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Love, Marriage, and Divorce: Newlyweds' Stress Hormones Foreshadow Relationship Changes

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Neuroendocrine function, assessed in 90 couples during their first year of marriage (Time 1), was related to marital dissolution and satisfaction 10 years later. Compared to those who remained married, epinephrine levels of divorced couples were 34% higher during a Time 1 conflict discussion, 22% higher throughout the day, and both epinephrine and norepinephrine were 16% higher at night. Among couples who were still married, Time 1 conflict ACTH levels were twice as high among women whose marriages were troubled 10 years later than among women whose marriages were untroubled. Couples whose marriages were troubled at follow-up produced 34% more norepinephrine during conflict, 24% more norepinephrine during the daytime, and 17% more during nighttime hours at Time 1 than the untroubled.

Broadly stated, social learning models suggest that disordered communication promotes poor marital outcomes (Bradbury & Carney, 1993). Although communication measures have been linked to marital discord and divorce across a number of studies, the results are inconsistent (Heyman & Slep, 2001; Karney & Bradbury, 1995; Rogge & Bradbury, 1999a, 1999b). Some of the inconsistencies may be a function of researchers' failure to represent marital satisfaction and marital dissolution as different outcomes, each with its own unique risk factors; thus, although communication problems may eventually culminate in divorce, different variables may be important in predicting divorce and marital dissatisfaction, particularly within the early years of marriage (Rogge & Bradbury, 1999a, 1999b). For example, Rogge and Bradbury's (1999b) "two factor" hypothesis suggests that aggression and aggressive tendencies appear to be a key risk factor for early divorces, whereas marital communication contributes to the variability in satisfaction in intact marriages.

The prognostic importance of individual difference variables such as hostility and psychological distress is further highlighted in an alternative to the social learning model: *Enduring vulnerabilities*, the stable demographic, historical, personality, and experiential factors that individuals bring to a marriage, influence a couple's responses to stressful events and, through adaptive processes, to marital quality and marital dissolution (Karney & Bradbury, 1995). Couples with fewer vulnerabilities should have a greater capacity to adapt when they confront stressful circumstances and, thus, should experience better marital outcomes. Although a number of individual difference variables have been associated with poor marital outcomes, psychological distress in the form of negative affectivity or neuroticism has produced the strongest associations (Karney & Bradbury, 1995). Negative affectivity may have particularly potent effects because it likely serves as a surrogate for a constellation of deleterious interpersonal behaviors, particularly those associated with personality disorders (Whisman, 1999).

Trait hostility, another individual difference variable, has also been associated with marital satisfaction (Kiecolt-Glaser & Newton, 2001). Compared with their low-hostile counterparts, high-hostile individuals behave more negatively during marital conflict and demonstrate greater physiological reactivity (Kiecolt-Glaser & Newton, 2001; Smith & Brown, 1991; Smith, Sanders, & Alexander, 1990). Although effects are typically larger for men than women, wives' emotional and physiological functioning is influenced by their husbands' hostility (Kiecolt-Glaser & Newton, 2001).

In addition to the research demonstrating behavioral and trait correlates of marital quality, declines in marital quality may have

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physiological correlates. Among 19 married couples selected on the basis of high or low marital satisfaction, greater autonomic arousal at baseline was associated with larger declines in marital satisfaction 3 years later (Gottman & Levenson, 1985). In other work from the same research team, smaller finger pulse amplitudes (suggesting greater autonomic activation) in wives during conflict were associated with a greater likelihood of marital dissolution 4 years later among 73 couples (Gottman & Levenson, 1992). Four years later 42 of these same couples returned for a second laboratory assessment, and the researchers reported a number of correlations between five autonomic indices measured at study entry and seven behaviors assessed at follow-up (Gottman & Levenson, 1999); these data reflected different patterns of associations for men and women (e.g., in this subset larger finger pulse amplitudes prior to conflict were associated with *greater* stonewalling among women but not men). Because these analyses did not control for the frequency of baseline conflict behaviors, it is unclear if physiology actually enhanced prediction of behavioral change.

Further work from Gottman's laboratory using a sample of 130 newlywed couples suggested that decreases in the husband's heart rate in response to four behavioral sequences during conflict were associated with a lessened probability of divorce 6 years later (Gottman, Coan, Carrere, & Swanson, 1998). These behavioral sequences, characterized as the "physiological soothing" of the husband by himself or his wife, were related to the researchers' escape-conditioning model in which they suggest that diffuse physiological arousal is a greater problem for the husband than the wife and thus a central reason that men are more likely to avoid or withdraw from conflict than women; comparable analyses with wives' data were not presented.

However, a recent literature review concluded that the relationships between physiological change during conflict and negative behaviors were reliably stronger for women than for men, and women's physiological changes following marital conflict showed greater persistence than men's (Kiecolt-Glaser & Newton, 2001). Indeed, these pervasive physiological gender differences likely reflect women's greater sensitivity to negative marital interactions and other relationship events (Kiecolt-Glaser & Newton, 2001). Thus, if physiological change during or after marital conflict is associated with subsequent marital outcomes, wives should show stronger relationships than husbands.

Studies that include physiological measures allow researchers to investigate an additional facet of the marriage experience. It is informative to examine the relationship between physiological functioning and marital outcomes in conjunction with more traditional behavioral and individual difference variables, particularly in view of the close ties between physiology and emotion. This approach would provide the foundation for a more integrated model of marital quality and stability.

Samples of newlywed couples typically start with a low incidence of marital distress and thus provide an excellent, homogeneous sample for examining the factors that lead to maintenance or declines in satisfaction (Karney & Bradbury, 1995). In fact, declines in self-rated marital quality appear to be a stable response to the first year or two of marriage (Markman, 1981). For some couples this drop is dramatic; about a third of divorces occur within the first 4 years of marriage (Kurdek, 1991). Accordingly, in this article we describe predictors of marital dissolution and satisfaction from a 10-year follow-up of 90 newlywed couples. The original selection requirements for this sample make them particularly valuable for study: We had stringent inclusion criteria that eliminated couples in which either spouse had current or past mental or physical health problems (Kiecolt-Glaser et al., 1993, 1996; Malarkey, Kiecolt-Glaser, Pearl, & Glaser, 1994). As one consequence, our participants were very low on negative affectivity, the personality dimension most strongly associated with adverse marital changes (Karney & Bradbury, 1995).

The rigorous multistage recruitment of these newlyweds was designed to minimize extraneous factors that might affect physiological functioning. In prior data from this cohort, conflict clearly altered physiological functioning, and negative or hostile behavior during conflict markedly enhanced physiological change, with stronger and more persistent associations between physiology and behavior for women than men (Kiecolt-Glaser et al., 1993, 1996; Malarkey, Kiecolt-Glaser, Pearl, & Glaser, 1994). We used this well-characterized sample to examine factors associated with poor marital outcomes.

Our hypotheses were based on the premise that marital satisfaction and dissolution represent different outcomes; following prior work, better communication and problem-solving behavior assessed early in marriage should be linked to subsequent marital satisfaction, with aggression and aggressive tendencies showing stronger links to divorce within the first 4 years of marriage (Rogge & Bradbury, 1999a, 1999b). Among couples who were still married, we anticipated that lower initial marital satisfaction and poorer problem-solving behaviors would be associated with larger longitudinal declines in marital satisfaction, with stronger relationships for wives than husbands. We also investigated the contributions of enduring vulnerabilities (the stable demographic, historical, personality, and experiential factors that individuals bring to a marriage) that influence a couple's responses to stressful events and, through adaptive processes, to marital quality and marital dissolution (Karney & Bradbury, 1995); greater negative affect, aggressiveness, and hostility were expected to be associated with a greater likelihood of divorce, as well as with lower marital satisfaction in intact couples. Finally, we hypothesized that higher levels of stress hormones during and following the problem-solving interaction would also be associated with both greater marital instability and lower marital satisfaction at follow-up, with stronger relationships for women than men.

Method

Participant Selection

Immunological, endocrinological, autonomic, behavioral, and self-report data were collected from 90 newlywed couples during a 24-hr admission to the Ohio State Clinical Research Center (CRC), a hospital research unit. The stringent selection criteria and the three-stage process that were used for screening and recruitment are described in detail elsewhere (Kiecolt-Glaser et al., 1993). Importantly, we used the Structured Clinical Interview for *DSM–III–R*, Nonpatient version (SCID-NP) to eliminate participants who had met *Diagnostic and Statistical Manual of Mental Disorders* (3rd ed., rev.; *DSM–III–R*; American Psychiatric Association, 1987) criteria for any psychotic diagnosis, any depressive or anxiety disorder other than simple phobia, or substance abuse. These criteria were designed to exclude previously impaired or vulnerable individuals whose psychopathology might produce marital discord (Whisman, 1999), as well as associated endocrinological or immunological alterations. Psychopathology in first-

degree relatives was assessed using Family History Research Diagnostic Criteria (Andreasen, Endicott, Spitzer, & Winokur, 1977), a method that has good to excellent reliability for specific disorders (Zimmerman, Coryell, Pfohl, & Stangl, 1988).

The sociodemographic characteristics of our final sample were as follows: The average age of wives and husbands was 25.21 (*SD* = 3.01) and 26.13 (*SD* = 3.05), respectively, with a range from age 20 to 37. Couples were well-educated: 6.1% were high school graduates, 23.3% had some college training, 53.3% were college graduates, and 17.2% had additional postgraduate training. The average couple's combined income was $43,464 (*SD* = $16,739). The majority was Caucasian (95%). Couples dated an average of 36.58 months (*SD* = 25.32 months) before marriage, and 55 couples (61.11%) lived together before marriage. An average of 10.44 months (range: 6–14 months) elapsed between their marriage and their CRC admission.

Time 1: First Year of Marriage

Participants were admitted to the CRC at 7:00 A.M., and a heparin well was inserted in each participant's arm. After the 1.5-hr adaptation period following insertion of the heparin well, participants were positioned in chairs facing each other in front of a curtain. The couples completed several questionnaires and then sat quietly for 10 min.

Interviews. At the end of the baseline period, a research assistant conducted a brief interview to help identify the best topics for the problem discussion. On the basis of this interview and the couples' independent ratings of their disagreements about common relationship issues (e.g., in-laws, finances, leisure time), couples were asked to discuss and to try to resolve the two or three marital issues that the interviewer judged to be the most conflict producing. During the 30-min problem discussion that followed immediately, the research team remained out of sight behind a curtain.

Blood-sampling protocol. For frequent, unobtrusive endocrine sampling during the interaction tasks, a long polyethylene tube was attached to the heparin well, allowing nurses to draw blood samples at set intervals, out of participants' sight. Approximately 90 min after the heparin well had been inserted, participants were asked to sit quietly for 10 min in the chairs used for interviews, after which baseline blood samples were drawn. During the marital interaction tasks the couples were seated facing each other in front of a curtain, with the polyethylene tubes easily accessible to two nurses who sat behind the curtain. At the end of the 10–20-min interview, and immediately before the 30-min problem-solving or conflict task, the second blood sample was drawn; the third and fourth samples were drawn 15 min after conflict began and again at the end of the 30-min conflict task. The fifth blood sample was drawn at the end of a 15-min recovery period following the end of the problem-solving discussion.

In addition to individual blood samples drawn during interviews, aliquots of additional blood samples acquired hourly from 8:00 A.M. through 10:00 P.M. were pooled to provide composite samples for daytime values (and 11:00 P.M. through 7:00 A.M., nighttime values) for the four stress hormones (epinephrine [EPI], norepinephrine [NEPI], cortisol, and ACTH), using assay methods described previously (Malarkey et al., 1994). Although individual analyses of these 24 hourly samples would have provided interesting data on changes over 24 hr, the cost was prohibitive. Moreover, these pooled samples provided desirable information on tonic levels of stress hormones, augmenting our prior data on "phasic" or acute changes; chronic stimulation of stress hormones at lower levels has clear links to pathology (Seeman & Robbins, 1994).

Cardiovascular reactivity. The couples had no further experimental tasks following completion of the morning interviews until 5:00 P.M. when we assessed cardiovascular reactivity during 2-min mental arithmetic serial subtraction tasks. Following a 2-min baseline, each member of the couple performed serial subtraction while the spouse was outside the room. Cortronics 7000 units provided continuous assessments of heart rate and blood pressure.

Behavioral data. The Marital Interaction Coding System-IV (MICS) provided data on problem-solving behaviors during the 30-min marital conflict task (Weiss & Summers, 1983). The videotapes were coded by the Oregon Marital Studies Program (OMSP) under the direction of Robert L. Weiss. A number of studies have shown that the MICS discriminates well between happy and unhappy couples, and marital therapy studies have shown changes in MICS-coded behaviors from pre- to posttreatment (Sayers, Baucom, Sher, Weiss, & Heyman, 1991). Following OMSP coding conventions, each coder maintained code-by-code agreement with a master coder of at least 70% on a random sample of 20% of the tapes. Tapes were recoded when agreement fell below this criterion.

For these follow-up analyses, we focused on the relative frequency of positive behaviors (e.g., agreeing, approving, and positive mind reading), negative or hostile behaviors (e.g., criticizing, disagreeing, interrupting), and negative reciprocity, a behavioral sequence characterized by negative behavior of one partner followed by negative behavior of the spouse, a tit-for-tat chain; these have been related to marital dissolution and satisfaction (Markman, 1981; Notarius, Benson, Sloane, Vanzetti, & Hornyak, 1989; Notarius, Krokoff, & Markman, 1981; Weiss & Heyman, 1990; Weiss & Summers, 1983) and were key sequences in our earlier reports from this cohort. For greater detail concerning the rationale for combining codes, see Kiecolt-Glaser et al. (1993).

Psychological assessment. The Marital Adjustment Test (MAT), administered during the initial telephone screening interview and at follow-up (Locke & Wallace, 1959), is widely used in marital research because of its reliability and validity in discriminating satisfied and dissatisfied couples. Lower scores indicate lower marital satisfaction. A separate question asked participants to estimate how much time they spent talking to their spouse on a daily basis.

The 27-item revised Social Support Questionnaire (SSQ) provides a way to separate the support provided by the spouse from support provided by other people (Sarason, Levine, Basham, & Sarason, 1983). Each item asks participants to list the people to whom they can turn and/or on whom they can rely in a given circumstance and also asks them how satisfied they are with each of these supports.

The Profile of Mood States (POMS), one of the best self-report measures for identifying and assessing transient, fluctuating moods, was administered at baseline before the interviews began and at the end of the conflict task (McNair, Lorr, & Dropelman, 1981). The POMS has excellent norms and psychometrically is very strong in terms of both reliability and validity (McNair et al., 1981); we were particularly interested in changes on the Hostility and Depression subscales.

The Cook–Medley Hostility Scale (Ho) provided a measure of trait hostility (Cook & Medley, 1954). Higher Ho scores have been associated with more frequent marital conflict, as well as with more hostile behavior during marital conflict (Smith & Brown, 1991; Smith & Christensen, 1992). Our sample's mean was 15.23 (*SD* = 6.79), with a Kuder–Richardson of .81.

High scorers on the Marlowe-Crowne Social Desirability Scale tend to describe themselves in unrealistically positive ways on self-report measures (Crowne & Marlowe, 1960). The Kuder-Richardson was .77.

The Personality Diagnostic Questionnaire—Revised (PDQ–R; Hyler, Skodol, Oldham, Kellman, & Doidge, 1992), a 133-item true-false self-report questionnaire, was designed as a screening instrument to assess *DSM–III–R* personality disorders. The PDQ–R has high sensitivity and moderate specificity for Axis II disorders, even in samples with low base rates (Hyler et al., 1992).

The Conflict Tactics Scale (CTS) provided self-report data on psychological and physical aggression during conflicts with the partner (Straus, 1979). Spouses were asked to report the frequency for each behavior during the past year on a 7-point scale with options from 0 (*never*) to 6 (*more than 20 times*). Although each person described his or her own behavior, not that of the partner, other researchers have reported good interpartner agreement on physical aggression (O'Leary et al., 1989).

Ten-Year Follow-Up

Obtaining follow-up data. At the time of follow-up, participants in the study had not been contacted for 7 to 10 years. We first searched county records for divorces. Next, letters mailed to remaining couples at their last known address offered each spouse $50 for completion of short questionnaires either through a phone interview or at a web site; if divorced, they could each receive $10 by independently providing the date of divorce. Couples were invited to call, to e-mail, or to visit the web site; they were told that we would initiate a call if we did not hear from them to inquire about their interest. Internet searches for addresses and phone numbers provided additional information.

At Time 1 couples had provided names, addresses, and phone numbers of three people who would likely know their whereabouts in the future. When other search methods had failed, the letters mailed to these individuals mentioned that they had been named as a contact person during a research project (not described); they were asked to forward a sealed letter addressed to the couple. Social security numbers, needed to process payment, provided a means to verify identities of respondents.

Seventeen couples were divorced at follow-up. This follow-up occurred an average of 9.56 years ($SD = 0.63$, range: 8.43–10.89) after the first CRC visit or 10.43 ($SD = 0.61$) years after the couples' weddings. The mean time between the wedding and the divorce was 45.53 months ($SD = 27.10$, range: 18–103). In accord with other research, we found that 11 of the 17 divorces occurred within the first 4 years of marriage (Karney & Bradbury, 1995).

Follow-up measures. Through these means we ascertained marital status for 100% of the original sample and collected follow-up MAT data and an estimate of the average daily time spent talking to the spouse from all of the 144 participants who were still married. One couple who had been separated for over a year and who were in the process of finalizing their divorce were included among the 34 divorced individuals (19% of the original sample); 1 woman had died.

Data Analyses

Our data analyses addressed potential correlates of marital dissolution and quality in three domains: (a) individual differences (corresponding with the enduring vulnerabilities model), (b) behavior during marital conflict (corresponding with the social learning model), and (c) endocrine function during and after marital conflict. A final set of analyses addressed the relative importance of the three areas in predicting degree of marital satisfaction among intact couples at follow-up.

Similar to previous approaches to marital outcome, we treated marital satisfaction and marital dissolution as different outcomes (Rogge & Bradbury, 1999a, 1999b). Following the two-factor hypothesis (Rogge & Bradbury, 1999b), we first assessed differences between intact and dissolved marriages. Next, we conducted analyses that examined couples' marital satisfaction in those participants who were married at both points in time. In each case, we first evaluated sociodemographic variables, followed by key individual difference variables that have been important predictors across other similar studies (Karney & Bradbury, 1995). Subsequent analyses address communication and problem-solving behaviors observed during the conflict resolution task. A final series of analyses examined relationships between stress hormones and marital outcomes. On occasion, the sample size for analyses show lower numbers because of missing data within a particular assay or measure.

Repeated assessments of mood and endocrine responses were analyzed with multivariate analyses of variance (MANOVAs) as a multivariate approach to repeated measures. Simple effects were analyzed with MANOVAs and univariate analyses of variance (ANOVAs) when appropriate, using within-group variability of only those observations involved in each effect as a conservative test of the simple effects. Hormone analyses included participant as the unit of analysis. Thus, these analyses included change across the five time points during and after conflict as a within-subjects variable, whereas gender and group (married vs. divorced or satisfied vs. dissatisfied) were analyzed as between-subjects variables.

Other analyses were conducted using couple as the unit of analysis (i.e., gender was treated as a within-dyad variable) on the basis of the fact that the interactional behaviors were interdependent (Notarius et al., 1981). For the group comparisons presented in Tables 1 and 2, behavioral data from the MICS were analyzed using MANOVAs with gender as a within-dyad factor; because base rates are percentages, they were transformed using an arcsine square root (Notarius et al., 1981). Similarly, data from the MAT, the CTS, the Ho scale, and the self-reported daily talk time were analyzed with gender as a within-dyad factor because of the possibility of spousal influence.

ELAG, a sequential analysis program (Bakeman, 1983), was used to assess lag 1 behavioral sequences across the 30-min conflict. Positive z statistics indicate that the criterion behavior increases or facilitates the likelihood of the target behavior, whereas negative z statistics indicate that the behavior decreases the likelihood of the target behavior.

Results

Divorced Versus Married Couples

Enduring Vulnerabilities Model

Sociodemographic data. The 17 couples who divorced did not differ at Time 1 from the 72 who remained married on age at marriage or income, Fs < 1, and Hollingshead-coded education and race were similarly unrelated to subsequent marital status. The married and divorced couples did not differ in the length of time they had dated before marriage, $F < 1$, or whether they had lived together before marriage, $\chi^2(1, N = 89) = 2.78$, $p = .10$.

Marital satisfaction, social support, and talk time. Marital satisfaction at Time 1 did not distinguish between those who divorced and those who remained married, and the Gender $\times$ Group interaction was also nonsignificant, Fs < 1; MAT means and other self-report data are provided in Table 1. Similarly, satisfaction with nonmarital relationships (as measured by the SSQ) did not demonstrate either a significant group difference or a Group $\times$ Gender interaction, Fs < 1.

Because data for self-reported daily talk time were not distributed normally, they were log (base 10) transformed prior to analysis. Talk time at Time 1 did not significantly differ between couples who later divorced and those who were still married at follow-up, $F < 1$. There was no effect of gender and no effect of Marital Status $\times$ Gender on talk time.

Affect, mood changes, and personality. Mood measures provided no evidence of reliable group differences (Table 1). Data from the POMS Hostility and Depression subscales were unrelated to subsequent marital status, to Marital Status $\times$ Gender, or to Marital Status $\times$ Time $\times$ Gender, Fs < 1.62.

Personality data did not distinguish between those whose marriages endured and those who divorced. Although men had higher trait hostility (Ho) scores than women, $F(1, 169) = 21.97$, $p < .001$, neither group nor Group $\times$ Gender interaction was significant, Fs < 1. Groups did not differ significantly on the total symptom score on the PDQ–R, $F(1, 169) = 2.34$, and the Gender $\times$ Group interaction was nonsignificant as well, $F < 1$. Time 1 social desirability differences between those who were married and divorced at follow-up were not significant, $F(1, 170) = 3.19$, $p = .08$.

CTS. A MANOVA that included both the Verbal Aggression and Physical Violence subscales for both husband and wife

Table 1
Mean (Standard Deviation) Self-Report Data by Marital Stability and Marital Satisfaction

	Marital stability		Marital satisfaction	
Questionnaire	Married (n = 144)	Divorced (n = 34)	Dissatisfied (n = 26)	Satisfied (n = 118)
MAT, Time 1**	128.64 (14.28)	125.97 (15.96)	119.04 (17.80)	130.75 (12.51)
MAT, 10-year follow-up***	122.94 (21.25)	—	92.27 (23.10)	129.70 (13.51)
SSQ, nonspouse support satisfaction, Time 1	493.01 (245.61)	540.86 (300.07)	416.14 (182.69)	509.64 (254.83)
POMS Depression, Time 1****				
Before conflict	40.94 (3.84)	40.03 (2.78)	42.69 (4.46)	40.55 (3.60)
After conflict	39.36 (3.54)	38.68 (2.24)	40.62 (3.37)	39.09 (3.54)
Next morning	38.49 (2.93)	39.06 (4.44)	38.19 (2.10)	38.56 (3.09)
POMS Hostility, Time 1****				
Before conflict	45.00 (6.41)	44.85 (6.46)	49.12 (8.91)	44.09 (5.35)
After conflict	40.83 (5.60)	39.74 (3.22)	42.19 (6.91)	40.53 (5.26)
Next morning	39.76 (5.18)	40.29 (8.41)	38.77 (2.49)	39.98 (5.58)
PDQ–R, total symptoms, Time 1*	18.53 (9.46)	21.38 (10.53)	22.27 (10.13)	17.67 (9.13)
Social desirability, Time 1**	17.68 (5.27)	15.91 (4.92)	15.31 (5.44)	18.22 (5.11)
Trait hostility, Time 1	15.39 (6.67)	14.36 (7.24)	16.54 (6.76)	15.13 (6.65)
CTS Verbal Aggression, Time 1**	7.17 (5.61)	9.18 (5.02)	9.77 (6.98)	6.59 (5.12)
CTS Physical Violence, Time 1	0.58 (1.82)	0.65 (1.57)	0.73 (2.20)	0.55 (1.73)

Note. Separate analyses were conducted for marital stability and marital satisfaction groups; divorced and intact marriages did not differ on any of these measures listed above. MAT = Marital Adjustment Test; SSQ = Social Support Questionnaire; POMS = Profile of Mood States; PDQ–R = Personality Diagnostic Questionnaire—Revised; CTS = Conflict Tactics Scale. A dash indicates data were not available.
Intact marriages, satisfied vs. dissatisfied, * $p < .05$. ** $p < .01$. *** $p < .001$. **** $p < .001$ (Group × Time interaction; subsequent analyses showed differences before conflict for both depression and hostility, $p < .01$).

showed a Group × Gender interaction that approached significance, $F(1, 86) = 3.20$, $p = .08$, with greater aggression shown among the couples who were divorced at follow-up than those who were married and with larger differences for men than women. A subsequent planned comparison using only divorced participants divided the cohort into two groups, the 11 who divorced within the 4 years and the remaining 6 couples; consistent with prior work (Rogge & Bradbury, 1999b), those who divorced earlier reported more aggressive behavior than those who divorced later, $F(1, 15) = 4.39$, $p = .05$.

Social Learning Model: MICS-Coded Behaviors During Conflict

Although there was no main effect of marital status on negative reciprocity, $F < 1$, the Marital Status × Gender interaction reflected differences in negative reciprocity between married and divorced groups for men but not for women. Specifically, there were significantly higher rates of negative reciprocity (Table 2) among men who divorced than among those who remained married, $F(1, 87) = 15.53$, $p < .001$, without a main effect for marital

Table 2
Mean (Standard Deviation) MICS-Coded Behavioral Data at Time 1 by Marital Stability and Marital Satisfaction

	Marital stability		Marital satisfaction	
Behavior	Married (n = 144)	Divorced (n = 34)	Dissatisfied (n = 26)	Satisfied (n = 118)
Negative behaviors[a]				
Wife	0.47 (0.16)	0.53 (0.17)	0.56 (0.27)	0.46 (0.14)
Husband	0.43 (0.15)	0.48 (0.15)	0.50 (0.18)	0.41 (0.13)
Positive behaviors				
Wife	0.73 (0.19)	0.64 (0.15)	0.76 (0.27)	0.72 (0.17)
Husband	0.73 (0.16)	0.69 (0.15)	0.69 (0.17)	0.74 (0.16)
Negative reciprocity (z score)[b]				
Husband negative/wife negative	−0.09 (1.43)	−0.61 (1.03)	0.16 (1.60)	−0.14 (1.39)
Wife negative/husband negative	−0.30 (1.18)	0.70 (1.80)	−0.11 (1.29)	−0.31 (1.17)

Note. Separate analyses were conducted for marital stability and marital satisfaction groups. MICS = Marital Interaction Coding System—IV.
[a] $p < .05$, Intact marriages, satisfied versus dissatisfied. [b] $p < .05$. Marital stability, married versus divorced couples, Group × Gender interaction. Husband negative/wife negative refers to the propensity of the wife to respond in kind to the husband's negativity, whereas wife negative/husband negative is the opposite.

status, $F < 1$. There was no difference between divorced and married couples in negative behaviors, $F(1, 87) = 2.18$, $p = .11$, and no other effects involving gender and marital status on negative behaviors were significant, Fs < 1.11. Analysis of positive behaviors showed no significant effect of marital status, $F(1, 87) = 2.98$, $p = .09$. In addition, gender and Group × Gender interaction effects were not significant, Fs < 1.10.

Hormone Changes

Hormone changes during conflict. Although at Time 1 we initially drew blood for endocrine analyses only at the beginning and end of the conflict discussion, we began taking more frequent endocrine samples after we had already collected data from the first 10 couples in this study. Thus, the sample size for the analyses reported below is 158 (79 couples), with lower numbers on occasion because of missing data within a particular assay.

Analysis of EPI data (see Figure 1A) showed significantly higher levels at Time 1 in the divorced group than in those who remained married, $F(1, 155) = 4.27$, $p = .04$. Men had higher levels than women, $F(1, 155) = 13.30$, $p < .001$. The interactions between Group × Gender, Group × Time, and Group × Gender × Time were all nonsignificant, Fs < 1.31.

In contrast, the divorced and married groups did not differ on NEPI (see Figure 1B), and the Group × Time interaction was not significant, $F(4, 135) = 1.83$, $p = .13$. Effects were all nonsignificant for gender, Group × Gender, and Group × Gender × Time interactions, Fs < 1.

ACTH (see Figures 2A, 2B) showed a reliable interaction between Group × Gender, $F(1, 109) = 4.07$, $p < .05$. Simple effects analyses indicated that divorced women had marginally higher ACTH levels than married women, $F(1, 53) = 3.06$, $p < .10$, whereas divorced and married men did not differ in ACTH, $F(1, 56) = 1.19$. In addition, there was a significant interaction between Gender × Change over time, $F(4, 109) = 3.16$, $p < .05$. Women showed no significant change in ACTH over time, $F(1, 53) = 1.25$. There was a significant change in ACTH over time for men, $F(1, 56) = 9.38$, $p < .05$. Specifically, men's postdiscussion ACTH levels were significantly higher than their baseline and beginning of conflict levels, $F(1, 56) = 9.38$.

Cortisol decreased over the five sample points, reflecting the normal diurnal fall from the early morning peak, $F(4, 134) = 17.41$, $p < .001$. We did not find a significant difference between marital outcome groups, $F(1, 137) = 1.24$, $p = .25$. There were no significant interactions between Group × Gender, $F(1, 137) = 2.02$, $p = .16$. In addition, there were no significant effects involving gender, group, and the pattern of cortisol changes with time, $F < 1$.

Daytime and nighttime hormones. A further series of endocrine analyses assessed group differences in blood samples acquired hourly at Time 1 from 8:00 a.m. through 10:00 p.m. and 11:00 p.m. through 7:00 a.m. that provided composite daytime and night values for each of the hormones. Technical problems with serial blood draws, storage of endocrine samples, or endocrine assays led to missing data in several cases. We excluded cortisol data from 1 woman who fell more than 4 *SD*s above the women's mean for daytime cortisol.

Divorced individuals had significantly higher daytime and nighttime EPI levels at Time 1 than did those who remained married, $F(1, 155) = 4.27$, $p < .05$ (see Figure 3A). Nighttime values were reliably lower than daytime samples, $F(1, 155) = 66.20$, $p < .001$, as expected. In addition, men had higher values than women, $F(1, 155) = 13.30$, $p < .001$, without significant Group × Gender, Group × Time, or Group × Gender × Time interactions, Fs < 1.40.

Analysis of Time 1 NEPI data (see Figure 3B) showed a significant decline in the evening, $F(1, 158) = 150.00$, $p < .001$. The Group × Time interaction reflected the fact that although divorced and married groups did not differ during the daytime, divorced individuals had significantly higher nighttime values, $F(1, 158) = 4.19$, $p < .05$. All remaining effects were nonsignificant, Fs < 1.

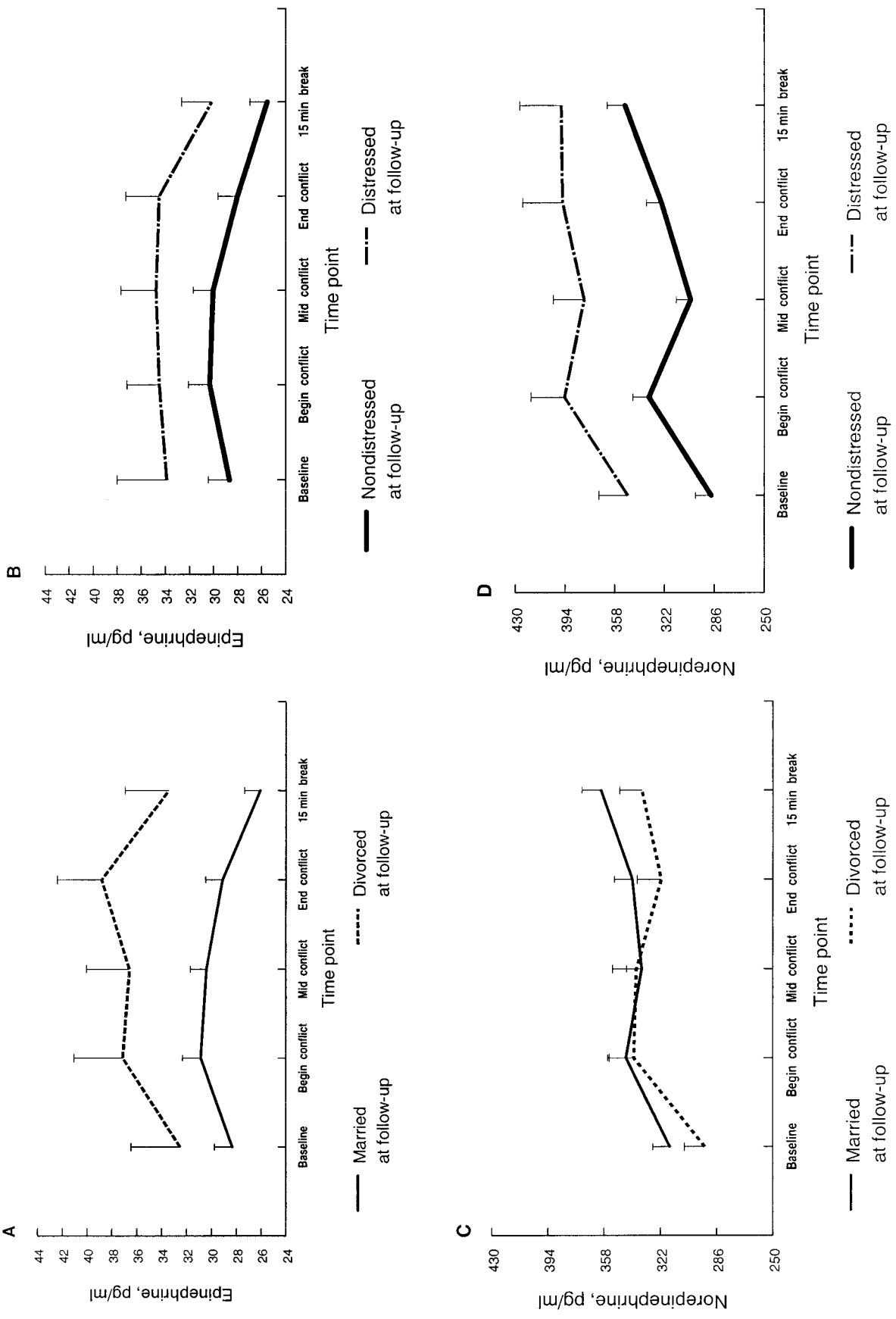
Additional analyses showed significant diurnal change as expected for cortisol, $F(1, 169) = 25.89$, $p < .001$. There were no significant main effects or interactions associated with the divorced versus still married group for cortisol or ACTH, Fs < 1.

Health-related behaviors, cardiovascular reactivity, and family history. Further analyses assessed the possibility that the relationships between subsequent marital status and endocrine function might simply reflect the contribution of Time 1 health habits. Alcohol intake did not differ between married and divorced individuals at Time 1, nor was the Gender × Group interaction significant, Fs < 1.31. However, individuals who subsequently divorced exercised significantly more than those who remained married, $F(1, 174) = 3.89$, $p < .05$, with a mean of 6.53 hr ($SD = 8.34$ hr) per week reported by the former and 4.45 hr ($SD = 4.69$ hr) for the latter. Inclusion of exercise as a covariate in the endocrine analyses did not alter previous significant findings.

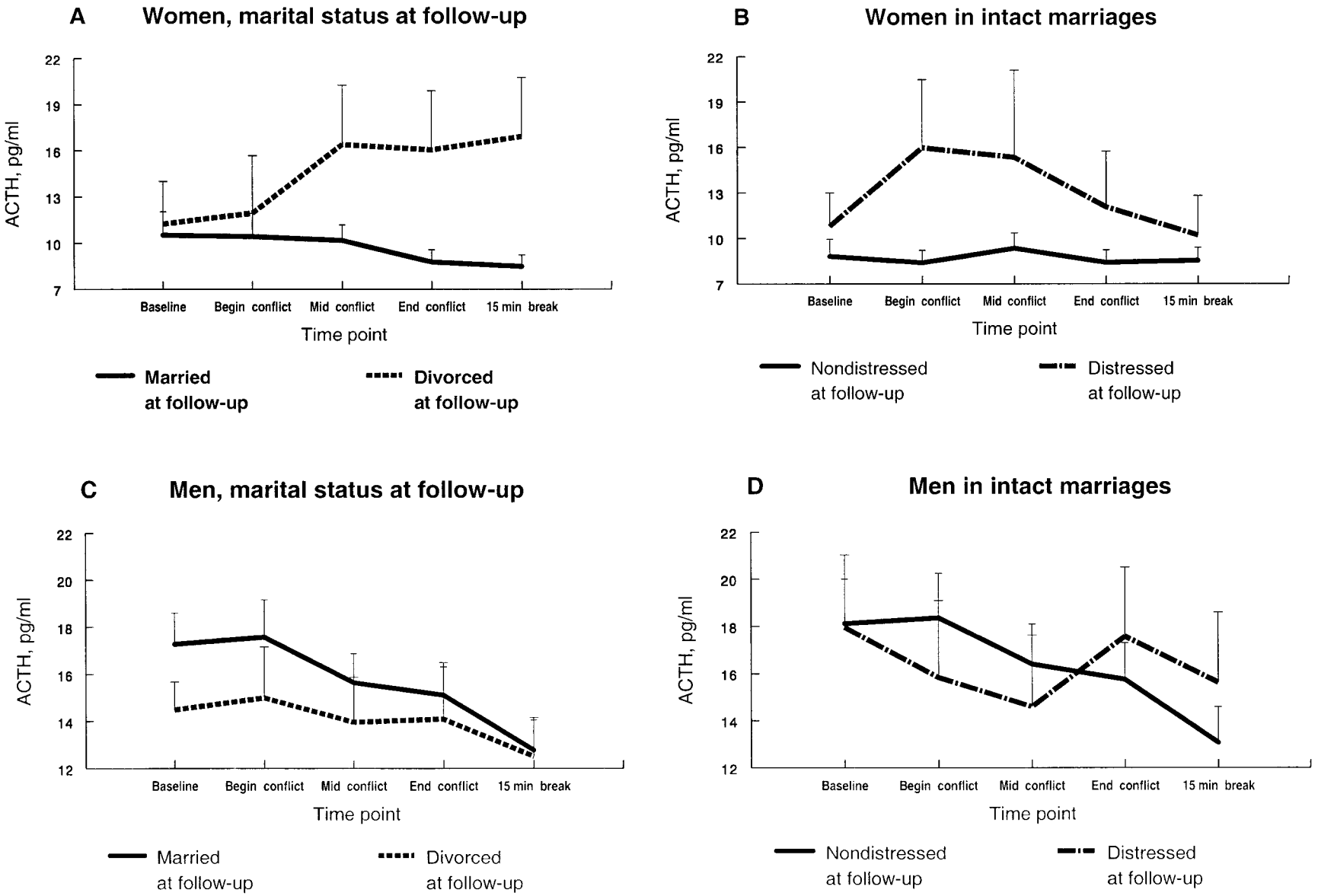
The groups did not differ on the baseline data collected for the cardiovascular reactivity task in the late afternoon, with all Fs < 1 for heart rate, diastolic blood pressure (DBP), and systolic blood pressure (SBP). Similarly, compared with those whose marriages survived, individuals who subsequently divorced did not show even marginal differences in change on any of these indices during mental arithmetic, all Fs < 1 for both main effects and Group × Gender interactions; the math task produced the expected significant increases across heart rate, SBP, and DBP, ps $< .01$. Thus, the group differences in hormones did not appear to be related to underlying stable individual differences in cardiovascular reactivity (Fredrikson, Tuomisto, & Bergman-Losman, 1991; Kiecolt-Glaser, Cacioppo, Malarkey, & Glaser, 1992).

Because individuals with a parental history of hypertension may show exaggerated catecholamine and cortisol responses to psychological stressors (Fredrikson et al., 1991), we used participants' medical history forms to assess the possibility that differences in these hormones might reflect underlying genetic differences. The presence or absence of a history of parental hypertension was not related to subsequent marital status for women, $\chi^2(1, N = 89) < 1$, or men, $\chi^2(1, N = 89) = 2.08$.

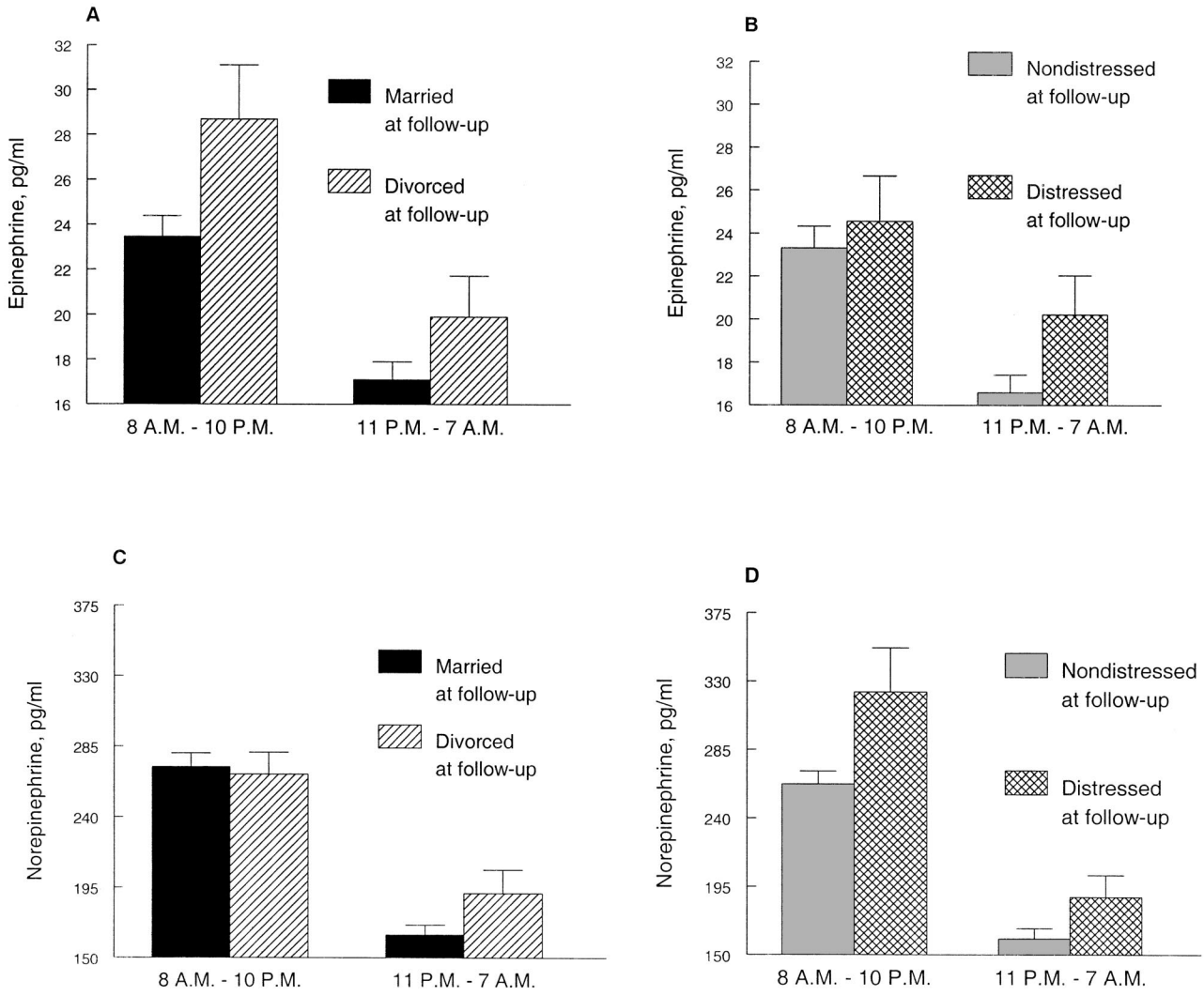
Marital dissatisfaction is clearly associated with psychiatric disorders, particularly depression (Whisman, 1999); moreover, depression is also associated with alterations in hormones (Rose, 1984). Although genetic liabilities clearly predispose individuals to major depression, recent data from a twin study suggested that genetic liabilities also enhance risk for the elicitation, or perception, of low levels of spousal support (Wade & Kendler, 2000). Thus, we used Time 1 data to assess the possibility that marital



Figures 1A–D. Time 1 mean (± SEM) epinephrine (upper panels) and nonepinephrine (lower panels) levels before, during, and after the marital conflict discussion that occurred in the first year of marriage for participants who were married or divorced at the 10-year follow-up (left side), as well as similar data among couples who were still married 10 years later and classified as distressed or nondistressed based on their follow-up Marital Adjustment Test scores (right side).



Figures 2A–D. Time 1 mean (± SEM) ACTH levels during a marital problem discussion that occurred in the first year of marriage in women and men who eventually divorced compared to those who were still married 10 years later (right side), as well as similar data among men and women who were still married 10 years later and classified as distressed or nondistressed based on their follow-up Marital Adjustment Test scores (right side).



Figures 3A–D. Time 1 mean (± SEM) daytime and nighttime epinephrine (upper panels) and norepinephrine (lower panels) levels in the first year of marriage for participants who were married or divorced at the 10-year follow-up (left side), as well as similar data among couples who were still married 10 years later and classified as distressed or nondistressed based on their follow-up Marital Adjustment Test scores (right side).

differences might reflect genetic influences. The presence or absence of psychiatric disorders in first-degree relatives was not related to subsequent marital status for men, $\chi^2(1, N = 89) < 1$, or women, $\chi^2(1, N = 89) = 1.79$.

Marital Satisfaction in Intact Marriages: Couples' Follow-Up Satisfaction as the Criterion

We next examined the three types of potential correlates of marital quality among those couples who were still married at follow-up. MAT scores at the 10-year follow-up ranged from 44 to 158, with a mean of 123.01 ($SD = 20.45$) and did not differ between the 78 who completed the questionnaires in a phone interview and those who completed them on a web form, $F(1, 142) = 0.18$. The mean change between follow-up and Time 1 was 5.63 ($SD = 19.38$), with a range from −43.0 to 82.0.

Following the procedure used by others (Rogge & Bradbury, 1999b), we classified couples as dissatisfied at follow-up if either spouse scored below 100 on the MAT. Using this criterion, we found 13 couples (18% of the follow-up sample) were dissatisfied. Application of the same criteria to Time 1 MAT scores produced 6 couples who were dissatisfied at Time 1; of those, 1 was divorced, 3 were still categorized as dissatisfied, and 2 were now satisfied. There were no Time 1 differences on age or income, Fs < 1, or race or education, $\chi^2(1, N = 72) < 2.94$, between those who were satisfied and those who were dissatisfied at follow-up.

Enduring Vulnerabilities Model

Marital satisfaction, social support, and talk time. Marital satisfaction at Time 1 was significantly higher among those couples who were satisfied at the 10-year follow-up than among those

who were dissatisfied, $F(1, 71) = 9.62$, $p < .01$; although the difference between men and women approached significance, with higher values for women, $F(1, 71) = 3.61$, $p = .06$, the Gender × Group interaction was nonsignificant, $F(1, 71) = 1.26$; MAT means and other self-report data are provided in Table 1. Satisfaction with nonspouse support (from the SSQ) did not produce a significant group difference, $F(1, 131) = 3.04$, or Group × Gender interaction, $F < 1$.

Analyses of changes in log-transformed self-reported talk time at follow-up demonstrated a significant group difference, $F(1, 65) = 4.04$, $p < .05$, with satisfied couples ($M = 2.03$, $SD = 0.42$) talking more per day than dissatisfied couples ($M = 1.90$, $SD = 0.42$). Husbands reported talking to their wives more ($M = 2.02$, $SD = 0.46$) than wives reported talking to their husbands ($M = 1.99$, $SD = 0.41$), $F(1, 65) = 59.76$, $p < .001$. The Group × Gender × Time interaction, $F(1, 65) = 6.51$, $p < .05$, reflected no Group × Gender interaction at Time 1, $F(1, 65) = 1.45$, but showed a marginally significant Group × Gender interaction at the 10-year follow-up, $F(1, 65) = 3.50$, $p = .06$. At the 10-year follow-up, men in satisfied relationships reported talking to their spouses significantly more than men in dissatisfied relationships, $F(1, 65) = 7.02$, $p < .01$. In contrast, women in satisfied and dissatisfied relationships did not report differences in talk time at the 10-year follow-up, $F < 1$. To provide a frame of reference, the raw (untransformed) means for satisfied couples were 185.45 min at baseline and 98.65 min at follow-up, whereas the respective values were 156.92 min and 76.52 min among dissatisfied couples.

Affect, mood changes, and personality. Mood changes on the POMS assessed before and after conflict and again the following morning differed as a function of marital satisfaction at follow-up (Table 1). Data from the Hostility, $F(1, 140) = 4.34$, $p < .04$, and Depression scales, $F(1, 140) = 3.92$, $p < .05$, showed greater mood disturbance in the dissatisfied couples than among the satisfied, with significant Group × Time interactions in each case that reflected the largest differences between groups on entry into the CRC, ps $< .001$; simple effects analyses showed differences before conflict for both depression and hostility (ps $< .01$).

Similarly, some personality data distinguished couples who differed in marital satisfaction at the 10-year follow-up (Table 1). Members of dissatisfied couples had higher total symptom scores on the PDQ–R, $F(1, 135) = 5.11$, $p < .05$, and lower social desirability scores, $F(1, 136) = 6.81$, $p < .01$, than their satisfied contemporaries. In contrast, trait hostility (Ho) did not distinguish groups, and the Group × Gender interaction was similarly negligible, Fs < 1.

CTS. A MANOVA with the Verbal Aggression and Physical Violence subscales for both husband and wife showed a Group × Gender interaction, $F(1, 70) = 5.96$, $p < .02$. These data reflected greater aggression during the first year of marriage among the couples who were dissatisfied at follow-up than among those who were satisfied, and this difference was larger for men than women. Subsequent analyses by scale demonstrated differences in Verbal Aggression, $p < .01$, but not in Physical Violence.

Social Learning Model: MICS-Coded Behaviors During Conflict

Negative behaviors during the Time 1 conflict were higher in couples who were dissatisfied at the 10-year follow-up than they were among the satisfied (Table 2), $F(1, 71) = 4.86$, $p < .04$. Neither positive behaviors nor negative reciprocity produced significant differences between groups or Group × Gender interactions, Fs < 2.54.

Hormone Changes

Hormone changes during conflict. Analysis of EPI data from the Time 1 conflict showed no significant difference between those who were in satisfactory and those who were in unsatisfactory marriages at the 10-year follow-up, $F(1, 110) = 1.97$ (see Figure 1C). The interactions between Group × Gender, Group × Time, and Group × Gender × Time were all nonsignificant, Fs < 1.

In contrast, NEPI from the Time 1 conflict was significantly higher among those in relationships classified as dissatisfied at follow-up than among those classified as satisfied, $F(1, 108) = 5.73$, $p < .02$ (see Figure 1D). The Group × Time, Group × Gender, and Group × Gender × Time interactions were not significant, Fs < 1.30.

There was a significant gender effect on ACTH (see Figures 2C, 2D), $F(1, 83) = 6.02$, $p < .05$, with men showing higher levels of ACTH than women. A reliable interaction of Gender × Group × Time qualified the main effect, $F(4, 80) = 2.66$, $p < .04$. The Gender × Group interaction approached significance only at the beginning of the conflict discussion, $F(1, 83) = 2.23$, $p < .14$. Among women, means showed higher values at the beginning of conflict among those who were dissatisfied at follow-up than it did among those who were satisfied at follow-up, $F(1, 40) = 7.99$, $p < .01$. Men who were in dissatisfied relationships at the 10-year follow-up did not differ from men who were in satisfied relationships at follow-up in the ACTH levels they showed at the beginning of the conflict discussion, $F < 1$. No other main effects or interactions were significant.

For cortisol analyses, there were no significant effects for group, Group × Gender, or the interactions among Group × Gender × Time (pattern of cortisol changes), Fs < 1.

Daytime and nighttime hormones. Similar to the patterns observed between marital status and catecholamines, marital satisfaction at follow-up was also related to data collected at Time 1. Members of satisfied couples had significantly lower NEPI levels, $F(1, 127) = 5.96$, $p < .02$ (see Figure 1D). There were no other significant effects on NEPI. There were not significant group differences for EPI, $F < 1$, for Group × Time, $F < 1$, or for the Group × Gender × Time interaction, $F(1, 124) = 2.00$. Neither the group difference for ACTH, $F(1, 116) = 2.17$, nor the interactions with group were significant, Fs < 1. For cortisol, all main effects and interactions with group were nonsignificant, Fs < 1.

Health-related behaviors, cardiovascular reactivity, and family history. Paralleling the analyses comparing divorced and intact marriages described earlier, we assessed the possibility that endocrine differences at Time 1 simply reflected health habits, cardiovascular reactivity, or family history among those who remained married. Alcohol intake at Time 1 did not differ between satisfied and dissatisfied marriages at the 10-year follow-up, nor was the Group × Gender interaction significant, Fs < 1.58. There was no significant difference between groups in exercise time per week at Time 1. The groups did not differ on the baseline cardiovascular data, with all Fs < 1 for heart rate, DBP, and SBP. Similarly, satisfied and dissatisfied individuals did not differ in their re-

sponses to mental arithmetic, Fs < 1 for both main effects and Group $\times$ Gender interactions. Family histories of hypertension were not related to a couple's follow-up marital satisfaction classification for either men or women, both $\chi^2(1, N = 72) < 2.13$. The presence or absence of psychiatric disorders in first-degree relatives was not related to subsequent marital satisfaction among men, $\chi^2(1, N = 72) < 1$, or women, $\chi^2(1, N = 72) = 1.84$. Thus, there was no evidence that the differences in endocrine function or negative mood at Time 1 between couples who were maritally satisfied or dissatisfied 10 years later reflected health behaviors, cardiovascular reactivity, or family history.

Discussion

This 10-year follow-up provided an opportunity to examine the relationships between marital outcomes and individual differences, problem-solving behaviors, and neuroendocrine function. A notable strength of the study was the ascertainment of marital status for 100% of the original sample, with follow-up data collected from all participants who were still married. The strongest and most consistent findings were from the physiological realm: Stress hormones demonstrated robust relationships with both marital dissolution and satisfaction. At the end of the Time 1 problem-solving discussion, the EPI levels of divorced couples were 34% higher than those who were still married at Time 2. Importantly, the endocrine differences were not limited to the intervals when couples were interacting; divorced spouses' EPI levels were 22% higher throughout the day, whereas EPI and NEPI were both 16% higher at night than were the mean values recorded among those who were still married at Time 2. Thus, couples who subsequently divorced differed on three of the four stress hormones assessed during their 1st year of marriage.

Time 1 stress hormones were also related to marital satisfaction 10 years later among couples whose relationships had endured. During the Time 1 problem-solving discussion, ACTH levels were twice as high among women whose marriages were troubled at the 10-year follow-up than among women whose marriages were not troubled; in addition, dissatisfied couples' NEPI values were 34% higher at the end of conflict than satisfied couples. These NEPI differences were not limited to the conflict period; couples whose marriages were troubled at follow-up had produced 24% more NEPI during the daytime and 17% more during nighttime hours at Time 1 than the untroubled.

Consistent with the social learning model, couples who were dissatisfied at the 10-year follow-up showed higher rates of negative behaviors during conflict in the 1st year than couples who were satisfied at the 10-year follow-up. In addition, negative reciprocity occurred more frequently in divorced than in intact couples; the propensity to respond in kind to negativity is one of the signatures of marital distress (Notarius et al., 1989). At Time 1, these behaviors were not significantly associated with marital satisfaction; in the early stages of marriage, negative interactions appear to influence subsequent marital satisfaction rather than the reverse (Kelly, Huston, & Cate, 1985; Markman, 1981).

Despite the methodological strengths of this study, it is important to interpret these results with caution; most notably, we conducted a large number of data analyses to contrast the three different conceptual models. Additionally, a relatively small number of couples were divorced or dissatisfied at follow-up. To assess the extent to which a lack of statistical power could have limited our ability to detect effects in the comparison of divorced versus intact marriages associated with enduring vulnerabilities and social learning approaches, we calculated effect sizes for the series of variables that were nonsignificant in these analyses and found partial η^2 values ranging from .0002 to .05, all within a small effect size range; therefore, even a much larger sample would not have produced statistically significant differences. Clearly, more research will be necessary to draw firm conclusions about the influence of individual difference, behavioral, and physiological variables on marital outcomes. Thus, these data represent an initial step in the process of incorporating physiological responses into established models of marital outcomes.

The absence of any strong association between divorce and negative affect contrasts with findings reported by a number of other investigators (Karney & Bradbury, 1995). This discrepancy may well be a function of our stringent selection criteria and the consequent truncated range for distress in our sample, that is, our couples were, on average, almost a standard deviation below the population mean for depressive symptoms (Table 1). Accordingly it is notable that endocrinological variables discriminated two different outcomes, marital stability and satisfaction, even in this restricted sample.

One explanation for our stress hormone findings was suggested by data from a recent ambulatory monitoring study in which spouse or partner interactions were associated with reduced blood pressure in the natural environment compared with interactions with other people or periods of not interacting; however, relationship satisfaction was not associated with any differences in blood pressure (Gump, Polk, Kamarck, & Shiffman, 2001). Although these findings might initially seem inconsistent with our data, Gump et al. (2001) also found that partners in troubled relationships interacted significantly less with their companion than those in untroubled relationships, thereby minimizing any adverse physiological repercussions. Indeed, we also found that partners in troubled marriages reported that they spent less time talking with their spouses than those in untroubled marriages; thus, the fact that we sequestered spouses in the same room for 24 hr forced exposure in some dyads who had probably used avoidance as one means of coping, a condition which would have exacerbated stress-related hormone changes (Wolff, Hofer, & Mason, 1964).

Could our endocrine data reflect trait characteristics? For example, might individuals who tend to have higher catecholamines also be predisposed to be more easily aroused in novel situations, be more conflict oriented, and also be less able to sustain relationships? Although we cannot rule out such an interpretation, other data argue strongly against it. Importantly, there were no significant differences in cardiovascular reactivity at baseline associated with marital satisfaction or dissolution, and cardiovascular reactivity is reliably related to heightened catecholamine responsiveness to psychological stressors (Fredrikson et al., 1991). Additionally, there were no differences in family psychiatric or cardiovascular histories or in trait hostility (Fredrikson et al., 1991). It is true that couples classified as dissatisfied at the 10-year follow-up reported lower marital satisfaction in the 1st year of their marriage, higher negative affect, more personality disorder symptoms, and more verbal aggression than their satisfied counterparts. However, in sharp contrast, no individual difference variables distinguished between divorced and intact couples, despite

the fact that their baseline endocrine patterns were very similar to those which distinguished between couples who were subsequently satisfied or dissatisfied at follow-up. These data do not support a trait interpretation of our endocrine findings.

We found acute alterations in serum hormonal levels during conflict, as well as more persistent changes over the day and night. Might our daytime endocrine samples have simply reflected the acute changes during conflict? Both biological and statistical considerations argue strongly against such an interpretation. The pooled daytime endocrine samples represented a summary measure across 15 different time points, from 8:00 a.m. through 10:00 p.m. The half-life for the catecholamines is 1 to 2 min, compared with 60 to 90 min for cortisol and 10 min for ACTH (Baum & Grunberg, 1995; Rose, 1984); thus, normal turnover or decay rapidly diminishes any extreme neuroendocrine peaks in the absence of further stimulation. In addition, the conflict discussion and the preparatory interview lasted less than an hour; a single point would have to be remarkably high to eclipse the other 14 values, and the average magnitude of change across hormones was clearly not sufficient (Malarkey et al., 1994). Moreover, we found differences in the nighttime pools, as well as during the day. Accordingly, we believe these pooled data provide a window on endocrine function in couples for whom the day included a disagreement, not simply a reflection of acute hormone changes during the conflict itself. Clearly, however, a day without a conflict at baseline would have provided the ideal comparison condition to answer many of the questions raised by the longitudinal findings.

Among our newlyweds, marital dissolution and marital satisfaction were linked to alterations in hormone levels from both the hypothalamic–pituitary–adrenocortical and the sympathetic–adrenal–medullary axes. These endocrine data have implications for the growing literature on marital functioning and health because the endocrine system serves as one prominent gateway for the multitude of illnesses that have immunological or cardiovascular components or mediators; stressors can provoke the release of pituitary and adrenal hormones that have myriad effects (Uchino, Cacioppo, & Kiecolt-Glaser, 1996). Longer term consequences are suggested by the evidence that marital stress substantially worsened the prognosis for women with coronary heart disease, increasing the risk for recurrent coronary events including cardiac death, acute myocardial infarction, and revascularization procedures threefold (Orth-Gomer et al., 2000). Similarly, greater dyadic conflict was associated with a 46% increased relative death risk among female (but not male) hemodialysis patients (Kimmel et al., 2000). Among patients with congestive heart failure, marital quality predicted 4-year survival as well as the patient's illness severity; associations between survival and marital quality were stronger for women than men (Coyne et al., 2001).

Although married and divorced couples differed on three of the four stress hormones, they did not diverge significantly on any self-report dimension, including marital satisfaction, depression, and hostility. An observational study of endocrine stress responses in 139 critical care nurses and physicians offers an interesting parallel; among these well-trained professionals, fully 71% of endocrine stress responses occurred without the conscious perception of stress (Fischer, Calame, Dettling, Zeier, & Fanconi, 2000). Moreover, the majority of the stress response spikes occurred in the context of stressful but routine events (e.g., the hand over to the next shift or presentation of a patient at ward rounds; Fischer et al., 2000). Indeed, there is substantial evidence that emotional reactions can occur without conscious recognition or thought, and emotional responses can precede cognition (Zajonc, 1980). In concert with these findings, our data from this relatively small sample suggest that stress hormones may function as a kind of bellwether in early marriage, reflecting emotional responses that individuals, particularly women, have not yet acknowledged consciously.

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