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The Roles of Marriage and Anger Dysregulation in Biobehavioral Stress Responses

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Abstract

Physiological and behavioral correlates of anger dysregulation in adults were evaluated in the context of marital stress. Fifty-four married couples participated in a series of laboratory procedures that included electrocardiogram measures during a 15-min marital conflict interaction and an interview assessing their inability to regulate anger (anger dysregulation). Results from the multivariate regression analyses indicated that the nature of the couple's relationship, rather than individual levels of anger dysregulation, predicted lower parasympathetic cardiac activity (indexed by high-frequency heart period variability) and shorter cardiac interbeat intervals. Anger dysregulation, rather than the dyadic relationship, was predictive of greater displays of angry behavior during the marital conflict interaction. The importance of contextual factors in stress processes, such as stress due to marriage, are discussed in light of research linking poor marital quality to greater health risks for women than for men.

Keywords

anger dysregulation; marriage; heart period variability; cardiovascular reactivity; gender; marital stress

The leading cause of mortality for women is disease associated with the cardiovascular system (Kochanek, Murphy, Anderson, & Scott, 2004), yet owing to disparities in research on the biobehavioral stress processes that could lead to increased risk for cardiovascular disease (CVD), we do not have as clear an understanding of what those processes may be for women as we do for men. This disparity is due, in part, to a previous CVD research paradigm that considered men the standard by which both women's and men's CVD processes could be understood (U.S. Department of Health and Human Services, 1984). One area in which this disparity in knowledge is apparent is in our understanding of the association between anger dysregulation and cardiovascular response to emotionally salient stressors for women. The

goal of the current study was to evaluate gender differences in the association between anger dysregulation and cardiovascular responses to the emotional stress of marital conflict.

Anger dysregulation refers to difficulties with regulating the intensity and frequency of angry emotions in stressful social situations (Brosschot & Thayer, 1998; Carrère et al., in press).¹ Brosschot and Thayer (1998) suggested that anger-dysregulated individuals have difficulty soothing their anger emotionally, physiologically, and behaviorally under stressful situations. Some prospective research found an association between anger dysregulation and increased risk for CVD (e.g., Barefoot, Larsen, Von der Lieth, & Schroll, 1995; Niaura et al., 2002), and a meta-analysis of this area of research concluded that anger dysregulation is an independent predictor of CVD (Miller, Smith, Turner, Gujjarro, & Hallet, 1996). Although some research linked anger dysregulation prospectively to CVD among women (e.g., Chaput et al., 2002), most research to date indicates that (a) the strength of the association between anger dysregulation and CVD risk is stronger for men than for women, (b) research results related to issues of sex differences are not consistent (e.g., Fichera & Andreassi, 1998; Smith, Cranford, & Mann, 2000), and (c) there are not as many studies of anger dysregulation in women as there are for men (cf. Fichera & Andreassi, 1998).

Sloan and associates (Sloan, Shapiro, Bagiella, Myers, & Gorman, 1999; Sloan et al., 2001) proposed that diminished autonomic nervous system (ANS) control plays a key role in the link between anger dysregulation, cardiovascular reactivity, and the development of CVD. Their psychophysiological model suggested that reduced vagal control in response to stressors among anger-dysregulated individuals results in greater blood pressure variability and subsequent excessive wear and tear on the cardiovascular system and a buildup of arterial plaque. This model is consistent with a body of research that finds anger dysregulation to be associated with weaker vagal control (Fukudo et al., 1992; Muranaka et al., 1988). It is also consistent with a growing research literature that links weaker parasympathetic control mechanisms with CVD and adverse cardiovascular events (e.g., Kleiger, Miller, Bigger, & Moss, 1987; Kristal-Boneh, Raifel, Fromm, & Ribak, 1995; Singh, Kartik, Otsuka, Pella, & Pella, 2002; Tsuji et al., 1996; VanRavenswaaij-Arts, Kollee, Hopman, Stoeltinga, & van Geijn, 1993).

It is unclear whether there are gender differences in the kinds of biobehavioral responses seen among anger-dysregulated individuals. People who have problems regulating their anger usually display angry behavior under conditions of interpersonal challenge. Research indicates that there are gender differences in the kinds of interpersonal challenges that elicit such angry behavior (e.g. Davis, Matthews, & McGrath, 2000). One reason for this may be that the

¹Individuals who have difficulty regulating the intensity and frequency of their anger have been described in various ways by different scientific disciplines. The psychosomatic medicine field describes this phenomenon as a hostile personality, a concept that evolved out of the Western Collaborative study of men and the Type A personality (Matthews, Glass, Rosenman, & Bortner, (1977). The hostile personality is considered the most toxic component of the Type A personality (Matthews & Haynes, 1986). The child developmental literature describes an emotion regulation phenomenon first found in infancy. Infants who have difficulty emotionally and physiologically soothing themselves in the presence of either higher levels of environmental stimuli or emotionally provocative situations are considered emotionally dysregulated. There is considerable support in the developmental literature for the emotion regulation paradigm (e.g., Bazhenova & Porges, 1997; Calkins, 1997; Eisenberg et al., 1995). Research by Porges and others (e.g., Doussard-Roosevelt & Porges, 1999; Fox, 1989; Hofheimer & Lawson, 1988; Linnemeyer & Porges, 1986; Porges, 1984, 1997, 2001; Porter, Porges, & Marshall, 1988) indicates that high-frequency heart period variability (HF-HPV), an indicator of parasympathetic activity, is associated with a child's ability both to self-regulate and to adaptively react to the environment. Research with infants and children finds that the ability to physiologically self-regulate is a developmental landmark that has been linked to important childhood outcomes such as physical and mental health (e.g., Fox, 1989; Garber & Dodge, 1991; Thompson, 1994) and aggression (e.g., Pine et al., 1996). Thayer and Lane (2000) extended this developmental paradigm of emotion regulation and dysregulation to adults and suggested that greater heart period variability is linked to more systemic flexibility in response to provocative stimuli. Sloan and his colleagues (e.g., Sloan, Shapiro, Bagiella, Myers, & Gorman, 1999; Sloan et al., 2001) also reported evidence that individuals who have emotional dysregulation characteristics, such as hostility, depression, and anxiety, exhibit reduced heart period variability in response to stressors. As we were specifically looking at individuals who had difficulty regulating the intensity and frequency of their anger, we chose to use the term *anger dysregulation* rather than *hostile personality* because we feel the emotion regulation/dysregulation paradigm, applied particularly to anger, best describes individuals who have difficulty physiologically and behaviorally soothing themselves in the presence of emotionally provocative stressors.

emotional salience and context of a setting is critical in the biobehavioral responses observed in women and men. Furthermore, patterns of developmental socialization may influence women's sensitivity to their emotional surroundings. Gottman and Carrère (1994) suggested that emotions and forging intimate relationships are an integral part of social interactions for girls. Friendships during childhood are usually formed with members of the same sex. Girls use their relationships with other girls to explore their emotions. Although both boys and girls play games in their same-sex groups, emotional displays are discouraged among boys. Maccoby (1990) theorized that these differences in developmental socialization patterns for girls and boys were the basis for research outcomes that indicated that, whereas females are responsive to the influence of others during social interaction, males tend to be responsive only to other males or figures of authority. This developmental difference in the socialization of males and females may help to explain some of the discrepancies found between anger-dysregulated men and women. Anger-dysregulated individuals may be more vulnerable and display greater cardiovascular reactivity in response to the gender-salient context of a stressor.

Women may be more reactive in response to marital social stressors because of the priority they put on intimate relationships (e.g., Gottman & Carrère, 1994; Raush, Barry, Hertel, & Swain, 1974). Marital research supports this supposition. Smith and colleagues (Smith, Gallo, Goble, Ngu, & Stark, 1998) found that wives displayed elevated cardiovascular reactivity in association with marital disagreement, but husbands did not. In contrast, husbands exhibited heightened cardiovascular response to achievement challenges, but wives did not. The importance of intimate relationships for women is further highlighted by research that indicates that the negative qualities of marriage are better predictors of morbidity and mortality rates for women than men. For men, just being married (versus being single or a widower) is more important than the quality of the marriage (e.g., Burman & Margolin, 1992; House, Landis, & Umberson, 1988; Robles & Kiecolt-Glaser, 2003; United States Department of Health and Human Services, 1984).

The goal of this study was to evaluate whether the gender-related emotional salience of a stressor influenced cardiovascular and affective behavioral outcomes among those individuals who scored higher on anger dysregulation. The study used the marital conflict situation as a stressor that would have greater emotional salience for women than for men. Because anger-dysregulated individuals may be more vulnerable and display greater cardiovascular reactivity in response to the gender-salient context of a stressor, we hypothesized that wives with higher anger dysregulation scores would exhibit lower levels of parasympathetic cardiovascular activity (as indexed by high-frequency heart period variability [HF-HPV]), higher autonomic cardiovascular arousal (as indexed by a shorter cardiac interbeat interval [IBI]), and greater displays of anger during marital conflict. In contrast, we hypothesized that for men, anger dysregulation scores would not be predictive of cardiovascular and affective behavioral outcomes during marital conflict interactions.

Methods

Participants

The 54 couples in the current study were part of a larger study of married couples in the Puget Sound area of Washington State.² A two-stage sampling procedure was used to draw a sample of couples from the target area. Couples were initially recruited using newspaper advertisements and flyers posted in the Puget Sound area. Couples expressing an interest in participating in the study were administered a screening interview via phone that included the

²The sample selection and methodology for the larger study are described in greater detail in Carrère, Mittmann, Woodin, Tabares, and Yoshimoto (in press). There were no statistical differences between the sample in the larger study ($N = 129$ couples) and the smaller sample of 54 couples on measures of marital satisfaction, income, education, and racial and ethnic composition.

telephone version of the Marital Adjustment Test, a scale measuring marital satisfaction (Krokoff, 1984; Locke & Wallace, 1959). Couples were excluded from participating in the study if either spouse reported taking medication (e.g., beta blockers or tranquilizers) or using medical instrumentation devices that may have affected cardiovascular functioning or if either spouse had diabetes. The health exclusion steps were taken so that the effects of such drugs and medical devices would not confound cardiovascular measures. Couples were also excluded if their scores on the Conflict Tactics Scale (Straus, 1979) indicated a history of physical violence on the part of either partner. Those individuals who indicated the use of physical violence within the marriage were given appropriate referral information. The sample was selected to match the racial and ethnic demographics of the metropolitan Seattle area (City of Seattle Planning Commission, 1990). European Americans represented 74% (80 individuals) of the sample, whereas 12% identified themselves as African American (13 individuals), 11% as Asian American (12 individuals), 2% as Native American (2 individuals), and 1% as of Hispanic origin (1 person). The median income for the couples was between \$25,000 and \$39,000. The modal level of education for both wives and husbands was a college degree.

Procedures

Marital Interaction Session—Couples were interviewed at the laboratory about areas of contention in their relationship and worked with a member of the research team to select the most emotionally salient two to three issues to discuss during the marital interaction session. The couples then discussed their chosen topics for 15 min. Continuous electrocardiogram measures and video recordings were made during the conflict interaction. Couples were debriefed, and counseling referrals were provided for the couples in unhappy marriages and those requesting referrals.

Marital Meta-emotion Interview—In a separate laboratory session, the study participants were individually interviewed about their experience of the emotions *anger* and *sadness* using the Marital Meta-emotion Interview (MMEI), a semistructured interview that takes about 90 min to complete (Carrère et al., 1998). These interviews were videotaped.

Measures and Materials

Marital Satisfaction—The 15-item Marital Adjustment Test (MAT; Krokoff, 1984; Locke & Wallace, 1959) was administered during the telephone screening interview. The MAT is used to assess marital satisfaction and is frequently used in marital research because of its strength in reliably and validly distinguishing between happily and unhappily married couples. (e.g., ; Locke & Wallace, 1959). The items on the questionnaire ask spouses to indicate the frequency with which they disagree about topics such as finances, sex, communication, and other common sources of marital discord. The questionnaire also explores whether spouses confide in their partner, whether they would marry the same person again, whether they have similar interests in activities, and their overall rating of the quality of their relationship. The scores for the different items are weighted based on their criterion validity in predicting maladjustment and divorce (Locke & Wallace, 1959). The range of scores possible on the MAT is 2 to 158, with higher scores indicating greater marital satisfaction. The mean marital satisfaction score using the MAT for United States samples is 100 (standard deviation = 15; Locke & Wallace, 1959). In the original study by Locke and Wallace, the Spearman-Brown split-half reliability technique was used to compute a reliability coefficient of .90. In the present study, the internal consistency of the questionnaire was moderate ($\alpha = .74$). The telephone version of the MAT used during the sample selection phase includes the same items used in the paper-and-pencil version of the MAT (Krokoff, 1984).

Conflict Tactics Scale—The Conflict Tactics Scale (Straus, 1979) assesses the level of violence in a relationship. This scale was used to screen out violent couples from the study.

The Conflict Tactics Scale is composed of three subscales: Reasoning, Verbal/Symbolic Aggression, and Physical Violence. Only the Physical Violence subscale was measured in the present study. There are seven items that evaluate behaviors such as hitting, kicking, beating up a spouse, and threatening a partner with a knife or gun. The Conflict Tactics Scale is a widely used scale with good internal consistency ($\alpha = .88$ in the original study by Straus, 1979). Internal consistency for this scale is not reported for the current sample because all potential study participants reporting physical violence were excluded from the study (thus, the score for all the study participants on this scale was zero).

Marital Meta-emotion Interview—All spouses were separately interviewed about the roles of anger and sadness in their lives (Carrère et al., 1998; Doohan, Carrère, & Taylor, 2004). They were asked about their own experiences of these emotions in the present day and growing up in their family, their philosophy of the emotional expression of anger and sadness, their ability to regulate their anger and sadness (anger and sadness dysregulation), and their spouse's emotions.

The videotapes of the MMEI were coded using a specific checklist rating system that codes for individuals' awareness of each of two of their own emotions (i.e., anger and sadness), their regulation of these emotions, and their acceptance of these emotions (Yoshimoto et al., 2000). The Anger Dysregulation scale is the primary focus of this study. The Anger Dysregulation score is a sum of five items: (a) individual has difficulty regulating the intensity of her or his anger, (b) individual has difficulty regulating the frequency of her or his anger, (c) anger is a problem/ concern in her or his social or occupational life, (d) anger is a problem/ concern in her or his home life, and (e) individual does not have adaptive remediation techniques (activities to help soothe her or him and get her or him through the emotional experience). Coders rate each of these with a 5-point response set (strongly agree, somewhat agree, neutral, somewhat disagree, strongly disagree). The internal consistency for this scale was moderate ($\alpha = .78$). The intraclass correlation for independent observers coding the Anger Dysregulation scale was moderate (.72).

Observational Coding of Marital Interaction—Marital interactions were coded using the Specific Affect Coding System—Version 4.0 (SPAFF-V4; Gottman, Woodin, & Coan, 1998). SPAFF draws on facial expression (Ekman & Friesen, 1978), voice tone, and speech content to characterize the emotions expressed by the couple. This system has 20 codes for emotions and emotional behavior patterns: 13 negative codes, 1 code for neutral affect, and 6 positive affect codes. Emotions are coded separately for each person and are coded in real time. Scores reflect the number of seconds for which each code was detected over the course of the marital interaction. Although only the anger code was used for these analyses, the reliability information about the coding procedures is described below. Two independent observers coded each interaction, and Cohen's kappas and free marginal kappas were computed for each spouse's set of affects (Dunn, 1989; Swanson, 1998).³ Only those interactions with .61 or higher Cohen's kappa statistic were used for analyses. Free marginal kappa statistics across the marital interactions in the current study averaged .84.

³Landis and Koch (1977) suggested that a kappa level of .61 to .80 represents a substantial strength of agreement between coders. The free marginal kappa was also used as a second reliability statistic because coders have no a priori knowledge of the distributions of SPAFF (Specific Affect Coding System) codes for a given subject. Dunn (1989) showed that Cohen's kappa could only reach the theoretical level of 1.0 if the marginals of a coding disagreement matrix (also called contingency table) are homogeneous. This was not the case for our data, as some codes might never occur for a given individual, and also because the neutral code was coded much more often than any other code. In a search for alternatives to Cohen's kappa (Swanson, 1998), we decided the free marginal kappa proposed by Brennan and Prediger (1981) was the most suited to our data. For this statistic, as the marginal proportions are not known to the observers before coding begins, the probability of chance agreement is $1/n$ ($n = 20$ codes for SPAFF). That is, the index of chance agreement does not depend on the level of actual agreement in the marginals. The overall kappa statistics are not means from individually coded files but rather are computed from a single disagreement matrix or contingency table that includes all the double-coded files from the current study.

Cardiovascular Reactivity—Electrocardiogram (EKG) data were collected during the 15-min marital interaction session using Coulbourn bioamplifiers (Coulbourn Instruments, Allentown, PA) and a three-lead configuration. The EKG waveform was digitized at 128 Hz using a MetraByte A–D converter (Keithley Instruments, Cleveland, OH) in conjunction with ASYST software (ASYST Technologies, Inc., Fremont, CA) and a standard desktop microcomputer for data monitoring and storage. Both the cardiac interbeat interval (IBI) and time domain measures of HF-HPV were derived from the EKG data. These physiological measures index both the more general autonomic influence on the cardiovascular system (IBI) and parasympathetic activity (HF-HPV). IBI is usually reported as the milliseconds between each R-spike of the EKG and is synonymous with heart period. A shorter IBI indicates greater autonomic cardiovascular arousal. We reported the mean cardiac IBI for the 15-min conflict discussion. The mean heart rate in beats per minute (HR) was also calculated for the 15-min marital interaction session and is presented in Table 1 to help illustrate the results.

The method used to quantify HF-HPV was the Porges V-hat method (Porges & Bohrer, 1990). This technique is a time-domain approach to assessing cardiac parasympathetic activity. The V-hat method extracts heart period variability through a series of steps. We first used Windaq® (Dataq Instruments, Akron, OH) CODAS software to identify the R-spikes in the EKG waveform data (Dataq Instruments, 1995, 1988–1997). The CODAS software gave us a file that contained the times of the R-spikes over the 15-min duration of the marital interaction session. We used a custom program to read this file and produce a formatted ASCII file of IBI (heart period) data for import into the Porges MXedit program (S. Porges, University of Illinois, Chicago). We then used the MXedit data-editing function to detect and correct artifacts and outliers in the heart period series. Next, we used the PBfilter (Porges-Bohrer filter) component of the MXedit program, which first applies an algorithm that performs band-pass filtering of IBI data using a moving polynomial method. It removes low-frequency rhythms and aperiodic baseline trend components from the heart period series at frequencies below the range associated with respiration, namely, the 0.10 Hz frequency associated with feedback from spontaneous oscillations in blood pressure and an even slower rhythm that reflects basic metabolic processes.⁴ The moving polynomial method models a complex baseline with a series of short-duration polynomials that are stepped through the dataset and that conform to the shifting levels of the baseline. Acting as a high-pass filter, it produces a smoothed template series containing the slow periodic and aperiodic activity that can then be subtracted from the unfiltered series. This creates a residual series that contains only the frequency components associated with respiratory sinus arrhythmia within the selected frequency band (Porges & Bohrer, 1990). PBfilter then analyzes the residual series and calculates the V-hat statistic used to estimate HF-HPV as the natural logarithm of heart period variance within the selected frequency band (units = $\ln \text{msec}^2$). We used the PBfilter parameters for adults at rest suggested by Porges (Delta-Biometrics, 1988–1993): 500 msec sampling interval, 0.12–0.40 Hz band-pass limits (the bandwidth of human adult respiration), a moving polynomial order of 3, and 21 coefficients. The V-hat method has been validated in both human and animal studies using both invasive and pharmacological techniques (e.g., Dellinger, Taylor, & Porges, 1987; Jansen & Dellinger, 1989; McCabe, Yongue, Porges, & Ackles, 1984, 1985; Yongue et al., 1982). It has predictive value for adult human populations in both clinical and nonclinical settings (Donchin, Constantini, Szold, Byrne, & Porges, 1992; George et al., 1989; Hatch, Klatt, Porges, Schroeder-Jasheway, & Supik, 1986). A separate estimate of HF-HPV was computed for 15 one-minute epochs over the course of the marital interaction to minimize nonstationarity in the data. We chose 1-min epoch durations because Berntson (Berntson et al., 1997; Berntson,

⁴Using PBFilter (Porges-Bohrer filter) to remove the low-frequency rhythms from the heart period series is a more aggressive approach to removing possible sympathetic influences from the HF-HPV (high-frequency heart period variability) measure than is usually taken in frequency domain analyses of heart period variability (R. Burr, personal communication, December 2004). This more aggressive approach to removing possible sympathetic influences allowed us to use the .12 to .40 Hz bandwidth to assess parasympathetic activity.

personal communication, May 2003) suggested minimizing nonstationarity in the time series data by analyzing short epochs across the full data series within which stationarity parameters are satisfactory. Finally, a mean and standard deviation of HF-HPV across all 1-min epochs were calculated. A higher mean HF-HPV value represents greater parasympathetic activity over the course of the marital interaction.

In the committee report on heart rate variability for the Society for Psychophysiological Research, Berntson and others (1997) presented a discussion of the possible importance of considering respiratory parameters in the interpretation of heart period variability, with some investigators suggesting that the influence of breathing on heart period variability must be controlled or accounted for, whereas others concluded that voluntary control of breathing does not affect heart period variability. Because the participants of this study were seated and conducting a conversation, it was very difficult to separate breathing patterns from other chest wall movements caused by talking, laughing, gesturing with the arms, and so on. For the foregoing reasons, we did not attempt to control for breathing frequency in our interpretation of HF-HPV estimates.

Results

Data Analyses

Preliminary analyses included calculating the means and standard deviations for the wives and husbands (Table 1) and separate sets of Pearson's bivariate correlations for the spouses (Tables 2 and 3). A series of hierarchical regression models were then estimated to test for (a) the influence of the marriage at the couple level, (b) the main effects of anger dysregulation, (c) sex, and (d) the interaction effect between anger dys-regulation and sex (Aiken & West, 1991; Tabachnick & Fidell, 1996). Raudenbush and Bryk (2002) recommend that nested data, such as the dyadic relationship found in marriage, be assessed to reduce an increase in Type 1 error in the interpretation of individual-level variables (e.g., anger dysregulation, sex). To evaluate the role of marriage in the association between the individual-level variables and the outcome variables, dummy codes were used for the couples to index the couple influence of the marriage ($k-1$, where k equals the number of couples) couples received a dummy code, and all 53 of these dummy codes were entered into the regression model in the first block). Z scores were created for the anger dysregulation variable based on recommendation to center continuous variables in testing interactions in multiple regression models. Variables were entered in sequence to assess the couple marital influence, anger dysregulation, sex, and the interaction between the sex and anger dysregulation variables.

Cardiovascular Reactivity

High-Frequency Heart Period Variability—As shown in Table 2, univariate analyses suggest that higher anger dysregulation scores for the wives were correlated with lower HF-HPV for the marital conflict discussion ($r = -.37, p < .05$), a moderate and significant relationship. This correlation suggests that greater anger dysregulation was associated with reduced cardiac parasympathetic activity for the wives. In contrast, Table 3 reveals there was virtually no correlation between the men's anger dysregulation scores and HF-HPV during the marital conflict interaction ($r = -.05, ns$).

The association of the spousal relationship, anger dysregulation, and sex with the mean discussion measure of HF-HPV was estimated using a hierarchical regression model. Table 4 presents the regression coefficients (B , standard error of B , and the standardized coefficient beta) for each of the four sequential models and the parameters of the final model (intercept, R^2 , adjusted R^2 , and R). There was a significant effect for the couple marital influence when it was entered in block 1 (Adjusted $R^2 = .23$; $F[1,52] = 1.60, p < .05$). When anger dysregulation

z scores were entered into the equation in Block 2, there was no significant increase in the variance effect (R^2 change = .02), nor was there a significant increase in the variance explained either by sex of the spouse when the variable was stepped into the equation in Block 3 (R^2 change = .00) or by the interaction between anger dysregulation and sex when it was added in Block 4 (R^2 change = .01). The influence of the marital relationship on HF-HPV during the conflict interaction is further supported by the strength of the intraclass correlation for the spouses' data ($r = .22$). The results indicate that although univariate analyses might suggest that anger dysregulation was predictive of the wives' HF-HPV, in fact, when the nature of the marriage was controlled by entering it into the regression equation first, anger dysregulation had no additional contribution in predicting the wives' cardiac parasympathetic activity.

Heart Interbeat Interval—Univariate analyses provided in Table 2 show that anger dysregulation scores for the wives had a low, negative correlation with IBI for the marital conflict discussion ($r = -.16$, ns). This finding suggests greater anger dysregulation in the wives is associated with greater autonomic cardiovascular arousal. The negative correlation between the husbands' anger dysregulation scores and their discussion IBI shown in Table 3 was also low and nonsignificant ($r = -.19$, ns).

A hierarchical regression model was estimated for the effects of the independent variables on cardiac IBI for the spouses (Table 5). The couple's relationship was significant in predicting cardiac IBI during the marital conflict (adjusted $R^2 = .31$; $F[1,52] = 1.92$, $p < .01$). When anger dysregulation z scores were entered into the equation, there was no increase in the variance effect (R^2 change = .00, ns). There was no significant increase in the variance explained by sex of the spouse (R^2 change = .01, ns), nor was there a significant increase in variance explained by the interaction between anger dysregulation and sex (R^2 change = .01, ns). The influence of the marital relationship on the outcome variable of discussion IBI was also demonstrated by the strength of the intraclass correlation for the spouses' data ($r = .31$). These results indicate that the nature of a couple's relationship, rather than anger dysregulation or the sex of the spouse, was predictive of the spouses' cardiac autonomic arousal (IBIs).

Anger

Univariate analyses shown in Table 2 show that there was a moderate and significant correlation between the number of seconds the women displayed anger during the marital interaction and their interview scores for anger dysregulation ($r = .44$, $p < .01$). Table 3 shows that the correlation was relatively low between the number of seconds the husbands displayed anger during the marital interaction and their anger dysregulation scores from the interview ($r = .25$, $p = .07$).⁵

The association of the spousal relationship, anger dysregulation, and sex with the number of seconds anger was displayed during the marital interaction was estimated using a hierarchical regression model (Table 6). There was no significant effect for the couple's marital influence (adjusted $R^2 = -.09$; $F[1,52] = .84$, ns). However, when the anger dysregulation z scores were entered into the equation, there was a significant effect (R^2 change = .07, F change = 8.34, $p < .01$). There was a moderate but nonsignificant change in the variance explained by the sex of the spouse (R^2 change = .03; F change = 3.55; $p = .065$). In the next step of the regression model, the interaction between anger dysregulation and sex was entered. Results indicated that there was a modest but nonsignificant interaction between anger dysregulation and sex for the level of anger displayed during the marital conflict discussion (R^2 change = .02; F change = 2.81; $p = .10$). The lack of association between the wives' and husbands' data was further

⁵Note that, for completeness, Tables 2 and 3 show the correlations between the dependent variables of anger displayed, HF-HPV (high-frequency heart period variability), and IBI (interbeat interval), but as those relationships were not the subject of our hypotheses, they were not explored further with hierarchical regression modeling.

substantiated by the intraclass correlation of the spouses' data for the anger displayed during the conflict interaction ($r = .0$). The data indicate that once the influence of the couple was controlled for, anger dysregulation scores were linked to the level of anger displayed during a marital conflict session. There were some differences in the amounts of anger predicted by the sex of the spouse and by the interaction between the sex of the partners and anger dysregulation, but neither of these predictor terms was significant in value.

Discussion

The primary goal of the study was to determine whether the gender-related emotional salience of a stressor influenced cardiovascular and affective behavioral outcomes among those spouses who scored higher on anger dysregulation. We hypothesized that the emotional salience of the marital conflict would be greater for wives than husbands, and thus wives who were more anger dysregulated would exhibit lower parasympathetic cardiac activity (indexed by HF-HPV), shorter cardiac interbeat intervals, and more seconds of angry behavior during the marital interaction than their husbands. The results turned out contrary to our predictions but nonetheless provide some interesting insights and raise further questions.

Univariate analyses for the wives suggested that women who were more anger dysregulated did have lower HF-HPV during the conflict interaction and displayed more seconds of angry behavior, although no similar univariate relationship was found with cardiac IBI. However, Raudenbush and Bryk (2002) highlight the importance of considering the nested nature of data, such as can be found in the dyadic relationship of marital couples. Relatively small intraclass correlations in the spouses' data can result in Type 1 error and lead to the conclusion that individual-level variables, such as anger dysregulation, may be significant in predicting cardiovascular activity levels. In fact, our multivariate hierarchical regression analyses indicated that once the nature of the couple's relationship was controlled for, there was no significant additional variance explained by anger dysregulation in either HF-HPV or cardiac IBI for either spouse. This suggests that the marital relationship, itself, may be an important factor in understanding women's cardiovascular response to stress.

For the husbands in the study, univariate analyses revealed no significant association between anger dysregulation and the cardiovascular outcomes. Comparing these results to the wives' univariate analyses might have suggested a gender difference in the relationship between anger dysregulation and HF-HPV. However, in the hierarchical regression analyses, only the nature of the marital relationship had a significant main effect in predicting the variance in both HF-HPV and cardiac IBI, thus revealing no gender differences in the spouses' cardiovascular responses to the marital conflict interaction.

Univariate analyses of the association between interview scores of anger dysregulation and angry behavior during the marital conflict interaction indicated a moderate, significant correlation for women but not for men. A multivariate hierarchical regression analysis, controlling for the influence of the marital dyad, found a main effect for anger dysregulation scores but not for the sex of the partners or the interaction between sex and anger dysregulation. This shows that people who report difficulties in controlling the intensity and frequency of their anger do display more angry behavior during marital conflict, at least in a laboratory setting.

The results of the study indicate that the nature of the couple's dyadic relationship predicts their cardiovascular responses during marital conflict. In terms of understanding gender-related health disparities, these results may be valuable in helping us to shift focus to the way in which couples' relationships play a differing role in men's and women's health. Although the multivariate analyses in our study indicate no sex differences in the association between the

dyadic relationship and cardiovascular outcomes, future studies using marital stress as a stimulus could tease apart those components of the relationship that may be most instrumental in predicting both women's cardiovascular response to and their health in unhappy marriages. This proposition is indirectly supported by cross-sectional and epidemiological research that indicates that for women the quality of the marriage is more important to their health than just being married (e.g., Burman & Margolin, 1992; House et al., 1988; Robles & Kiecolt-Glaser, 2003). In contrast, for men, research suggests that health benefits appear to come primarily from being married rather than the quality of the marriage.

The second lesson to be drawn from the results of our study is the importance of considering the nested nature of data when studying couple relationships. The univariate analyses in this study suggested that a characteristic at the individual level (anger dys-regulation) was predictive of cardiovascular response to a stressor for women. However, once the couple's relationship was controlled for, the individual-level variable of anger dysregulation no longer had a significant association with the HF-HPV data for the women. This tendency to focus on variables at the level of the individual as causal factors is not just limited to the work of psychophysiolgists—health care providers also tend to focus on characteristics of the individual and biological family health history in understanding the origins of health problems. Our research highlights the importance of considering the role of larger contextual issues, such as the impact of the marriage, on day-to-day stress processes.

Implications for Nursing Practice and Preventative Health Care

It is premature to draw conclusions about the implications of this research for nursing practice and preventative health care because of the small sample size and because the study did not deconstruct the elements of the marital relationship that drove the cardiovascular outcomes. However, the link between the nature of the couple's relationship and cardiovascular response during marital conflict highlights the importance of assessing the potentially harmful health effects of distressed marriages in patients' lives. This is particularly relevant for female patients given previous research indicating that women in unhappy marriages have higher morbidity and mortality rates (e.g., Burman & Margolin, 1992; House et al., 1988; Robles & Kiecolt-Glaser, 2003;). It is often difficult in the time-limited environment of health care to assess contextual factors in patients' lives. However, given the growing body of research that indicates an association between lower levels of heart period variability and cardiac events (e.g., Kleiger et al., 1987; Kristal-Boneh et al., 1995; Singh et al., 2002; Tsuji et al., 1996; VanRavenswaaij-Arts et al., 1993), recognizing the presence of a distressed marriage could be an important first step (particularly with female patients) in identifying those individuals who may be at future risk for cardiac and other problematic physical health outcomes.

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Table 1
Means and Standard Deviations of Variables for Husbands and Wives ($N = 54$)

Variable	Wife	Husband
	M (SD)	M (SD)
Anger dysregulation scores ^a	11.48 (2.57)	12.11 (3.63)
HF-HPV (ms ²)	5.38 (1.05)	5.34 (1.33)
IBI (ms)	795.85 (105.00)	813.87 (110.32)
Heart rate (beats/min)	77.13 (10.80)	75.51 (10.06)
Anger displayed ^b	4.69 (9.38)	2.11 (4.56)

NOTE: HF-HPV = high-frequency heart period variability; IBI = interbeat interval.

^a Anger Dysregulation scale of the Meta-emotion Interview.

^b Anger behavior is measured in the number of seconds the behavior occurred during the 15-min discussion.

Table 2
 Anger Dysregulation Pearson's Bivariate Correlations for Wives ($N = 54$)

Variable	1	2	3	4
Anger dysregulation ^a	—			
HF-HPV (ln ms ²)	-.37**	—		
IBI (ms ²)	-.16	.28*	—	
Anger displayed, discussion ^b	.44**	-.42**	-.16	—

NOTE: HF-HPV = high-frequency heart period variability; IBI = cardiac interbeat interval, which is the reciprocal of heart rate, and the correlations are approximately equivalent. Thus, correlations for heart rate are not presented in this table.

^a Anger Dysregulation scale of the Meta-emotion Interview.

^b Anger behavior is measured in the number of seconds during which the behavior occurred throughout the 15-min discussion.

* $p < .05$, 2-tailed significance.

** $p < .01$, 2-tailed significance.

Table 3
 Anger Dysregulation Pearson's Bivariate Correlations for Husbands ($N = 54$)

Variable	1	2	3	4
Anger dysregulation ^a	—			
HF-HPV (ln ms ²)	-.05	—		
IBI (ms ²)	-.19	.23	—	
Anger displayed, discussion ^b	.25	-.08	-.06	—

NOTE: HF-HPV = high-frequency heart period variability; IBI = cardiac interbeat interval, which is the reciprocal of heart rate, and the correlations are approximately equivalent. Thus, correlations for heart rate are not presented in this table.

^a Anger Dysregulation scale of the Meta-emotion Interview.

^b Anger behavior is measured in the number of seconds during which the behavior occurred throughout the 15-min discussion.

Table 4

Summary of Hierarchical Regression Analysis for Variables Predicting High-Frequency Heart Period Variability ($K = 54$ couples)

Variable	<i>B</i>	<i>SE B</i>	β
Block 1 (adjusted $R^2 = .23$)			
Couple influence ^a	-.58 (.94) ^b	1.05 (0)	-.07 (.11) [*]
Block 2 (R^2 change = .02)			
Couple influence	-.71 (.93)	1.04 (.01)	-.08 (.11) [*]
Anger dysregulation ^c	-.34	.16	-.28 [*]
Block 3 (R^2 change = .00)			
Couple influence	-.71 (.93)	1.05 (.01)	-.10 (.17) [*]
Anger dysregulation	-.27	.17	-.23
Sex ^d	-.05	.20	-.02
Block 4 (R^2 change = .01)			
Couple influence	-.62 (.92)	1.06 (.01)	-.07 (.11) [*]
Anger dysregulation	-.39	.21	-.33
Sex	-.05	.20	-.02
Anger dysregulation $\times$ Sex	.25	.25	.15
Final model: Intercept = 5.988	$R^2 = .636$	Adj $R^2 = .237$	$R = .798$

^a Couples in the study were dummy coded, and $k-1$ dummy codes were entered (e.g., couple 1 = 1 for the variable couple 1 and 0 if couple identification number did not equal couple 1, etc.).

^b Mean scores and standard deviations for *B*, *SE B*, and β are given for the dummy coding of couple influence because there are 53 values for this dummy-coded variable.

^c z scores used for anger dysregulation.

^d Sex coded 1 if husband and 0 if wife.

^{*} $p < .05$, 2-tailed significance.

Table 5

Summary of Hierarchical Regression Analysis for Variables Predicting Cardiac Interbeat Interval ($K = 54$ couples)

Variable	<i>B</i>	<i>SE B</i>	β
Block 1 (adjusted $R^2 = .31$)			
Couple influence ^a	-76.56 (87.55) ^b	89.17 (0)	-.10 (.11) *
Block 2 (R^2 change = .00)			
Couple influence	-78.65 (86.68)	90.87 (1.18)	-.10 (.11) *
Anger dysregulation ^c	-4.65	14.44	-.04
Block 3 (R^2 change = .01)			
Couple influence	-78.65 (86.66)	90.80 (1.18)	-.10 (.11) *
Anger dysregulation	-4.66	14.43	-.04
Sex ^d	18.03	17.29	.08
Block 4 (R^2 change = .01)			
Couple influence	-72.13 (88.02)	91.43 (1.14)	-.09 (.11) *
Anger dysregulation	-14.86	18.15	-.14
Sex	18.03	17.32	.08
Anger dysregulation $\times$ Sex	20.36	21.95	.13
Final model: intercept = 866.83	$R^2 = .667$	Adj $R^2 = .300$	$R = .816$

^a Couples in the study were dummy coded, and $k-1$ dummy codes were entered (e.g., couple 1 = 1 for the variable couple 1 and 0 if couple identification number did not equal couple 1, etc.).

^b Mean scores and standard deviations for *B*, *SE B*, and β are given for the dummy coding of couple influence because there are 53 values for this dummy-coded variable.

^c z scores used for anger dysregulation.

^d Sex coded 1 if husband and 0 if wife.

* $p < .05$, 2-tailed significance.

Table 6

Summary of Hierarchical Regression Analysis for Variables Predicting Angry Behavior in the Marital Interaction
($K = 54$ couples)

Variable	<i>B</i>	<i>SE B</i>	β
Block 1 (adjusted $R^2 = -.09$)			
Couple influence ^a	3.46 (5.06) ^b	7.76 (0)	.06 (.09)
Block 2 (R^2 change = .07) **			
Couple influence	4.99 (4.81)	7.36 (.1)	.09 (.09)
Anger dysregulation ^c	3.38	1.17	.45 **
Block 3 (R^2 change = .03)			
Couple influence	4.99 (4.81)	7.19 (.09)	.09 (.09)
Anger dysregulation	3.38	1.14	.45 **
Sex ^d	-2.58	1.37	-.17
Block 4 (R^2 change = .02)			
Couple influence	4.11 (4.66)	7.11 (.09)	.07 (.09)
Anger dysregulation	4.81	1.41	.64 **
Sex	-2.58	1.35	-.17
Anger dysregulation $\times$ Sex	-2.86	1.71	-.27
Final model: intercept = .70	$R^2 = .580$	Adj $R^2 = .119$	$R = .762$

^a Couples in the study were dummy coded, and $k-1$ dummy codes were entered (e.g., couple 1 = 1 for the variable couple 1 and 0 if couple identification number did not equal couple 1, etc.).

^b Mean scores and standard deviations for *B*, *SE B*, and β are given for the dummy coding of couple influence because there are 53 values for this dummy-coded variable.

^c z scores used for anger dysregulation.

^d Sex coded 1 if husband and 0 if wife.

** $p < .01$, 2-tailed significance.