Published in final edited form as:

Biol Psychol. 2014 October ; 102: 51–53. doi:10.1016/j.biopsycho.2014.07.005.

Trait Hostility is Associated with Systemic Inflammation in Married Couples: An Actor-Partner Analysis

Timothy W. Smith^a, Bert N. Uchino^a, Jos A. Bosch^b, and Robert G. Kent^a

^aDepartment of Psychology, University of Utah

^bDepartment of Clinical Psychology, University of Amsterdam, The Netherlands; and Mannheim Institute of Public Health, Social and Preventive Medicine, University of Heidelberg, Germany

Abstract

Trait anger and hostility predict the development of coronary heart disease, and systemic inflammation may partly mediate this association. In a sample of 94 middle-aged and older married couples, we replicate research showing a within individuals (i.e., actor effect) association of trait hostility with high sensitivity C-reactive protein (hsCRP). As a novel extension of that research, the present study also examined the association of individuals' trait hostility with their partners' hsCRP (i.e., partner effect). Controlling for potential confounds, trait hostility, measured with the Buss-Perry Aggression Questionnaire, was significantly associated with both participants' own hsCRP, $b=.0528$ ($SE=.0196$), $p=.008$ and their partners' levels $b=.0473$ ($SE=.0194$), $p=.016$. Hence, the inflammatory correlates of trait hostility occur not only within individuals but between them, as well. The effects of unhealthy personality traits may extend to intimate partners and possibly other social network members.

Keywords

hostility; inflammation; C-reactive protein; marriage; actor-partner analysis

Trait hostility and anger predict the development of coronary heart disease (CHD) (Chida & Steptoe, 2009). Several physiological mechanisms may contribute to this association, including inflammation (Smith, Glazer, Ruiz, & Gallo, 2004). Inflammation denotes a coordinated immune system response that eliminates bodily threats (e.g., infection) and initiates repair. This response can cause significant harm when it becomes non-localized and protracted. Such systemic and chronic inflammation contributes to atherosclerosis and CHD (Hansson, 2005). Control of inflammation is in part regulated by neural and endocrine systems, and sources of psychological stress, including hostility and anger, are associated with elevated systemic inflammation (Suarez, 2012). For example, C-reactive protein (CRP), an indicator of systemic inflammation that predicts CHD (Emerging Risk Factors

Corresponding Author: Timothy W. Smith, PhD, Department of Psychology, University of Utah, 380 South 1530 East (room 502), Salt Lake City, UT, 84112, tim.smith@psych.utah.edu, Phone: 801-581-6124.

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Collaboration, 2010), is positively associated with trait hostility and anger (Elovaino et al., 2011; Marsland et al., 2008).

Hostility is closely related to interpersonal processes, including the quality of intimate relationships (Smith, Baron & Grove, 2014). One spouse's trait anger and hostility predict their own marital quality, and their partner's (Baron et al., 2007; Renshaw, Blais, & Smith, 2010), with similar effects on cardiovascular stress responses in couples (Smith & Gallo, 1999). Chronic and recurring exposure to a hostile spouse's aversive behavior (e.g., criticism, unwelcome control) and reduced expressions of positive behavior (e.g., support, affection) could result in a partner's heightened physiological stress responses and lower reports of marital quality (Smith et al., 2014). Thus, hostility and anger may influence disease risk both within and between individuals in intimate relationships, with the latter association reflecting potential adverse interpersonal effects on the partner's health and well-being.

In pursuing this possibility, actor-partner analyses of couples (Campbell & Kashy, 2002) permit replication and extension of prior research. Associations of individuals' trait hostility with their own levels of CRP (i.e., actor effects) would replicate prior findings (Suarez, 2012). In light of evidence that marital quality predicts physical health, perhaps in part through the mechanism of inflammation (Robles et al., 2014), examination of associations of individuals' trait hostility with their spouses' levels of CRP (i.e., partner effects) represents an important extension of prior research. Such partner effects would suggest a potential influence of a spouse's typical social behavior and affective responses on their partner's risk of CHD, by being a source of chronic stress for the partner (Smith et al., 2014). The present study replicated actor associations of trait hostility with CRP, and is the first to test these predicted partner associations in married couples.

Method

Participants

Ninety-four married couples were included (age range = 42 to 78). Most participants were White (94.6%), college educated (70.3%), and had annual household incomes over \$40,000 (87.6%). We excluded individuals on immunosuppressive treatment (e.g., corticosteroid therapy), and those with cancer or HIV, due to concerns about potential effects on CRP. Table 1 presents descriptive information.

Procedure

The protocol was approved by the University of Utah Institutional Review Board. Following informed consent, participants completed questionnaires (see below). Approximately 20 cc of blood was drawn and treated with EDTA. Plasma was separated via centrifuge. Participants were debriefed and received \$60.00 each.

Measures

The hostility scale of the *Aggression Questionnaire* (Buss & Perry, 1992) contains 8 self-report items (e.g., "I am suspicious of overly friendly strangers," "When people are

especially nice, I wonder what they want.”) assessing cognitive aspects of hostility (e.g., cynicism, mistrust), and is closely correlated with anger. Prior research provides evidence of reliability and validity (e.g., Buss & Perry, 1992; Gallo & Smith, 1998), and internal consistency in the present sample was $\alpha = .75$. Individuals rated how helpful/positive and upsetting they perceived their spouse using the *Social Relationships Index*. Prior research supports the reliability and validity of the spouse positivity and negativity scales (Campo et al., 2009), and internal consistencies in this sample were $\alpha = .77$ and $.81$. Participants also completed the *Marital Adjustment Test* (MAT), a self-report measure of marital quality (Locke & Wallace, 1959) with well-documented reliability and validity (Snyder, Heyman, & Haynes, 2005). Internal consistency in the present sample was $\alpha = .80$.

A health questionnaire assessed medications, medical conditions, exercise frequency, tobacco use, weekly alcohol consumption, and height and weight to calculate body mass index (BMI). High sensitivity CRP (hsCRP) was measured from serum by immunonephelometry (Behring Nephelometer II). The detection limit is 0.015 mg/L. All samples were assayed in the same run, yielding a within-assay CV% of 4.5%. To normalize the distribution, hsCRP was natural log transformed.

Statistical Analyses

We utilized Proc Mixed (SAS institute, Littell, Milliken, Stroup, & Wolfinger, 1996) to examine actor and partner effects. All factors were specified as fixed. Proc Mixed treats unexplained variation within individuals as a random factor. We modeled the covariance structure for the repeated factor of dyad (i.e., husband, wife) using the compound symmetry structure to control dependency within dyads, and used the Satterthwaite approximation to determine the degrees of freedom for actor and partner effect parameter estimates (b) (Campbell & Kashy, 2002). In this approach, the first order actor effect represents the average association across both spouses, as does the first order partner effect. Interactions with gender test sex differences in these effects.

Results

Exercise, tobacco use, and alcohol use were unrelated to hsCRP. BMI, age, and use of statin, anti-inflammatory, and hormone replacement medications were controlled in the primary analyses. BMI, $t(151) = 5.61$, $p < .001$, and hormone replacement therapy, $t(169) = 2.04$, $p = .043$, were independently associated with hsCRP, such that higher BMI and use of hormone replacement were associated with higher hsCRP.

As predicted, actor hostility was positively associated with hsCRP, $t(170) = 2.69$, $p = .008$ (see Figure 1). Also as predicted, independent of the individual's hostility, partner hostility was positively associated with hsCRP, $t(170) = 2.44$, $p = .016$. Non-significant actor hostility $\times$ gender and partner hostility $\times$ gender interactions indicated that these associations did not differ for women and men.

Similar analyses indicated significant actor effects of hostility on MAT scores, $b = -1.231$ (SE = .432), $t(153) = 2.85$, $p = .005$, and spouse negativity, $b = .0446$ (SE = .0155), $t(161) = 2.88$, $p = .0046$, and a marginally significant effect on spouse positivity, $b = -.0240$ (SE = .

0132), $t(163) = 1.85$, $p = .067$. In the only partner effect, higher partner hostility was associated lower positivity, $b = -.0298$ ($SE = .0129$), $t(163) = 2.31$, $p = .022$. Statistical control of marital measures did not alter the actor and partner associations of trait hostility with hsCRP, and marital measures were not significantly related to hsCRP.

Discussion

The present study examined associations of individuals' trait hostility with their own and their spouses' levels of systemic inflammation. Given the central role of marriage or similar intimate relationships in the lives of most adults, this is a key context in which to examine the interpersonal aspects of personality and health (Smith et al., 2014). The novel association of trait hostility with the partners' hsCRP demonstrated here is consistent with a small but growing literature suggesting that the health effects of personality operate not only within individuals as is most commonly studied, but between them, as well. For example, hostility has significant actor and partner associations with various aspects of marital functioning (Smith et al., 2014) and with cardiovascular stress responses during stressful marital interactions (Smith & Gallo, 1999). The present results for hsCRP suggest that the biological consequences of partners' trait hostility extend beyond acutely stressful marital interactions, perhaps reflecting cumulative effects of heightened exposure to aversive spouse behavior and reduced affection and support.

The significant actor effect of trait hostility on hsCRP replicates prior research and supports the hypothesis that inflammatory processes are a potential link between the individual's own level of hostility and CHD risk (Suarez, 2012). Those prior studies only examined individual participants, and the present study therefore extends that research by controlling for potential overlapping effects of partner hostility.

The significant actor and partner associations of trait hostility with marital quality are consistent with prior research (Baron et al., 2006; Renshaw et al., 2010), but did not account for the effects of trait hostility on inflammation. Marital processes (e.g., exposure to aversive spouse behavior and conflict, reduced support and affection, rumination about on-going relationship difficulties) undoubtedly are involved in the partner effects of trait hostility on hsCRP, but such interpersonal mechanisms might not be captured well by traditional self-report measures of marital quality. Behavioral observation might provide a better assessment of these health-relevant couple processes (Smith et al., 2011).

There are important limitations of this preliminary study. The cross-sectional design precludes causal inferences, and the generally healthy and homogeneous sample underscores the need for replication with more diverse groups. Prior research also suggests that self-reports of trait hostility may lead to under-estimates of the magnitude of associations with health (e.g., Smith et al., 2007). Finally, the effects of actor and partner hostility were small in magnitude, with the observed variability occurring largely within the normal range of hsCRP. Hence, the effects may have limited implications for the development of CHD. However, chronic systemic low-grade inflammation can have deleterious effects on CHD and other health outcomes (Rohleder, 2014).

These limitations notwithstanding, the present results support prior research in suggesting that trait hostility may influence the development and course of CHD through inflammatory processes (Suarez, 2012). And in a novel extension of those prior findings and the previous research on effects of trait hostility within couples, the present results also suggest that these inflammatory correlates of trait hostility occur not only within individuals but between them, as well.

Acknowledgments

The research reported here was supported by grant #R01 HL08106 (PI: Bert N. Uchino) from the National Heart, Lung, and Blood Institute of the National Institutes of Health

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Highlights

Trait hostility predicts coronary heart disease.

Systemic inflammation measured as C-reactive protein may contribute to this effect.

In couples, individuals' trait hostility predicted their own and their partners' CRP.

Inflammatory correlates of hostility occur within and also between individuals.

—————▶ Actor Effect: $b = .0528$ (SE = .0196), $p = .008$

- - - - -▶ Partner Effect: $b = .0473$ (SE = .0194), $p = .016$

Figure 1.

Actor-Partner associations of trait hostility with high sensitivity C-reactive protein. The association of wives' hostility with their own hsCRP and the association of husbands' hostility with their own hsCRP are combined in the test of the first-order actor effect. Associations of wives' hostility with husbands' hsCRP and husbands' hostility with wives' hsCRP are combined in the test of first order partner effect. Unstandardized coefficients (and standard errors) for the actor and partner effects are presented.

Table 1

Sample Descriptive Information

	Men	Women
Mean Age (SD)	57.4 (7.4)	54.9 (7.0)
Mean Body Mass Index (SD)	27.4 (4.9)	25.1 (4.4)
Statin Use (%)	8.5	7.5
Hormone Replacement Therapy Use (%)	0	28.7
Regular Anti-Inflammatory Use (%)	26.5	28.7
Regular Tobacco Use (%)	1.1	3.2
Mean Alcoholic Drinks per Week (SD)	4.3 (8.7)	2.4 (6.4)
Exercise Frequency (%)		
Less than once per month	2.2	1.1
A few times per month	7.7	3.2
1 to 2 times per week	23.1	17.2
3 to 5 times per week	44.0	47.3
Daily or almost daily	23.1	31.2
Mean Hostility (SD)	15.0 (3.9)	14.0 (4.5)
Mean Marital Adjustment Test Score (SD)	118.0 (23.9)	117.0 (25.5)
Mean Spouse Positivity (SD)	4.7 (0.7)	4.7 (0.8)
Mean Spouse Negativity (SD)	2.2 (0.8)	2.3 (1.0)
Mean high sensitivity C-Reactive Protein (SD)	0.17 (.210)	0.20 (.29)