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Attachment avoidance predicts inflammatory responses to marital conflict[☆]Jean-Philippe Gouin^{a,b,*}, Ronald Glaser^{b,c,d}, Timothy J. Loving^e, William B. Malarkey^{b,c,d,g}, Jeffrey Stowell^f, Carrie Houts^a, Janice K. Kiecolt-Glaser^{a,b,g}^a Department of Psychology, The Ohio State University, USA^b Institute for Behavioral Medicine Research, The Ohio State University College of Medicine, 193 McCampbell Hall, 1581 Dodd Drive, Columbus, OH 43210, USA^c Department of Molecular Virology, Immunology, and Medical Genetics, The Ohio State University College of Medicine, USA^d Department of Internal Medicine, The Ohio State University College of Medicine, USA^e Department of Human Ecology, University of Texas at Austin, USA^f Department of Psychology, Eastern Illinois University, USA^g Department of Psychiatry, The Ohio State University College of Medicine, USA

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ABSTRACT

Marital stress has been associated with immune dysregulation, including increased production of interleukin-6 (IL-6). Attachment style, one's expectations about the availability and responsiveness of others in intimate relationships, appears to influence physiological stress reactivity and thus could influence inflammatory responses to marital conflict. Thirty-five couples were invited for two 24-h admissions to a hospital research unit. The first visit included a structured social support interaction, while the second visit comprised the discussion of a marital disagreement. A mixed effect within-subject repeated measure model indicated that attachment avoidance significantly influenced IL-6 production during the conflict visit but not during the social support visit. Individuals with higher attachment avoidance had on average an 11% increase in total IL-6 production during the conflict visit as compared to the social support visit, while individuals with lower attachment avoidance had, on average, a 6% decrease in IL-6 production during the conflict visit as compared to the social support visit. Furthermore, greater attachment avoidance was associated with a higher frequency of negative behaviors and a lower frequency of positive behaviors during the marital interaction, providing a mechanism by which attachment avoidance may influence inflammatory responses to marital conflict. In sum, these results suggest that attachment avoidance modulates marital behavior and stress-induced immune dysregulation.

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1. Introduction

Marital strain is associated with poor health. Individuals reporting lower marital satisfaction experienced more non-specific physical illness symptoms over a 4-year period than individuals with higher marital satisfaction (Wickrama et al., 1997). Among healthy women, lower marital satisfaction was also associated with a more rapid progression of carotid atherosclerosis (Gallo et al., 2003; Wang et al., 2007). Furthermore, women who were initially dissatisfied in their marital relationship were more likely to develop metabolic syndrome over an 11-year period (Troxel et al., 2005). Among women hospitalized for an acute coronary event, those

who reported moderate to severe marital strain at baseline were 3 times more likely to experience a recurrent coronary event during a 5-year follow-up, compared to women reporting less marital stress (Orth-Gomer et al., 2000). Poor marital quality was also associated with a lower 3-year survival rate among end-stage renal disease patients (Kimmel et al., 2000), and a lower 8-year survival rate among congestive heart failure patients (Rohrbaugh et al., 2006). Collectively, these results from prospective observational studies provide evidence of an association between marital stress and negative health outcomes.

In laboratory marital interaction studies, negative and hostile behaviors during discussions of marital disagreements promote immune dysregulation. Among newlywed couples, participants who exhibited more hostile and negative behaviors during a 30-min marital conflict discussion had greater decrements over 24 h in immune cell function than participants who exhibited fewer negative behaviors (Kiecolt-Glaser et al., 1993). Similarly, older men and women who showed relatively poorer immunological responses across three immune assays displayed more negative behavior during a marital conflict than did participants who had

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relatively better immune responses (Kiecolt-Glaser et al., 1997). Furthermore, compared to couples who displayed fewer negative behaviors across two marital interaction tasks, more hostile couples had larger increases in the proinflammatory cytokines interleukin-6 (IL-6) and tumor necrosis- α (TNF- α), up to 18 h following a conflict resolution task, but not after a structured social support interaction (Kiecolt-Glaser et al., 2005).

Enhanced inflammation following negative marital interaction is a key mechanism by which marital stress may be associated with poor health outcomes (Black, 2006). Elevated serum IL-6 levels have been linked to the development of a host of age-related diseases including cardiovascular disorders, osteoporosis, arthritis, type 2 diabetes mellitus, certain cancers, frailty and functional decline, and even mortality (Black, 2006; Ershler and Keller, 2000). Negative behaviors during marital conflict may lead to frequent stress-induced immune dysregulation that promotes persistent elevations in serum IL-6 and subsequent poor health outcomes. Indeed, larger inflammatory responses to a laboratory stressor have been related to larger increases in ambulatory systolic blood pressure and carotid arterial stiffness over the course of a 3-year period (Brydon and Steptoe, 2005; Ellins et al., 2008).

Attachment style is an individual difference that may modulate partners' physiological responses to marital conflict. Bowlby (1982) proposed that attachment is a behavioral system that evolved to regulate an infant's proximity with his or her primary caregiving parent in times of danger or distress, in order to promote survival. Different attachment styles develop in response to parents' availability and responsiveness. Securely attached children exhibit distress upon separation from their mothers, but are quickly comforted when reunited. In contrast, anxious children exhibit intense distress upon separation, and are not easily soothed following their mother's return. Avoidant children do not display signs of distress upon separation, and refrain from seeking contact upon reunion with their mothers (Ainsworth et al., 1978).

Bowlby (1982) suggested that infants develop expectations about their parents' availability and responsiveness in times of need. These mental representations influence the individual's expectations and behaviors in intimate relationships. Infants are also thought to learn to regulate their negative affect on the basis of their interaction with their primary caregivers (Crittenden, 1994). Hazan and Shaver (1987) argued that in adulthood, the attachment bond established between long-term romantic partners is similar to that of the parent–child relationship, albeit both partners serve reciprocally as attachment figures for one another. Adulthood attachment style is defined along two dimensions. Attachment anxiety reflects fear of the partner's rejection, separation or abandonment, while attachment avoidance represents difficulties in relying upon and opening up to others, and avoidance of intimacy with and dependency on one's romantic partner (Brennan et al., 1998). Prototypically anxious individuals worry about being rejected in their close relationships and are overly dependent on others for support and self-esteem; avoidant individuals become uncomfortable and pull away when their partners get too close and prefer being self-reliant rather than asking others for help (Brennan et al., 1998).

During threatening or stressful events, attachment style influences the perception and interpretation of social information, and shapes the individuals' cognitive, emotional, and behavioral responses to stressful events (Collins and Read, 1994). Indeed, differences in attachment style leads to behavioral differences during marital interactions. Individuals with secure attachment (i.e., low in both attachment anxiety and avoidance) are better able to seek and provide support in anxiety-producing situations, and are less likely to show rejection during the discussion of a marital disagreement than anxious and avoidant individuals (Kobak and Hazan, 1991; Simpson et al., 1992). Conversely, individuals with higher

levels of either attachment avoidance or anxiety exhibited more negative behavior during marital conflict than secure individuals (Creasey, 2002). Moreover, during marital conflict resolution, anxiously attached women display greater distress than secure women, whereas avoidant men showed less warmth and support than secure men (Simpson et al., 1996).

Attachment style is also thought to impact emotion regulation patterns and, as such, may influence physiological stress responses (Crittenden, 1994). Both attachment avoidance and anxiety predicted heightened cardiovascular reactivity to a mental arithmetic task (Carpenter and Kirkpatrick, 1996; Feeney and Kirkpatrick, 1996). Maunder et al. (2006) found that attachment anxiety was associated with self-reported distress, but not cardiovascular responses to mental arithmetic, while attachment avoidance was associated with cardiovascular responses, but not self-reported distress to the same laboratory stressor. Attachment avoidance has also been associated with higher skin conductance reactivity in response to both interpersonal and non-interpersonal stressors (Diamond et al., 2006). Moreover, in a cross-sectional study among healthy women, attachment avoidance was also associated with lower natural killer (NK) cell cytotoxicity but was unrelated to perceived stress, while attachment anxiety was associated with perceived stress, but unrelated to the immune measure (Picardi et al., 2007).

Bowlby (1982) argued that any stressful or threatening experience can potentially activate the attachment system. However, situations that induce threat in romantic relationships, such as the discussion of marital disagreements, provide a relevant model to study the impact of attachment on stress responses (Mikulincer et al., 2002). Among dating college students engaged in a conflict negotiation task, women's cortisol responses were associated with their own attachment avoidance, while men's cortisol responses were related to their own attachment anxiety (Powers et al., 2006). This study provided evidence that attachment styles influence cortisol responses to conflict in romantic relationship. However, because the sample comprised college students in uncommitted relationships between the ages of 18–21, the generalizability to older married couples is unclear.

In order to investigate how attachment style might modulate IL-6 responses to marital conflict, married couples participated in two marital interaction tasks during two visits in a hospital-based research unit. We hypothesized that attachment anxiety and avoidance would influence individuals' IL-6 responses to the marital interaction tasks. Given that the conflict resolution task is more likely to create threat in the romantic relationship than the social support interaction, we hypothesized that impact of attachment style on inflammatory responses would be stronger during the conflict visit than the social support visit. We also hypothesized that attachment avoidance and anxiety would be associated with individuals' positive and negative behaviors during marital conflict.

2. Methods

2.1. Participants

Forty-two heterosexual, married couples were recruited as part of a larger study on marital stress and wound healing through newspaper and radio ads, notices posted on campus and in the community, and referrals from other participants. Thirty-five couples who provided attachment data were included in this study. Exclusion criteria included (1) health problems or related medications that had an obvious immunological or endocrinological component or consequences for wound healing (e.g., cancer, recent surgeries, strokes, diabetes mellitus, peripheral vascular disease,

conditions such as asthma or arthritis that required regular use of antiinflammatories) and (2) blood pressure medication, smoking, or using excessive alcohol or caffeine. The Ohio State University Biomedical Research Review Committee approved the project; all subjects gave written informed consent prior to participation.

2.2. Protocol

Thirty-five couples (70 individuals) participated in two 24-h visits at the General Clinical Research Center (GCRC), a hospital-based research unit. At 7 AM, couples were admitted to the GCRC, fed a standard breakfast (after fasting since midnight before admission), and given questionnaires to complete. A heparin well was inserted in each subjects' arms to facilitate blood draws throughout the day. At 9:15 AM, nurses performed the experimental blistering procedure for the wound healing study (Kiecolt-Glaser et al., 2005). At roughly 10:45 AM, couples were positioned in chairs facing each other in front of a curtain, completed several questionnaires, and sat quietly for 10 min before starting the marital interaction task. The marital interaction tasks were videotaped and the research team remained out of sight during all discussions. Blood samples were drawn at admission in the GCRC, at the end of the interaction tasks, 3 h later, and the next morning at 7 AM, respectively, at 0, 4, 7, and 22 h after the GCRC admission. To assure consistent physical activity across dyads and admissions, couples remained together in the same room throughout the rest of the day. The two visits differed only by the marital interaction tasks performed by the couples. The two visits occurred on average 2.37 months apart from each other (SD = 1.93 months).

For the interaction task during the first visit, each spouse identified an important personal characteristic, problem, or issue that he or she wished to change, but were explicitly instructed to avoid discussing issues that might lead to marital dissension. Each spouse was then asked to talk about what they would like to change about themselves, while the partner was asked to be involved in the discussion in whatever way he or she wished. Roles were reversed after 10 min of discussion (Pasch and Bradbury, 1998). After the structured social support interaction, couples were asked to tell the story of their relationship for 30 min following the Relationship History Interview (Veroff et al., 1993). During the second visit, the marital interaction was a conflict resolution task. Couples completed the Relationship Problem Inventory and a 20-min interview to identify the best topics for the problem discussion (Kiecolt-Glaser et al., 1993; Knox, 1971). Couples were then asked to discuss and try to resolve 1 or 2 marital issues that the interviewer judged to be the most conflict-producing (with at least one issue identified by each spouse; e.g., money, communication, or in-laws) for 30 min (Kiecolt-Glaser et al., 1997).

2.3. Observational coding system

The Rapid Marital Interaction Coding System (RMICS; (Heyman, 2004) was used to quantify marital interaction data for the social support and conflict resolution tasks. Negative behaviors were computed by summing five RMICS codes: psychological abuse, distress-maintaining attributions, hostility, dysphoric affect, and withdrawal. A positive behavior index was created by aggregating the acceptance, relationship-enhancing attribution, self-disclosure, constructive problem solving, and humour codes. The RMICS has high reliabilities both for the overall system as well as for individual codes, and it discriminates distressed from non-distressed couples (Heyman, 2004).

2.4. Questionnaires

The Experiences in Close Relationship (ECR) Questionnaire assessed adult attachment in romantic relationships (Brennan et al., 1998). The scale includes 36 items rated on a 7-point Likert scale from strongly agree to strongly disagree. The questionnaire includes two factor-analytically derived subscales: Attachment Anxiety (evaluating anxiety about rejection and abandonment), and Attachment Avoidance (measuring avoidance of intimacy and dependency on one's partner). Scores on these two dimensions were computed by averaging the score on the items of each subscale (Brennan et al., 1998). The anxiety subscale had a Cronbach's alpha of 0.88, and the avoidance subscale had a Cronbach's alpha of .94. The ECR was administered during both admissions. Given the high correlations between the two administrations of the ECR (.88 for attachment anxiety and .92 for attachment avoidance), an average attachment anxiety and avoidance score was computed for each individual.

Health-related behaviors assessed during the admission included exercise, alcohol intake, and body mass index (Kiecolt-Glaser and Glaser, 1988). Health questions from the Older Adults Resources Survey assessed medication use and underlying diseases (Fillenbaum and Smyer, 1981). The Pittsburgh Sleep Quality Index assessed sleep quality and disturbances (Buysse et al., 1989). Sleep efficiency was assessed through self-report on the morning following the admission. The Marital Adjustment Test (Locke and Wallace, 1959) measured marital adjustment and satisfaction.

2.5. Plasma cytokine levels

Plasma IL-6 was assayed using Quantikine High Sensitivity Immunoassay kits (R&D Systems, Minneapolis, Minn), per kit instructions. Samples were run undiluted in duplicate, and all samples for a couple were run at the same time.

2.6. Statistical analyses

The total serum IL-6 production was quantified by computing an area under the curve variable for each 24-h visit. An Actor-Partner Interdependence model (Kashy and Kenny, 2000) was first tested to evaluate whether husbands' attachment styles influenced wives' inflammatory responses, and vice versa. However, because none of the partner attachment variables were significantly associated with IL-6 production (all p 's > .59), we decided to use a simpler model looking only at the individual's own attachment style. Mixed effect within-subject repeated measure models were used to examine differences in IL-6 production across the two GCRC visits and the extent to which these changes were influenced by attachment anxiety and avoidance. Subsequently, a second mixed effect model was used to evaluate whether change in IL-6 over time within the GCRC visit was associated with attachment style. Mixed effect models were chosen because of their adequacy in dealing with the dependent data obtained from two members of the same couple interacting with each other, and for their capacity to control for the auto-correlations between assessment points in a repeated measure design. The couple was used as the unit of analysis, with the individual's attachment and cytokine data nested within couple. The time variable was rescaled to set the intercept at the assessment point immediately after the marital interaction tasks. Cytokine and attachment data were log-transformed to correct for their skewed distribution. Attachment variables were centered around their grand mean to facilitate interpretation (Singer, 1998). Age and body mass index (BMI) were used as covariates in all the models to control for the influence of adipose tissue and age on circulating levels of IL-6 (Ershler, 1993; Mohamed-Ali

et al., 1998). Statistical analyses were performed with SAS version 9.1.

We restricted our analyses to IL-6 data based on recent evidence that acute stress does not elicit immediate changes in TNF- α production (Steptoe et al., 2007). In fact, in our sample, changes in TNF- α were not observed immediately after the marital interaction task nor 3 h later, but only the next morning, 18 h later (Kiecolt-Glaser et al., 2005).

3. Results

Socio-demographic, psychological, and anthropomorphic characteristics of the participants are presented in Table 1. There were no gender differences in attachment anxiety $F = 2.32, p = 0.13$ or avoidance, $F = 0.88, p = .78$. Attachment anxiety and avoidance were significantly correlated, $r = .39, p = .01$. Attachment anxiety was negatively correlated with age, $r = -.26, p = .03$, marriage length, $r = -.33, p = 0.01$, and marital satisfaction, $r = -.23, p = .07$. Attachment avoidance was negatively correlated with marital satisfaction only, $r = -.43, p = .001$. In terms of health behaviors, attachment anxiety was negatively associated with sleep efficiency during the two GCRC visits, $r = -.26, p = .04$. Attachment anxiety and avoidance were unrelated to weekly physical exercise, alcohol, and caffeine intake (all $r > .15$).

3.1. Inflammatory responses to the two marital interaction tasks

To test our hypothesis that the impact of attachment style on inflammatory responses to the marital interaction tasks would be stronger following conflict than after social support, the total IL-6 production during each 24-h visit was summarized by computing an IL-6 area under the curve. Baseline levels of inflammation, sex, age, marriage length, marital satisfaction, body mass index, and sleep efficiency during the GCRC visits were included as covariates in the repeated measures model to account for potential confounding factors.

Results showed that there was a significant interaction between visit and attachment avoidance, $F(1, 66) = 2.38, p = .02$. Fig. 1 illustrates changes in IL-6 production across the two visits as a function of a median split of the sample based on attachment avoidance. Individuals with lower attachment avoidance had similar IL-6 plasma levels across the two visits, whereas participants with higher levels of attachment avoidance exhibited a marked increase in IL-6 plasma levels during the conflict visit as compared to the social support visit. The attachment anxiety by visit interaction term

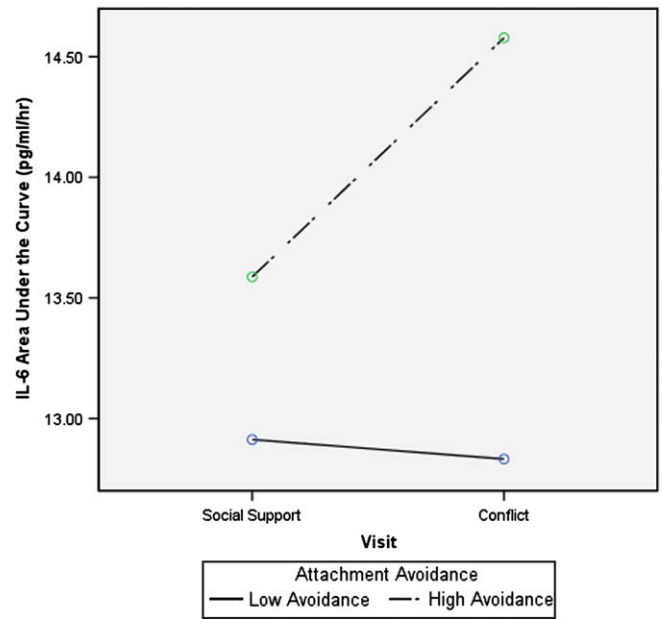


Fig. 1. Interleukin-6 Area Under the Curve Across the Two GCRC Visits.

was not statistically significant, $F(1, 66) = 0.71, p = .48$. We also evaluated whether there were gender differences in the relationships between attachment style and IL-6 responses to the marital interaction tasks. Neither the interaction terms of sex, GCRC visits, and attachment avoidance, $F(1, 66) = 0.82, p = .42$, or attachment anxiety $F(1, 66) = 0.65, p = .52$ were significant.

3.2. Attachment avoidance and IL-6 responses during the conflict visit

Given that the IL-6 plasma levels during the conflict visit were significantly elevated among individuals with higher levels of attachment avoidance, compared to less avoidant participants, we investigated whether the temporal pattern of change in IL-6 was associated with attachment avoidance. A mixed effects model was used to adjust for the auto-correlations of the IL-6 data over time and for the dependent data obtained from both members of each couple. An unconditional model first fit to the data showed that the IL-6 response to the conflict resolution task followed a curvilinear pattern over the 24 h. Plasma IL-6 levels increased from baseline to 3 h after the marital interaction tasks and then slightly decreased the next morning. Importantly, data indicated the presence of substantial individual differences in the IL-6 response to the conflict resolution task; the variance of the intercepts and the slopes were all significantly different from zero (all $p < .001$).

In a model controlling for age, sex, marital satisfaction, and body mass index, attachment avoidance was significantly associated with the intercept variability, $F(1, 66) = 3.68, p < .001$. Because the time variable was rescaled to set the intercept at the assessment point immediately following the conflict resolution, these results show that individuals reporting higher levels of attachment avoidance had higher plasma IL-6 levels immediately after the discussion of a marital disagreement, compared to less avoidant individuals. The quadratic time by attachment avoidance interaction term was also significant $F(4, 194) = 1.98, p = .05$, indicating that the pattern of change in IL-6 following the discussion of a marital disagreement was modulated by the participant's level of attachment avoidance. Fig. 2 depicts the temporal change in plasma IL-6 as a function of a median split of the sample based on attachment avoidance. Individuals with higher attachment avoidance pro-

Table 1
Couples' socio-demographic, psychological, and physical characteristics.

| | Mean (SD) | Range |
|----------------------------|---------------|-------------|
| Age | 37.64 (13.48) | 25–69 |
| Length of marriage (years) | 11.23(12.47) | 2–52 |
| Marital satisfaction | 118 (17.62) | 79–144 |
| Attachment anxiety | 2.48 (0.88) | 1.11–4.83 |
| Attachment avoidance | 2.17 (0.92) | 1.00–4.61 |
| Body mass index | 26.33 (5.29) | 18.30–50.39 |
| Frequency (%) | | |
| Ethnicity | | |
| Caucasian | 62 (88.6) | |
| Black | 4 (5.7) | |
| Hispanic | 1 (1.4) | |
| Asian | 1 (1.4) | |
| Education | | |
| High school | 5 (7.1) | |
| Some college | 15 (21.4) | |
| College graduate | 29 (41.4) | |
| Postgraduate training | 21 (30.0) | |

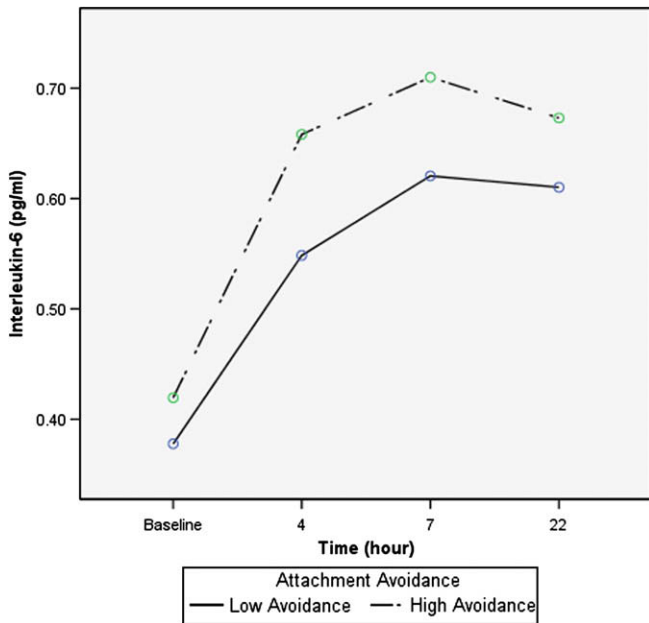


Fig. 2. Patterns of Changes in Interleukin-6 in Function of Attachment Avoidance.

duced more IL-6 in response to the conflict resolution task than less avoidant individuals.

3.3. Attachment style and positive and negative behaviors during the conflict visit

We also hypothesized that attachment style would influence the behavioral response to the conflict resolution task. Attachment avoidance was associated with the frequency of both negative behaviors $F(1,70) = 4.34, p < .001$ and positive behaviors $F(1,70) = 4.42, p < .001$. Individuals reporting higher attachment avoidance exhibited a greater frequency of negative behaviors and a lower frequency of positive behaviors during the discussion of a marital disagreement than individuals with lower levels of attachment avoidance. Attachment anxiety was unrelated to the frequency of negative behaviors, $F(1,70) = -0.98, p = .33$, and positive behaviors, $F(1,70) = 1.70, p = .09$, during the conflict resolution task. The higher levels of negative behaviors and lower levels of positive behaviors of avoidant individuals during the discussion of a marital disagreement suggest a mechanism by which attachment avoidance may influence IL-6 responses to marital conflict.

4. Discussion

This study addressed the impact of attachment style on inflammatory responses to marital conflict. Individuals with higher levels of attachment avoidance had larger IL-6 responses to a marital disagreement, compared to less avoidant individuals. The enhanced IL-6 response was evident after conflict, but not after a social support interaction. Participants with higher attachment avoidance also displayed more negative behaviors and less positive behaviors during the discussion of a marital disagreement, suggesting one mechanism by which attachment avoidance may modulate IL-6 responses to marital conflict.

Individuals with higher attachment avoidance had, on average, an 11% increase in total IL-6 production during the conflict visit as compared to the social support visit, while individuals with lower attachment avoidance had, on average, a 6% decrease in IL-6 production during the conflict visit as compared to the social support visit. When frequently repeated over time, these exacerbated IL-6

responses to marital conflict may place avoidant individuals at greater risk for detrimental health outcomes (Black, 2006).

Stress-induced increases in proinflammatory cytokines have been prospectively associated with the development of cardiovascular risk factors (Brydon and Steptoe, 2005; Ellins et al., 2008). Moreover, the heightened IL-6 responses to marital conflict observed among avoidant individuals may reflect a more chronic response to spousal interactions. Distressed couples tend to experience more daily interpersonal tensions, greater spillover of conflict from one topic to another, and more recurring conflicts over several days (Christensen and Margolin, 1988; Margolin et al., 1996). These more frequent negative social interactions may promote sustained elevations in proinflammatory cytokines among avoidant individuals. Such elevations in plasma IL-6 place the individual at a greater risk of developing cardiovascular diseases, even among initially healthy individuals (Ridker et al., 2000). Among older individuals, higher IL-6 has also been associated with greater risk of developing a host of age-related diseases such as osteoporosis, arthritis, type 2 diabetes mellitus, certain cancers, frailty and functional decline, and even mortality (Ershler and Keller, 2000).

The conflict visit focused on discord-related issues between partners, a situation likely to generate stress and threat in the romantic relationship. In contrast, during the social support visit, partners discussed personal characteristics they would like to change and related the history of their relationship, a pleasant task for most couples (Veroff et al., 1993). Attachment theory stipulates that the impact of attachment style on the individual response to stress is strongest in situations eliciting threat in key relationships (Bowlby, 1982). In our study, the discussion of a marital disagreement appeared to have elicited such threat, but not the social support visit. Indeed, attachment avoidance modulated IL-6 responses during the conflict visit, but not during the social support visit.

The individual's attachment style influences his or her appraisal and response to stressful situations. During the marital conflict discussion, attachment style alters spouse's perception and interpretation of their partner's behaviors. Individuals with an insecure attachment style perceived their partner's positive behaviors as less helpful and more pessimistic (Collins and Feeney, 2004; Collins et al., 2006) and also exhibited less positive behaviors during stressful dyadic interactions (Simpson et al., 1992). Similarly, avoidant individuals may view their marital interactions as more threatening and react more negatively toward their partners (Campbell et al., 2001).

During marital conflict, individuals with higher levels of attachment avoidance exhibited more negative behaviors and fewer positive behaviors than less avoidant individuals; these data are consistent with other studies in which avoidant individuals displayed more unhelpful and antagonistic behaviors during marital interactions than secure individuals (Campbell et al., 2001; Creasey, 2002; Simpson et al., 1992). Behavioral differences during the conflict discussion may promote greater IL-6 responses to the interaction task among avoidant individuals. Indeed, in a prior analysis of the same data, it was found that couples exhibiting a greater frequency of negative behaviors across both the social support and the conflict visits had larger IL-6 responses following marital conflict than couples consistently displaying fewer negative behaviors (Kiecolt-Glaser et al., 2005). Furthermore, positive marital behaviors in the context of negative interaction can modulate ACTH and cortisol responses to marital conflict (Fehm-Wolfsdorf et al., 1999; Robles et al., 2006), a process that may also contribute to greater IL-6 production.

The fact that the marital interaction task induced increases in IL-6 is in line with a large body of evidence showing that psychological stress can trigger inflammatory responses (Steptoe et al., 2007). The characteristics of the stressor appear to influence the magnitude of the physiological response that it evokes. Stressors

that are uncontrollable or that induce greater social-evaluative threat elicited larger cortisol responses to psychological stress (Dickerson and Kemeny, 2004). Avoidant individuals may render the marital interaction task more threatening and uncontrollable than less avoidant individuals by engaging in more negative and less positive behaviors, perceiving their partner's supportive behaviors as less helpful, and by eliciting more negative behaviors from their partner (Campbell et al., 2001). In the current attachment analysis, this suggests that this escalation in negative behavior, combined with a relative paucity of positive behavior, may be a mechanism through which higher levels of attachment avoidance lead to enhanced IL-6 production during marital disagreements.

In our study, attachment anxiety, in contrast to attachment avoidance, was unrelated to IL-6 responses. Similarly, Picardi et al. (2007) found that attachment avoidance, but not attachment anxiety, was associated with functional immunologic assays. These findings reflect a trend in the attachment literature suggesting that attachment anxiety is often related to subjective distress, but not to physiological stress responses, while attachment avoidance is associated with increased physiological stress reactivity, but not perceived stress (Diamond et al., 2006; Maunder et al., 2006).

One limitation of the study is the fact that our participants had relatively low levels of attachment anxiety and avoidance. Using the categorical classification of attachment style, 75% of the participants would be considered securely attached. This may explain why unlike prior studies, we found that attachment anxiety was unrelated to negative behaviors during the conflict resolution task. On the other hand, the overall high levels of attachment security in our sample suggest that we may actually be underestimating the effects of attachment style on inflammatory responses to marital conflict.

To our knowledge, this is the first study showing that attachment avoidance modulates the inflammatory response to marital conflict discussion among adults in long-term, committed relationships. Attachment style was a relevant individual difference that modulated the behavioral and physiological responses to relationship stress, suggesting that attachment style may moderate relationships between marital stress and health outcomes. Further studies are needed to test this interesting hypothesis.

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