What Predicts Change in Marital Interaction Over Time? A Study of Alternative Models

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This is a report on what predicts the deterioration of affective marital interaction over a 4-year period. Four models were compared for their ability to predict Time-2 dysfunctional marital interaction (a set of reliable predictors of marital dissolution). These four models were: (1) baseline physiology at Time-1; (2) interaction physiology at Time-1; (3) a balance model based on the ratio of positivity to negativity at Time-1; and, (4) cognitions about the relationship operationalized from our coding of the Oral History Interview. All four models predicted Time-2 dysfunctional marital interaction. All four models were also able to predict change, operationalized as predicting Time-2 interaction, controlling for Time-1 interaction, that is, using a covariance regression analysis. The most powerful model in predicting change was the balance ratio model.

Fam Proc 38:143–158, 1999

THIS is a report of a longitudinal study of marital interaction over time. The question addressed in this article is what is there about Time-1 interaction that predicts Time-2 variables that have been found to be the predictors of divorce as well as changes in these variables.

In this report, we examine patterns of emotional expression during nonimprovised marital conflict resolution, in which the real conflict issues were determined by the couple, and across a longer, nonnormative period of 4 years. We have limited ourselves to the domain of emotion because investigators in the area of marital interaction have concluded from the data that emotional expression forms the best set of correlates of marital satisfaction (for a review see Gottman, 1994). In fact, most studies have summarized their data as either positive or negative interaction, variously defined. Furthermore, we have found emotional patterns of interaction predictive of marital stability or dissolution (Gottman, 1993; Gottman, 1994; Gottman & Levenson, 1992).

To briefly summarize the results of these divorce predictions: in three separate longitudinal studies, it was possible to identify specific dysfunctional patterns of conflict resolution that predicted a couple's cascade toward divorce (Gottman, 1994; Gottman, Coan, Carrere, & Swanson, 1998; Gottman & Levenson, 1992). Similar results have been replicated in other laboratories (Matthews, Wickrama, & Conger, 1996). In these studies, the most consistent specific affective predictors of divorce during the resolution of conflict

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were: disgust, contempt, defensiveness, stonewalling, domineering, and belligerence (see Methods section for a definition of codes). Recently, in a 9-year longitudinal study of newlywed couples, Gottman et al. found that positive affect was the only predictor of marital stability or dissolution, as well as the eventual marital satisfaction of those couples who stayed married. Hence, in this article, we will examine the prediction of and change in the positive as well as negative affect.

The question of the etiology of the predictors of divorce is actually two questions. The first question is: Are these patterns predictable at all? The second question is: What might be the specific etiology of these predictors of divorce? We will address the first question by attempting to predict the predictors of divorce from a variety of data obtained 4 years previously. These data also make it possible to address the second question by evaluating various models of marital stability or change over time.

As interesting as the question of stability is in its own right, the question of whether there are any systematic changes over time and what may account for these changes is also of considerable interest. We ask whether there are predictors of systematic changes over time that are related to the interaction cascade variables. That is, we ask whether there are any models of Time-1 interaction that can predict what have come to be interactive indices of the progressive deterioration of the marriage.

Four Models of Prediction

Four models of prediction of these Time-2 behavioral indices of the cascade toward divorce were examined. The first two models tap into the physiological response systems of the spouses. *The first model is a baseline physiological arousal model,* which states that the degree of baseline physiological arousal, that is physiological arousal before the conflict discussion at Time-1 will predict further progress in the cascade toward marital dissolution over time. This model is supported by Levenson and Gottman (1985) who found that declines in marital satisfaction over 3 years (controlling for initial levels of satisfaction) could be predicted by baseline levels of physiological arousal in both cardiovascular and electrodermal systems.

The second model is an interaction physiological arousal model, which predicts that the degree of physiological arousal during the conflict discussion at Time-1 will predict further progress in the cascade toward marital dissolution over time. This model is also supported by Levenson and Gottman (1985), which found that declines in marital satisfaction over 3 years (controlling for initial levels of satisfaction) could be predicted by conflict interaction levels of physiological arousal in both cardiovascular and electrodermal systems. The two models test somewhat different concepts. If a baseline physiology model holds, it suggests that the physiology is tapping an *expectation* that the forthcoming marital interaction will be aversive. If only the interaction physiology model holds, it suggests that actual aversive events in the interaction are probably related to the prediction. These first two models, therefore, tap different theoretical constructs.

If the baseline physiology model is as capable of prediction as the interaction physiology model, this would suggest that it is *the anticipation* of some distress during the pre-conversation period that is doing the work of prediction, rather than specific negative events in the conflict interaction per se. Thus, the baseline physiological variables would index the expectation of an aversive state and, if this model were effective, it would suggest that this expectation is sufficient to pre-

dict that indeed the couple is on a trajectory toward dissolution. This is consistent with our earlier findings with another sample of couples (Levenson & Gottman, 1985) in which the dependent variable was change in marital satisfaction. It would also be consistent with the results of Fincham, Garnier, Gano, and Osborne (1995), who recently applied a creative approach to operationalizing the couples' anticipation of what their conflict interaction will be like. Vanzetti, Notarius, and NeeSmith's (1992) concept of "relational efficacy" is also relevant to this model. Notarius found that a couple's expectation that they will be able to cope with marital conflict is predictive of the longitudinal course of the marriage. Buehlman, Gottman, and Katz (1992) found a similar result, namely, that if a couple has a philosophy that marital conflict is "worth the struggle," their marriage is significantly more likely to remain stable. Thus, the baseline physiology results would tap an expectation that a hopeless, inexorable, and aversive event was on the way.

Alternatively, if only the interaction physiology model were effective in prediction, it would suggest that negative marital interaction during conflict alone was driving physiological arousal and doing the job of prediction. If both models were useful (as was the case in Levenson and Gottman, 1985), it would suggest that both expectations and negative marital interaction during conflict were driving the prediction. Separating out the spillover of arousal from the baseline to the conflict discussion is not possible using these data because the two events (baseline and interaction) follow one another so closely.

The third model is a ratio model, derived from set-point theory (Gottman, 1993, 1994), which predicts that, to the extent that there is a low ratio of positive to negative affect at Time-1, there will be evidence at Time-2 of the cascade toward divorce. This is a balance theory of marriage, which suggests that since negative affect is endemic to all marital conflict (regardless of marital quality), the marriage will work to the extent that this negative affect is balanced by positive affect. Gottman (1994) reported that, in three different marital types, stable marriages had a 5:1 ratio of positivity to negativity during conflict, whereas in unstable marriages the ratio was .8:1.

The fourth model is a cognitive model, suggesting that the couple's cognitive narratives about the marriage and its history will predict the Time-2 cascade toward divorce. These narratives are designed to assess more stable stories, thought patterns, and attributions about one's partner and the marriage. To assess these narratives, Krokoff (1984) and Gottman (1996) developed an interview they called the "Oral History Interview," using the interviewing techniques of sociologist Studs Terkel (see Terkel, 1986). Buehlman, et al. (1992) later reported that their observational coding of this interview in another longitudinal study with 56 couples predicted divorce with 94% accuracy over a 3-year period. They found that spouses who expressed more fondness for their partners, expressed less negativity toward them, and conveyed a greater sense of solidarity or "we-ness" as a couple, were less likely to divorce. We are particularly interested in this model because so many of the oral history variables tap a cognitive "Fondness and Admiration system" that we think may be an antidote to contempt in the marital interaction. The fourth model, then, is that the Time-1 oral history coding will predict the Time-2 cascade toward divorce.

Analytic Methods

Some discussion of our analytic methods is in order. There has been considerable debate on the methodology for assess-

ing change over time (see Gottman, 1995 for an edited book of methodological articles on this issue). These methods include debates about the use of difference scores, or the analysis of covariance, with Time-1 data as the covariate (for a critique of these methods, see Rogosa, 1995). In this report, we take two approaches. First, the least controversial approach is to consider a question quite different from the assessment of change, namely the assessment of Time-2 status using models derived from Time-1 data. In this article, we use this approach. Essentially, then, we examine questions of prediction (rather than change) by assessing the extent to which the Time-1 variables specified by each model could predict the Time-2 interaction variables, which we know form a cascade that predicts divorce (Gottman, 1994). Hence, we will present correlations between the Time-1 variables from each model and the following six Time-2 interaction variables: disgust, contempt, defensiveness, stonewalling, domineering, and belligerence. We first present the stability correlations and then the correlations with these Time-2 marital interaction variables for each explanatory model.

Our second approach is to address issues of change by performing regression analyses in which the dependent variables were again Time-2 disgust, contempt, defensiveness, stonewalling, domineering and belligerence. These Time-1 marital interaction variables were then entered into a regression first, before the predictors for each of the four models, which were then entered in stepwise fashion. This is a multivariate covariance analysis. To compare models, we will use the regression covariance analyses and use the multiple R, or the percent variance accounted for each model.

METHODS

Participants

Couples were recruited in 1983 in Bloomington, Indiana by using newspaper advertisements. Approximately 200 couples who responded to these advertisements were administered a demographic questionnaire and two measures of marital satisfaction (Burgess, Locke, & Thomes, 1971; Locke & Wallace, 1959) for which they were paid $5.00. From this sample, a smaller group of 85 couples was invited to participate in the laboratory assessments and to complete a number of additional questionnaires (including measures of health). The goal of this two-stage sampling was to obtain a distribution of marital satisfaction in which all parts of the distribution would be equally represented. Due to equipment problems, physiological data from six couples were incomplete, leaving a sample of 79 couples who, in 1983, had the following mean characteristics: (a) Husband age = 31.8 (SD = 9.5); (b) Wife age = 29.0 (SD = 6.8); (c) Years married = 5.2 (SD = 6.3); (d) Husband marital satisfaction (average of two marital satisfaction scales) = 96.80 (SD = 22.16); and (e) Wife marital satisfaction = 98.56 (SD = 20.70).

Procedure

Oral History Interview

The oral history interview asks the couple about their dating and marital history, their philosophy of marriage, and how their marriage has changed over time. It is a semi-structured interview conducted in the couple's home. The interviewer asks a set of open-ended questions about the history of the couple's relationship, how they met, how they courted and decided to get married, about the good times and the bad times in their marriage, how their marriage is similar or

different from their parents' marriages, their philosophy of what makes a marriage work, their views of marital conflict, and how their marriage has changed over the years.

Interaction Session

The procedures employed in this experiment were modeled after those described in Levenson and Gottman (1983). Couples came to the laboratory after having not spoken for at least 8 hours. After recording devices for obtaining physiological measures were attached, couples engaged in three conversational interactions: (a) discussing the events of the day; (b) discussing the major problem area of continuing disagreement in their marriage; and (c) discussing a mutually agreed upon pleasant topic. Each conversation lasted for 15 minutes, preceded by a 5-minute silent period. During the silent periods and discussions, a broad sample of physiological measures was obtained and a video recording was made of the interaction. Prior to initiating the problem area discussion, couples completed the Couple's Problem Inventory (Gottman, Markman, & Notarius, 1977), in which they rated the perceived severity (on a 0 to 100 scale) of a standard set of marital issues such as money, in-laws, and sex. The experimenter, a graduate student in counseling psychology, then helped the couple select an issue, which both spouses had rated as being of high severity, to use as the topic for the problem area discussion. The Couple's Problem Inventory also provided an index of each spouse's ratings of the severity and chronicity of problems in the relationship (alpha = .79 [husbands]; alpha = .75 [wives]).

For purposes of the present study, only data from the problem area discussion were used. This decision was based on our previous research, in which data from the problem area discussion were the best longitudinal predictors of change in marital satisfaction (Levenson & Gottman, 1985), and on our plan to repeat the same conflict resolution discussion 4 years later.

1987 Followup

In 1987, 4 years after the initial assessment, the original subjects were recontacted and at least one spouse (70 husbands, 72 wives) from 73 of the original 79 couples (92.4%) agreed to participate in the followup. These 73 participants represented 69 couples in which both spouses participated, one couple in which only the husband participated, and three couples in which only the wife participated. Data from the nonparticipating partner in these four couples were treated as missing data. For the followup, spouses completed the two marital satisfaction questionnaires, a measure of physical illness (the Cornell Medical Index), and several items relevant to other stages of the hypothesized cascade model (that is, during the 4-year period, had the spouses considered separation or divorce, had they actually separated or divorced, and the length of any separation).

There were no Time-1 significant differences between participants who returned to the laboratory at Time-2 and those who did not. In Time-1 husband marital satisfaction ($t[77] = .28$, ns, nonreturned mean = 97.54; returned mean = 96.14); in Time-1 wife marital satisfaction ($t[63] = -1.79$, ns, nonreturned mean = 94.08, returned mean = 102.50); in Time-1 severity of problems identified by the husband ($t[77] = .53$, nonreturned mean = 19.42, returned mean = 17.86); or the Time-1 severity of problems identified by the wife ($t[58] = .90$, nonreturned mean = 19.62, returned mean = 16.91); or their Time-1 chronicity as identified by the husband ($t[77] = -1.08$, nonreturned mean = 27.03, returned mean = 35.44); or by the wife

($t[77] = -.49$, nonreturned mean = 24.11, returned mean = 26.62).

Second Interaction Session

Of the original 79 couples, we were able to recruit 42 couples to return to the laboratory for another laboratory interaction. We designed recruitment of our subjects so that we would sample couples across a wide range of marital satisfaction. Couples who returned to the laboratory had two conversations. First they discussed what we called the "events of the last 4 years." We said:

> It has been about four years since we last spoke with you and we would like to get some idea about how these last four years have been for the two of you. In this first conversation, I would like you to discuss with each other the important events that have occurred in the past four years and to discuss how these events changed your lives and changed your marriage. For example, have there been changes in your health, your jobs, your residence, your finances, your friends, your family? Discuss what happened and how these things affected you.

The second conversation was the conflict conversation. For this interaction, we followed the same procedures we had used 4 years ago, in which spouses discussed the major area of continuing disagreement in their marriage.

Apparatus

Physiological: At both Time-1 and Time-2, five physiological measures were obtained using a system consisting of two Lafayette Instruments six-channel polygraphs and a DEC LSI 11/73 microcomputer: (a) Cardiac interbeat interval (IBI)—Beckman miniature electrodes with Redux paste were placed in a bipolar configuration on opposite sides of the subject's chest and the interval between R-waves of the electrocardiogram (EKG) was measured in msec; shorter IBIs indicate faster heart rate, which is typically interpreted as indicating a state of higher cardiovascular arousal; (b) Skin conductance level—a constant voltage device passed a small voltage between Beckman regular electrodes attached to the palmar surface of the middle phalanges of the first and third fingers of the nondominant hand, using an electrolyte of sodium chloride in Unibase; increasing skin conductance indexes greater autonomic (sympathetic) activation; (c) General somatic activity—an electromechanical transducer attached to a platform under the subject's chair generated an electrical signal proportional to the amount of body movement in any direction; (d) Pulse transmission time to the finger—a UFI photoplethysmograph was attached to the second finger of the nondominant hand. The interval was measured between the R-wave of the EKG and the upstroke of the finger pulse; shorter pulse transmission times are indicative of greater autonomic (sympathetic) activation; and (f) Finger pulse amplitude (FPA): the trough-to-peak amplitude of the finger pulse was measured; finger pulse amplitude measures the amount of blood in the periphery; reduced FPA often indicates greater vasoconstriction, which is associated with greater autonomic (sympathetic) activation. This set of physiological measures was selected to sample broadly from major organ systems (cardiac, vascular, electrodermal, somatic muscle); to allow for continuous measurement; to be as unobtrusive as possible; and to include measures used in our previous studies (Levenson & Gottman, 1983).

The computer was programmed to process the physiological data on-line and to compute second-by-second averages for each physiological measure for each spouse. Later, averages were determined

for each measure for the entire 15-minute interaction period and for the 5-minute baseline pre-interaction period.

Nonphysiological: Two remote-controlled, high-resolution video cameras which were partially concealed behind darkened glass, were used to obtain frontal views of each spouse's face and upper torso. These images were combined into a single split-screen image using a video special effects generator, and were recorded on a VHS video recorder. Two lavaliere microphones were used to record the spouses' conversations. The DEC computer enabled synchronization between video and physiological data by controlling the operation of a device that imposed the elapsed time on the video recording.

Observational Coding

Coding emotional expression: The videotapes of the problem area interaction were coded using an observational coding system, the Specific Affect Coding System (SPAFF; Gottman, 1996), which provided information on specific affects. SPAFF is a cultural informant coding system in which coders consider an informational gestalt consisting of verbal content, voice tone, context, facial expression, gestures, and body movement. Coders were first trained using the Ekman and Friesen (1978) Facial Action Coding System, then with a set of our own audio tapes for recognizing affect in the voice, and a set of video tapes for detecting specific features in affect using paralinguistic, contextual, linguistic, and kinesic channels. However, the training went beyond specific features and trained observers to use a Gestalt approach to recognizing specific emotions in all channels combined. For this coding, a newer version of the SPAFF was used. The newer version of the SPAFF, called the "affect wheel SPAFF," included several changes. First, it made finer-grained distinctions among the negative affects (including separating disgust from contempt, and adding the codes of domineering and belligerence); and second, rather than using the turn as a unit of coding, it employed continuous real-time coding of the data coupled with a computer-readable time code that made it possible to summarize the data as the number of seconds in a 15-minute period each code was detected.

Additional advantages of the computer-assisted coding were that no verbatim transcripts were required to unitize the coding, and the entire 15-minute interaction could be coded twice by two independent observers in 45 minutes (15 minutes for viewing the interaction without coding it, and two 15-minute segments for coding each spouse). This compares favorably with the 25 hours it took to code each 15-minute segment with the earlier version of the SPAFF. Also, Cohen's kappa reliability assessments, now made on every videotape instead of a subsample, could be obtained instantly by the computer, without entering the data manually.

The new coding system made several finer distinctions. The new SPAFF codes were: neutral affect; for the negative affects—disgust, contempt, belligerence, domineering, anger, tension/fear, stonewalling, defensiveness, whining, and sadness; for the positive affects—interest, validation, affection, humor, and joy/excitement. Anger was used for more "pure" expressions of anger, while domineering was used for a form of anger that is threatening and condescending (for example, "I have told you that all I expect from you is a little understanding. Can you at least agree with that?"), while belligerence was provocative ("What are you going to do about it if I decide to go drinking with Dave, huh? What can you do about it?"). Disgust and contempt were coded separately, and key facial expressions from the Ekman and Friesen (1978)

Facial Action Coding System were used in SPAFF to make these distinctions. Fear was divided into defensiveness, a code called "stonewalling" (in which the listener appears frozen like a stone wall, looking away, not moving the face and not giving the usual listener backchannels), and tension/fear. Defensiveness was coded separately from whining, and coded for apparent self-protective responses to perceived attack. Tension/fear was a "purer" fear response, including, for example, non-ah speech disturbances. An additional positive affect code was created for validation, which included listener tracking backchannels (vocal and nonverbal) as well as emotional validation.[1]

The duration of each code in seconds was computed. Coding manuals, computer programs, training and test video and audio tapes for the SPAFF are now available from Lawrence Erlbaum Associates publishers (Gottman, 1996). Reliability was computed using a one-second window on either side of a code's occurrence and checking to see if the other coder had detected this code within this window. Kappas for the affect wheel SPAFF coding averaged .85 for the entire recoding. Time-1 and Time-2 video tapes were mixed together for this coding, and each observer coded only one tape of a couple.

Oral History Narratives Coding: The oral history interview was coded on the following four dimensions (Buehlman et al., 1992; Buehlman & Gottman, 1996):

1. *Fondness/Admiration* (husband and wife) is a dimension that rates couples according to how much they seem to be in love or fond of each other. This includes any compliments, positive affect, and reminiscing about romantic, special times.

2. *Negativity Toward Spouse* (husband and wife) assesses the extent to which spouses are vague or general about what attracted them to their spouse, the extent to which they express disagreement during the interview, the display of negative affect toward one another during the interview, and the extent to which they are critical of each other during the interview.

3. *We-ness* versus Separateness (husband and wife) codes how much a spouse identifies his or her self as part of a couple versus emphasizes his or her individuality or independence (this includes use of "we" and "us" versus "I" and "me" in each person's language).

4. *Cognitive Room* is a measure of the extent to which people spontaneously recall details about salient periods in their marriage. We have found that it is strongly related to the amount of knowledge each person has about their partner's psychological world, and the extent to which they periodically update this knowledge.

Overall reliability for the Oral History Coding System was maintained at 75% agreement between coders. Intercorrelations for individual dimensions ranged between .77 and .89.

RESULTS

Predicting Marital Dissolution

In the following analyses, the objective is the prediction of Time-2 interaction variables that are themselves predictive of marital dissolution.

Model 1: Baseline physiology: Table 1 is a summary for husbands of the ability of the Time-1 baseline, pre-interaction physiology to predict disgust, contempt, defensiveness, stonewalling, domineering, and belligerence 4 years later at Time-2. Husbands whose heart rates at baseline were higher at Time-1 were significantly more contemptuous and belligerent at Time-2, and husbands whose blood was flowing

[1] In the present study, the ability of these six SPAFF codes for each spouse to predict divorce at Time-2 in a discriminant function analysis yielded a canonical R of .62, with χ^2 (12) = 29.59, p = .0032. The percent correct classification was 91.18%.

TABLE 1

Model 1: Husband Baseline Physiology and Time-2 Marital Interaction, Cascade Variables

Predictor Variable	Cont	Bellig	Defen	Stone	Domin	Hpos
Interbeat Interval	−.30*	−.45**	.26[a]	.22[a]	−.19	−.22[a]
Activity	.09	−.02	.02	.06	−.01	−.10
Skin Conductance Level	−.02	.01	.07	.00	−.10	.17
Pulse Transit Time	−.37**	−.24[a]	.02	−.01	−.26[a]	−.12
Finger Pulse Amplitude	−.13	−.06	.14	.02	−.34*	.23[a]

Note: The following abbreviations of variables will be used for Tables 1 through 6: Disg = Disgust, Cont = Contempt, Bellig = Belligerence, Defen = Defensiveness, Domin = Domineering, Stone = Stonewalling, Hpos, Wpos = Husband, Wife Positivity.

[a] $p < .10$; * $p < .05$; ** $p < .01$

faster at baseline at Time-1 were significantly more contemptuous at Time-2. Husbands who had less blood in the periphery at Time-1 were more likely to be domineering at Time-2.

Table 2 is a summary for wives of the ability of the Time-1 baseline, pre-interaction physiology to predict disgust, contempt, defensiveness, stonewalling, and belligerence 4 years later at Time-2. Wives whose baseline skin conductance levels were higher at Time-1 were significantly more disgusted and contemptuous at Time-2, and wives who at baseline had more blood at the periphery (higher finger pulse amplitude) were significantly more likely to stonewall at Time-2.

Model 2: Interaction physiology: Table 3 is a summary for husbands of the ability of the Time-1 interaction physiology to predict disgust, contempt, defensiveness, stonewalling, and belligerence 4 years later at Time-2. These results show that, once again, husbands whose heart rates during the interaction were higher at Time-1 were significantly more contemptuous and belligerent at Time-2, and husbands whose blood was flowing faster during the interaction at Time-1 were significantly more contemptuous and domineering at Time-2.

Table 4 is a summary for wives of the ability of the Time-1 interaction physiology to predict disgust, contempt, defensiveness, stonewalling, and belligerence 4 years later at Time-2. Wives whose interaction skin conductance levels were higher at Time-1 were significantly more disgusted and contemptuous at Time-2. Thus, essentially the same pattern of results held for the interaction physiology as for the baseline physiology.

Model 3: Ratio model based on set-point theory: Table 5 is a summary of the ability of the two ratio variables to predict disgust, contempt, defensiveness, stonewalling, domineering, and belligerence 4 years later at Time-2. These results show that

TABLE 2

Model 1: Wife Baseline Physiology and Time-2 Marital Interaction, Cascade Variables

Predictor Variable	Disg	Cont	Bellig	Defen	Stone	Domin	Wpos
Interbeat Interval	−.11	−.24[a]	−.09	.10	.11	.04	.25[a]
Activity	−.01	.13	.07	−.04	.27*	.14	−.19
Skin Conductance Level	.48***	.36*	.15	−.03	.15	.09	−.21[a]
Pulse Transit Time	−.11	−.12	.06	.03	−.07	−.02	.29*
Finger Pulse Amplitude	.10	.01	−.08	−.04	.29*	−.15	−.07

[a] $p < .10$; * $p < .05$; *** $p < .001$

TABLE 3

Model 2: Husband Interaction Physiology and Time-2 Marital Interaction, Cascade Variables

Predictor Variable	Cont	Bellig	Defen	Stone	Domin	Hpos
Interbeat Interval	−.27*	−.39**	.17	.24[a]	−.14	−.23[a]
Activity	.04	−.06	.21[a]	−.02	−.20	.06
Skin Conductance Level	−.03	−.03	.10	−.02	−.13	.16
Pulse Transit Time	−.34*	−.24[a]	−.07	.03	−.33*	−.07
Finger Pulse Amplitude	−.14	−.06	.15	−.07	−.23[a]	.16

[a] $p < .10$; * $p < .05$; ** $p < .01$

the husband's negative-to-positive ratio at Time-1 was strongly predictive of the husband's contempt and domineering at Time-2, and of the wife's disgust and contempt at Time-2. The more husband negativity with respect to positivity at Time-1, the more the cascade variables were present in the marital interaction at Time-2.

Model 4: Couple's Narratives: Table 6 is a summary of the ability of the three oral history narrative variables for each spouse to predict disgust, contempt, defensiveness, stonewalling, and belligerence 4 years later at Time-2. The husband's expressed fondness for his wife was related to significantly less husband contempt, domineering, and defensiveness at Time-2; his negativity at Time-1 was predictive of more husband contempt and domineering at Time-2; his expressions of we-ness at Time-1 predicted significantly less husband contempt, domineering, and defensiveness at Time-2; his Cognitive Room at Time-1 predicted less stonewalling at Time-2.

The wife's expressed fondness for her husband predicted significantly less wife disgust at Time-2; her negativity at Time-1 predicted significantly more wife disgust and contempt at Time-2; and her expressions of we-ness at Time-1 predicted significantly less wife disgust and contempt at Time-2.

Predicting Change: Regression Analyses

In these regression analyses the dependent variables were Time-2 disgust, contempt, defensiveness, stonewalling, belligerence, and positivity. The marital interaction variables disgust, contempt, defensiveness, stonewalling, belligerence, and positivity for Time-1 were entered into the regression first, before the predictors for each of the four models. Only the husband's variables were entered as predictors for Time-2 husband behavior, and only the wife's variables were entered as predictors for Time-2 wife behavior.

Baseline physiology model: For the husband's Time-2 codes, after the Time-1 interaction variable was stepped into the

TABLE 4

Model 2: Wife Interaction Physiology and Time-2 Marital Interaction, Cascade Variables

Predictor Variable	Disg	Cont	Bellig	Defen	Stone	Domin	Wpos
Interbeat Interval	−.11	−.22[a]	−.15	.05	.07	−.04	.26*
Activity	.07	.17	.20	.18	.03	.21[a]	−.10
Skin Conductance Level	.51***	.39**	.18	−.03	.14	.12	−.14
Pulse Transit Time	−.13	−.17	.14	−.11	−.01	−.01	.33*
Finger Pulse Amplitude	.25[a]	.11	−.06	−.08	.24[a]	−.11	−.12

[a] $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$

TABLE 5

Model 3: Test of the Ratio Model in Predicting Time-2 Interaction Cascade Variables

Predictor Variable	HUSBAND Cont	Bellig	Defen	Stone	Domin	Hpos
Husband Negative to Positive Ratio	.82***	.06	−.18	.01	.74***	−.32*
Wife Negative to Positive Ratio	.17	−.06	.10	.02	.23[a]	−.24[a]

Predictor Variable	WIFE Disg	Cont	Bellig	Defen	Stone	Domin	Wpos
Husband Negative to Positive Ratio	.75***	.65***	−.01	−.01	−.17	.06	−.37**
Wife Negative to Positive Ratio	.13	.46***	−.07	.14	−.15	.12	−.31*

[a] $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$

regression, the baseline physiology model selected the following statistically significant physiological variables: For the husband's Time-2 belligerence, the husband's interbeat interval was selected, with the F-ratio for change equal to $F(2, 37) = 5.36$, $p < .05$, $R = .70$. Faster baseline heart rates resulted in more husband belligerence at Time-2, even controlling for the amount of husband belligerence at Time-1. No other husband baseline physiology variable was selected for any other husband Time-2 interaction variable.

For the wife's Time-2 codes, for wife disgust, the wife's Time-1 baseline skin conductance level was selected, with the F-ratio for change equal to $F(2, 37) = 9.01$, $p < .01$, $R = .60$. Higher baseline wife skin conductance resulted in more wife disgust at Time-2, even controlling for the amount of wife disgust at Time-1. For the wife's Time-2 stonewalling, the wife's Time-1 baseline finger pulse amplitude was selected, with the F-ratio for change equal to $F(2, 37) = 4.49, p < .05, R = .35$. The more blood the wife had in the periphery at baseline at Time-1, the more she stonewalled at Time-2, even controlling the amount of her stonewalling at Time-1. No other analysis was significant. For both the husband's and the wife's positivity, no additional baseline physiology variables were entered in Step 2 of the regression.

Interaction physiology model: For the husband's Time-2 codes, after the Time-1 interaction variable was stepped into the

TABLE 6

Model 4: Test of the Narrative Variables in Predicting Time-2 Interaction Cascade Variables

Husband Predictor Variable	HUSBAND Cont	Bellig	Defen	Stone	Domin	Hpos
Fondness	−.46**	−.25[a]	−.34*	−.09	−.34*	.32*
Negativity	.45**	.24[a]	.01	−.06	.45**	−.23[a]
We-ness	−.36*	−.23[a] −	−.37*	.03	−.32*	.14
Cognitive Room	−.12	−.31*	.25[a]	−.32*	−.04	.14

Wife Predictor Variable	WIFE Disg	Cont	Bellig	Defen	Stone	Domin	Wpos
Fondness	−.41**	−.18	.16	.01	.05	.04	.06
Negativity	.53***	.44**	.07	−.29[a]	−.09	.21	−.26[a]
We-ness	−.61***	−.36*	.09	.01	.04	.16	.31*
Cognitive Room	−.12	.03	.06	.06	.00	.26[a]	.15

[a] $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$

regression, the interaction physiology model yielded no significant results. For the wife's Time-2 codes, for wife disgust, the wife's Time-1 interaction skin conductance level was selected, with the F-ratio for change equal to $F(2, 37) = 13.84, p < .001, R = .52$. For the wife's Time 2 contempt the wife's Time-1 interaction skin conductance level was selected, with the F-ratio for change equal to $F(2, 37) = 10.23, p < .01, R = .62$. Higher wife skin conductance during the interaction predicted more wife disgust and contempt at Time-2, controlling for the amount of these behaviors at Time-1. For both the husband's and the wife's positivity, no additional interaction physiology variables were entered in Step 2 of the regression. No other analysis was significant.

Ratio model: Three analyses yielded significant results. For the husband's Time-2 contempt, the husband's ratio of negative-to-positive affect at Time-1 resulted in an F-ratio for change of $F(2, 37) = 28.32, p < .001, R = .87$. The higher this ratio (more negative compared to positive affect), the greater the husband's Time-2 contempt, controlling for the amount of husband contempt at Time-1. For the husband's Time-2 domineering, the husband's ratio of negative-to-positive affect at Time-1 resulted in an F-ratio for change of $F(2,37) = 34.76, p < .001, R = .80$. The higher this ratio (more negative compared to positive affect), the greater the husband's contempt, controlling for the amount of husband contempt at Time-1. For the wife's Time-2 disgust, the husband's ratio resulted in an F-ratio for change of $F(2, 37) = 49.04, p < .001, R = .76$. For the wife's Time-2 contempt, the husband's ratio resulted in an F-ratio for change of $F(2, 37) = 19.47, p < .001, R = .69$. The higher this husband ratio (more negative compared to positive affect), the greater the wife's disgust and contempt, controlling for the amount of these interaction variables at Time-1. For both the husband's and the wife's positivity, no additional ratio variables were entered in Step 2 of the regression. No analyses with the wife's ratio were statistically significant.

Cognitive narratives model: Only husband variables were entered for husband Time-2 interaction variables, and similarly for the wife. For the husband's data, Time-2 defensiveness resulted in a statistically significant F-ratio for change of $F(2, 31) = 4.18, p < .05, R = .46$, with the husband's we-ness selected in a forward regression. For the husband's data, Time-2 domineering resulted in a statistically significant F-ratio for change of $F(2, 31) = 8.35, p < .01, R = .67$, with the husband's negativity selected.

For the wife's Time-2 interaction variables, disgust resulted in a statistically significant F-ratio for change of $F(2, 31) = 19.26, p < .001, R = .62$, with wife we-ness selected; contempt resulted in a statistically significant F-ratio for change of $F(2, 31) = 8.49, p < .01, R = .69$, with wife negativity selected; defensiveness resulted in a statistically significant F-ratio for change of $F(2, 31) = 5.61, p < .05, R = .61$, with wife negativity selected. In all cases, the more negativity and the less we-ness the greater the amount of Time-2 defensiveness, contempt, and disgust, controlling for Time-1 levels of the interaction variables. For the husband's positivity no cognitive variables were entered at Step 2, but for the wife's positivity at Time-2, the F-ratio for change was $F(2, 31) = 5.77, p < .05, R = .82$, with wife cognitive room selected.

Comparing Models: The comparison of models is difficult, but the largest multiple correlations were obtained using the balance ratio model. This is surprising since the covariance may also partial out common method variance from the regres-

sion, so one would expect this model to be the worst of the four models.

DISCUSSION

A major goal of this article was the prediction of Time-2 marital interaction variables that were themselves predictive of the cascade toward divorce, which we called the "interaction cascade" variables. There were very interesting patterns in terms of predicting Time-2 interaction cascade variables from Time-1 data. What is particularly interesting (but quite difficult to present in this brief report) is that it was often the case that some Time-1 variables did not correlate impressively with Time-1 marital interaction, but *did* with Time-2 marital interaction. This was true for the baseline and interaction physiological variables and for the oral history variables. These Time-1 variables were thus better *lead indicators* of the future state of corrosive marital interaction than they were concomitant correlates. This suggests that, rather than these variable domains all being clustered together, there is some as yet undiscovered timing phenomenon in these data. What changes first and why is the unaddressed question here.

The evidence suggests that all four of our models were able to predict the Time-2 dissolution codes. Because the baseline physiology model was as capable of this prediction as the interaction physiology model, this suggests that it is probably *the anticipation* of some distress during the pre-conversation period that is doing the work of prediction, rather than specific negative events in the conflict interaction per se. Thus, the baseline physiological variables are probably indexing the *expectation* of an aversive state, and this is sufficient to predict that indeed the couple is on a trajectory toward dissolution. This is consistent with our earlier findings with another sample of couples (Levenson & Gottman, 1985). Fincham et al. (1995) recently applied a creative approach to operationalizing the couples' anticipation of what their conflict interaction will be like. Vanzetti et al.'s (1992) concept of "relational efficacy" is also relevant here. Notarius found that a couple's expectation that they will be able to cope with marital conflict is predictive of the longitudinal course of the marriage. Buehlman et al. (1992) found a similar result, namely, that if a couple has a philosophy that marital conflict is "worth the struggle," their marriage is significantly more likely to remain stable. The baseline physiology results may be tapping an expectation that a hopeless, inexorable, and aversive event is on the way.

The ratio model showed a particular bias for the husband's ratio being predictive, and not the wife's. We wonder whether these results might be reflective of dimensions of power rather than dimensions of affect. Maccoby (1990)—in speculating on the cross-culturally universal gender segregation effect in childhood (in which boys and girls stop playing with one another quite early, usually by about age 7)—suggested that the segregation occurs because while girls will accept influence from both genders, boys accept influence from boys but not from girls, and that girls eventually become fed up with this state of affairs. If Maccoby's speculation is true, we wondered what would happen in puberty when boys and girls get together again, given that there has been no formal or informal socialization toward getting boys to accept more influence from girls in the interim. We speculated that marriages will succeed to the extent to which husbands will accept influence from their wives. Elsewhere (Coan, Gottman, Babcock, & Jacobson, 1997; Gottman et al., 1998; Jacobson, Gottman, Gortner, et al., 1996), we suggested and found evidence for this relatively elementary hypothesis:

that it is particularly the ability of men to accept influence from women (but not the converse) that is predictive of the longitudinal success of the marriage in terms of marital stability. Perhaps this ratio effect is, in part, a good and simple index of the male's accepting the female's influence attempts.

The oral history variables also showed that the couple's cognitive narratives about the marriage, literally based upon the stories they tell about the marriage and about their partner, are also predictive of the long-term course of the marriage.

Clearly, in terms of prediction,[2] the marital situation is overdetermined. The presence of these corrosive interaction patterns at Time-1 certainly is predictive of further deterioration by Time-2. This is clearly a cascade phenomenon. It means that to the extent that things are bad at Time-1, they will also be bad at Time-2. There is little evidence of "spontaneous remission" of dysfunctional marital interaction. In fact, analyses we did not present here but conducted on difference scores from Time-2 to Time-1 suggest the stronger hypothesis—that things get worse from Time-1 to Time-2 to the extent that they were already bad at Time-1. The regression analyses reported in this article controlled for Time-1 levels to some degree, and they suggest that, in general, the couple's relatively low level of physiological arousal, the husband's ability to maintain a ratio of low levels of negative affect compared to positive affect during conflict resolution, the couple's sense of we-ness, fondness for one another, and lack of negative thoughts about one another in the oral history interview all predict lowered levels of interaction patterns that have been found to be predictive of both marital dissolution, as well as marital violence (Jacobson et al., 1996).

This pattern of results is rife for building theory, particularly about temporal relationships across the four models. Any theory that we construct about marital dissolution must contend with the well-known fact that the thought patterns and attributional sets about the marriage and one's partner (which we probably tap with our oral history variables) are very resistant to disconfirmation (see Fincham & Bradbury, 1990), so that we need to build causal links from the micro-social processes to the more molar cognitive narratives that each spouse probably carries and rehearses even when they are not together. It is clear that thoughts about divorce are predictive of actual divorce (Booth & White, 1980; Gottman, 1994).

As noted above, it was interesting that, in our analyses (not reported here), we discovered that both the Time-1 physiology variables and the oral history variables (also Time-1) were unrelated to the Time-1 SPAFF coding, but they were both related to the Time-2 SPAFF variables. Because of this, we are led to propose that the Time-1 physiology and the Time-1 oral history variables are somehow lead indicators of micro-social processes that predict marital dissolution. We do not understand why these patterns would be lead indicators. However, there must be some process of temporary adaptation that occurs and eventually is reflected by the deterioration of Time-2 marital interaction. Perhaps chronic physiological arousal and negative narratives about the marriage will eventually lead the spouses to cross the critical threshold that separates adaptation from marital deterioration.

The theory we suggest is that the negative cascade micro-social processes of dis-

[2] But not in terms of the serious problem of common method variance that Bank, Dishion, Skinner, & Patterson (1990) termed "glop." We do not have a common method variance problem since we are using different methods across models, and since most of the Time-1 model variables across models were not highly related, but were predictors of Time-2 interaction cascade variables.

gust, contempt, belligerence, defensiveness, and stonewalling at Time-1 are indices of a pattern that the couple has created over time that produce higher levels of physiological arousal, even in anticipation of a conflict discussion. Furthermore, we suggest that if higher occupation times in these aversive states of physiological arousal are characteristic of the marriage, this probably produces the negative narratives we code during the oral history interview. Thus, we propose the link that the chronic presence of corrosive micro-social processes are causally connected to the baseline physiological arousal in anticipation of interaction, and that this aversive bodily state is what leads couples to begin to recast the stories they tell themselves and one another about their spouse and their marriage, particularly its toxicity.

At this point, we cannot test this theory with our data. In fact, longitudinal correlational data are inadequate to test such a theory. Instead, real experiments are needed in which we temporarily change one variable in the theory, such as preconversation baseline heart rate, presumed to be causally related to interaction patterns, and see if this is the case. We are currently conducting these experiments to study proximal rather than distal change.

We suggest that, over time, these corrosive patterns reverberate as chronically toxic interaction patterns, and this process occurs as follows: The narrative fondness variables are particularly central because we believe that what might be called the "Fondness and Admiration" system is the antidote for contempt. Fondness and admiration reflect a spontaneous, ongoing process in which spouses rehearse thoughts of respect and love for one another. This may be the antidote for contempt in marital conflict interaction. We thus propose that contempt in the marital interaction and physiological arousal in anticipation of the interaction are causally responsible for the corrosion of the fondness and admiration system. Finally, the change in these narratives leads to toxic visions of the marriage and one's partner that are highly nondisconfirmable, and this effect is then seen again in considerably further deteriorated marital interaction patterns 4 years later.

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Manuscript received January 12, 1999; accepted January 21, 1999.