensional hostility construct are most predictive of daily reports of hostile mood and quality of social interactions in addition to exploring the temporal relationships between hostile mood and social strain.

The findings regarding frequency of social interactions revealed an inverse relationship with the cognitive hostility factor, a result that resonates with previous findings using the Cook-Medley Hostility Scale (e.g., 17-18). The Cook-Medley Hostility Scale has largely been considered a cognitive measure of hostility that taps into the cynical mistrustfulness component of the disposition (e.g., 6), and as such, this finding of fewer social interactions may reflect the behavioral and perceptual influences of a cynical mistrust.

Regression analyses suggested that each of these factors was predictive of daily reports of hostile mood and social strain when tested separately, with the cognitive component accounting for the most variance in hostile mood and social strain. These results are consistent with previous findings regarding the predictive utility of various hostility measures (e.g., 13-14, 16-17), supporting the notion that several widely used hostility inventories are related to daily reports of hostile mood and social strain. Simultaneous entry of all 3 factors within the same model revealed both cognitive and affective components as predictors of hostile mood, and the cognitive component as the sole predictor of social strain.

Although the behavioral component of the hostile disposition is predictive of these daily reports when tested in separate models, the amount of variance explained is secondary to the

cognitive component in the context of social strain, and the cognitive and affective components for hostile mood. These findings highlight the salience of the cognitive component of the hostility construct in predicting the social dynamics inherent to the hostile disposition, and support the transactional model notion of cynical mistrust and hyper-vigilance to threat shaping a social environment conducive to antagonistic interactions and potentially prolonged experiences of anger (e.g., 9).

In contrast to the findings pertaining to hostile mood and social strain, the results of analyses predicting social interactions characterized as emotionally supportive and agreeable were unsupportive of the transactional model. Specifically, simple linear regressions indicated a significant inverse relationship between the affective component of hostility and daily magnitude of agreeable interactions, in addition to a marginal inverse link with regards to the cognitive component of hostility, only when not accounting for the competing variance pertaining to social strain. These associations were non-significant in multiple regression analysis. The behavioral component of hostility was unrelated to agreeable social interactions. Further, simple linear and multiple regression analyses revealed the dispositional hostility factors studied in the current report as unrelated to social interactions of emotional support. Previous research has found the Cook-Medley Hostility Scale to be inversely correlated with the magnitude of daily agreeable social interactions (17-18), but have not controlled for the influence of social strain. Moreover, the Cook-Medley Hostility Scale has been found to be unrelated to the magnitude of daily emotional support (18). The current report may represent the first analysis of different hostility factors pitted against one another in prediction models of daily positive social interactions, demonstrating null associations in combined models.

Additional analyses tested the temporal relationships between the daily reports of hostile mood and social strain, including evaluations of potential moderating influences of hostility disposition factors. The current findings provide evidence of previous hostile mood predicting higher levels of subsequent social strain, only in the absence of the competing variance pertaining to current hostile mood. Previous research has demonstrated that morning levels of hostile mood predicted a higher number of daily stressors among undergraduate participants, which included assessments of social strain, but they did not control for the variance pertaining to current hostile mood in their assessments (22). The results of the current report suggest that this relationship between previous hostile mood and subsequent social strain is diminished in the presence of variance pertaining to current hostile mood amid an older adult sample rating high in dispositional hostility. In addition to testing the relationship between previous hostile mood and subsequent social strain, the current results also provided evidence to suggest that hostile individuals may experience heightened hostile mood following episodes of social strain. The current report may represent the first exploration of the temporal relationships of hostile mood predicting subsequent social strain and social strain predicting subsequent hostile mood among hostile individuals in a single field investigation.

The current findings contribute to the extant literature by demonstrating the predictive utility of individual hostility factors for determining the frequency and magnitude of daily hostile mood and social strain, suggesting that trait cognitive and affective hostility are strong predictors of daily hostile mood, and cognitive hostility in particular is an independent predictor of daily social strain. However, such findings were not evident in regards to daily emotional support or agreeable social interactions.



The results of the current report also demonstrated the temporal relationships between hostile mood and social strain, indicating that previous social strain predicted elevated hostile mood and prior hostile mood predicted subsequent social strain, only when not accounting for current hostile mood as a covariate. However, the current findings did not indicate dispositional hostility factors to moderate the temporal relationships between hostile mood and social strain. These findings may merit replication in a sample of individuals with a broader range of hostility disposition scores, to provide more trait variance for the testing of potential moderator effects between these daily measures. Statistical power for testing interactive relationships is reduced under conditions of moderator variable range restriction (47). As such, restriction in range of dispositional hostility scores may have constrained the ability to detect the moderating effects of trait hostility factors on the temporal links between social strain and hostile mood, thereby suggesting a need for subsequent research involving a broader range of hostility disposition scores to more effectively test these interactive relationships. Moreover, the fact that the first order main effect predictions of hostility factors on daily measures of hostile mood and social strain survived this range restriction issue, suggests that the current effects reported here may underestimate the true associations in the general population.

Although the findings from the current report represent a novel contribution to the literature, a few limitations need to be noted. First, the requirements that participants be compliant treatment seekers who rate high on two separate measures of hostility may have resulted in a sample that does not adequately reflect the general populace. Second, the sampling selection criteria of healthy adults aged 30-50 yrs may have also restricted the generalizability of the current findings. Both cross-sectional and longitudinal evidence suggests notable age related changes in hostility disposition scores (5, 20), with cross sectional evidence suggesting that

cognitive hostility scores may be higher among older, as compared to middle aged samples (20). The current findings may merit replication among a broader age range. Finally, the social interactions sampled in the current report were broad in scope and nonspecific; as such, the analyses reported here cannot address the degree by which covert attributes of hostility predict the social dynamics specific to important interpersonal dyads as posited by interpersonal theory (48).

To our knowledge, the present study represents the first investigation to explore the degree to which individual factors of the hostility construct independently predict daily reports for social strain and hostile mood, as well as to test the temporal relationships between these outcome variables amid a sample of hostile adults. The current findings suggest that both cognitive and affective hostility are associated with daily experiences of hostile mood, with cognitive hostility being an independent predictor of daily social strain. To the extent that these daily bouts of interpersonal strain and hostile mood set the stage for disease promoting CV responses among hostile individuals, the current findings point toward a need to incorporate multiple modes of hostility assessment in future epidemiologic samples, in order to determine whether the relative importance of cognitive hostility in daily life shown here may have implications for disease risk. Finally, the findings from the current study also suggest that hostile individuals may display elevated hostile mood following bouts of social strain, results that may shed light on interactions between affective and cognitive processes related to disease risk amid this population.

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Table 1  
*Hostility Factor Scores (Varimax Rotated Factor Pattern)*

Measure	Cognition	Behavior	Affect
Buss-Durkee Factor 1 <sup>a</sup>	<b>.799</b>	.213	.115
Buss-Perry Hostility	<b>.796</b>	.166	.252
STAXI Anger-In	<b>.792</b>	-.201	.015
Cook-Medley Hostility Scale	<b>.750</b>	.428	.067
Buss-Durkee Factor 2 <sup>b</sup>	.079	<b>.885</b>	.214
Buss-Perry Physical Aggression	.222	<b>.785</b>	.136
Buss-Perry Verbal Aggression	.014	<b>.730</b>	.324
Buss-Perry Anger	.144	.261	<b>.797</b>
STAXI Anger Control	.181	-.215	<b>-.727</b>
Buss-Durkee Factor 3 <sup>c</sup>	.362	.017	<b>.685</b>
STAXI Trait Anger	.317	.354	<b>.654</b>

*Note.*  $N = 171$ . Factor loadings above .50 are featured in boldface and represent measures included in each of the 3 derived hostility factor scores. STAXI = Spielberger State-Trait Anger Expression Inventory.

<sup>a</sup>Sum of Resentment, Suspicion, and Guilt Subscales. <sup>b</sup>Sum of Assault, Verbal, and Negativism Subscales. <sup>c</sup>Sum of Indirect and Irritability Subscales.



Table 2  
*Sample Characteristics and Gender Differences in Hostility Scales*

	M (SD)	%
Demographic Variables		
Age, y	40.89 (5.76)	
Sex, % female		55
Race, % Non-White		18.7
Education level, %		
High School or less		15.2
Technical School or Some College		43.9
Bachelor's Degree		23.4
Master's Degree or higher		17.5
Frequency Variables		
		(% of Total Obs)
Total Observations	53.08 (11.06)	
Hostile Mood	23.27 (16.69)	44
Social Interactions	36.10 (13.19)	68
Social Strain	13.50 (12.70)	25
Agreeable Interactions	21.01 (12.70)	40
Emotional Support	17.89 (11.85)	34
Magnitude Variables		
Hostile Mood	26.15 (14.13)	
Social Strain	16.62 (11.66)	
Agreeable Interactions	68.87 (11.79)	
Emotional Support	47.47 (17.02)	
	</	

Note. N = 171; † $p < .1$ ; \* $p < .05$ ; \*\* $p < .01$ . STAXI = Spielberger State-Trait Anger Expression Inventory.

Table 3

*Intercorrelations of Hostility Factor Scores with the Frequency and Magnitude of Hostile Mood and Social Interaction Variables*

Measure	1	2	3	4	5	6	7	8	9	10	11	12
1. Affective Hostility Factor	---	.44***	.49***	.06	.21**	.32***	-.14	.01	.26***	.36***	-.15*	.03
2. Behavioral Hostility Factor		---	.32***	-.02	.14	.19*	-.04	.08	.19*	.21**	-.06	.07
3. Cognitive Hostility Factor			---	-.20**	.25***	.34***	-.11	.09	.29***	.38***	-.13	.10
4. Interaction Ratio <sup>a</sup>				---	-.08	-.11	-.01	-.20**	-.15*	-.10	-.02	-.29***
5. Social Strain Ratio <sup>b</sup>					---	.73***	-.47***	.15*	.89***	.66***	-.46***	.11
6. Hostile Mood Ratio <sup>c</sup>						---	-.41***	.09	.71***	.94***	-.49***	.08
7. Agreeable Interaction Ratio <sup>b</sup>							---	.25***	-.46***	-.41***	.89***	.27***
8. Emotional Support Ratio <sup>b</sup>								---	.16*	.09	.26***	.90***
9. Averaged Social Strain									---	.70***	-.49***	.13
10. Averaged Hostile Mood										---	-.49***	.08
11. Averaged Agreeable Interactions											---	.32***
12. Averaged Emotional Support												---

Note.  $N = 171$ . \* $p < .05$ ; \*\* $p \leq .01$ ; \*\*\* $p \leq .001$

<sup>a</sup>Variable indexed by proportion of diary entries in which participant indicated being in a social interaction within the past 10 minutes.

<sup>b</sup>Variable indexed by proportion of social interactions rating above the grand median (sample median of participant means) for variable.

<sup>c</sup>Variable indexed by proportion of diary entries rating above the grand median (sample median of participant means) for hostile mood.

## Figure Caption

*Figure 1.* Transactional model of hostility for predicting social interactions. The model depicted in this figure has been adapted from previous research (11).

