

Physiological and Affective Predictors of Change in Relationship Satisfaction

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In 1980, 30 married couples had engaged in a low-conflict and a high-conflict conversational interaction while continuous physiological data were obtained. In a separate session each spouse had provided a continuous self-report of affect while viewing the videotape of the interaction. In 1983, 19 of these couples were re-located to determine the change in relationship satisfaction that had occurred over the preceding 3 years. A broadly based pattern of physiological arousal (across spouses, interaction segments, and physiological measures) in 1980 was found to predict decline in marital satisfaction; the more aroused the couple was during the 1980 interactions, the more their marital satisfaction declined over the ensuing 3 years. Several affective variables also predicted decline in marital satisfaction, including a pronounced sex difference in negative affect reciprocity: Marital satisfaction declined most when husbands did not reciprocate their wives' negative affect, and when wives did reciprocate their husbands' negative affect.

In an earlier article (Levenson & Gottman, 1983), we used physiological and affective data obtained during conversational interactions to predict current levels of marital satisfaction in a sample of 30 married couples. As we noted there, measures of marital satisfaction, which have been developed in the sociological literature over the past 40 to 50 years, have reasonable levels of psychometric reliability, discriminant validity, and predictive validity. Thus, it makes good scientific sense to attempt to account for variation in marital satisfaction on some independent basis. To accomplish this, while couples engaged in these conversational interactions, we obtained continuous measures of the physiological state of each spouse and derived a measure of the physiological interrelatedness or "linkage" between spouses. In separate ses-

sions, each spouse viewed the videotape of the conversation and provided a continuous rating of his or her affective state during the interaction. Both physiological and affective measures were found to be highly predictive of the couple's current level of marital satisfaction. The relation between physiology and marital satisfaction was particularly powerful. For example, our measure of physiological linkage by itself accounted for over 60% of the variance in marital satisfaction. The strength of these findings, compared with previous work using questionnaires (see Burgess, Locke, & Thomes, 1971, for a review) and behavioral observation (e.g., Gottman, 1979), led us to an unexpected conclusion. Prediction of how satisfied a couple was with their marriage was more accurate if based on their physiological responses during an interaction than if based on a careful observation of the interaction.

Being able to predict current levels of marital satisfaction on some independent basis is undoubtedly useful, but being able to predict future levels of marital satisfaction may be even more important. Marital dissatisfaction has been shown to be predictive of marital instability (Terman & Wallin, 1949) and of stress in families, which has deleterious effects on the physical and psychological

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health of the spouses (Bloom, Asher, & White, 1978) and on the psychological health and adjustment of children (Emery, 1982). A technique that enables prediction of which marriages will become more satisfied and which will become less satisfied would have great importance both for understanding the nature of relationship satisfaction over time and for identifying marriages that are at high risk for future instability and stress. These marriages would be prime candidates for therapeutic intervention.

Research on marital satisfaction has been overwhelmingly cross sectional. Among the few longitudinal studies, Terman and Wallin (1949) found that their inventory of marital happiness was moderately successful ($r = .47$) in predicting marital stability. Bentler and Newcomb (1978) found that a number of demographic and personality variables (e.g., older wives, less extraverted husbands) measured at the time of marriage were predictive of marital stability 4 years later, but the correlations were low ($r_s = .23$ to $.33$). Markman (1979, 1981), in the only longitudinal study that attempted to predict future marital satisfaction on the basis of affective self-report during premarital interactions, found that the positivity of ratings of the impact of statements made during these laboratory interactions was predictive of marital satisfaction in nine couples followed up 2½ ($r = .67$) and 5½ ($r = .59$) years later. Skolnick (1981), using longitudinal data from the Berkeley Growth Study, the Berkeley Guidance Study, and the Oakland Growth Study, found that coders' ratings of the quality of adolescent relationships were moderately predictive of subjects' marital satisfaction in midlife.

Given the paucity of longitudinal research in this area and our previous finding that physiological and affective measures were excellent predictors of current levels of marital satisfaction (Levenson & Gottman, 1983), we decided to undertake a follow-up study to determine how well the measures we obtained in that study, which was conducted during the summer of 1980, would do in predicting changes in marital satisfaction 3 years later. Thus, in summer 1983, we began the process of trying to re-locate the 30 couples who had participated in the original study.

Method

Subjects

The only information we had on the 30 couples from Bloomington, Indiana, who had participated in the original study were their 1980 addresses and places of employment. Fortunately, the population of southern Indiana is quite stable; a number of the couples still lived in Bloomington or in the surrounding areas. Others who had moved were tracked down by using such resources as employer records and records kept by educational institutions and by contacting people with the same last name in search of relatives. In all, 21 couples were located and asked to participate in the follow-up study. One couple declined, and one couple had divorced, with only the wife agreeing to participate. Thus, we ended up with 19 intact couples for the follow-up (63%). This percentage compares favorably with other recent longitudinal studies, such as Bentler and Newcomb's (1978) 4-year follow-up (48%) and Markman's (1979) 2½-year follow-up (54%). Couples electing to participate were mailed a package of questionnaires to complete in return for a \$15 payment.

Procedure: 1980 Study

The methodological details of the original study were presented in Levenson and Gottman (1983) and thus will be reviewed only briefly here.

Married couples were recruited by newspaper advertisement and were scheduled for three laboratory sessions. The first session was scheduled for a time when the couple would not have spoken to each other for at least 8 hours. This session consisted of two 15-min conversations, each preceded by a 5-min preinteractional baseline during which they sat in silence. In the first conversation, the couple was asked to discuss the "events of the day" as if they were home alone at the day's end. In the second conversation, they discussed a conflictive problem area in their marriage. In the second and third sessions, each spouse returned separately to view the videotape of the first session's interaction. A continuous rating of affect was obtained by having the spouse manipulate a rating dial that traversed a 9-point scale (anchored by *very negative* and *very positive* on the extremes and by *neutral* at the center). Spouses were instructed to adjust the dial as often as necessary so that it always reflected the way they felt during the interaction. A laboratory computer monitored the position of the dial continuously and calculated an average every 10 s.

Four physiological measures were obtained from each spouse during the first session's baselines and interactions: (a) heart rate, measured by the interbeat interval (IBI); (b) pulse transmission time (PTT) to the finger, that is, the time interval between the R-wave on the electrocardiogram and the arrival of the pulse pressure wave at the finger tip; (c) skin conductance level (SCL); and (d) general somatic activity (ACT), a global measure of bodily movement. The laboratory computer monitored these physiological variables continuously, averaging them every 10 s.

Both affective and physiological variables were enlisted to attempt to predict couples' changing levels of marital satisfaction. The computations used to derive these predictor variables can be found in our earlier report

(Levenson & Gottman, 1983) and will be presented only briefly here.

For the affect ratings, affect frequency measures were derived by counting the number of 10-s periods during the interactions that met a priori criteria for being classified as positive or as negative. These criteria took into account both raw (the absolute dial position) and normalized (the dial position relative to that spouse's mean rating and rating variability) information. Then measures of affect reciprocity were computed that indicated the probability that a positive or negative rating by one spouse would be accompanied by the same rating by the other spouse in the same 10-s period or followed by the same rating in the next 10-s period. There were 24 affective predictor variables in all, including 8 affect frequencies (2 spouses \times 2 interaction segments [events of the day or conflict area] \times 2 affects [positive or negative]) and 16 affect reciprocity variables (2 spouses \times 2 interaction segments \times 2 affects \times 2 lags [same period or next period]).

For each spouse's physiological variables, we computed simple means for the preinteraction baselines and interaction segments (see Table 1). Then, using bivariate time-series analyses, we computed the extent of "physiological linkage" between spouses during each interaction. This indicated the degree to which each spouse's physiological activity (across all four physiological measures) could be predicted from the other's activity, controlling for the autocorrelation within each spouse's data. There were 34 physiological predictor variables in all: 32 means (2 spouses \times 4 segments [baseline or interaction for events of the day or conflict area] \times 4 physiological measures) and 2 linkage measures (2 segments—events of the day or conflict area).

Procedure: 1983 Follow-Up

Couples who were located and who agreed to participate were mailed a package of questionnaires that included the two inventories of marital satisfaction used in our original study (Burgess et al., 1971; Locke & Wallace, 1959), a physical health inventory,¹ and a general information questionnaire. As in the original study, a single measure of the couple's marital satisfaction was derived by averaging the marital satisfaction scores of both spouses on the two satisfaction inventories. This single measure reflects our view that in marriage research the couple is the most relevant unit of analysis. Nonetheless, separate data on each spouse's satisfaction levels were preserved to use in exploratory analyses.

Results

Changes in Marital Satisfaction

Marital satisfaction declined nonsignificantly over the 3 years in the follow-up sample, $t(18) = 1.84$. In 1980, these 19 couples averaged 117.1 on our satisfaction measure;² in 1983 they averaged 108.9. Of the 19 couples, 13 reported lower marital satisfaction in 1983 than in 1980, and only 6

reported higher satisfaction. Change in marital satisfaction for husbands and wives was highly correlated, $r(19) = .79$.

To determine whether any of the 1980 affective or physiological variables were able to predict changes in marital satisfaction 3 years later, we first calculated a simple change score by subtracting the 1980 satisfaction score from the 1983 score ($M = -8.2$, standard error = 4.5). Partial correlations were then computed between this change score and the set of affective and physiological predictor variables (controlling for the 1980 satisfaction scores³). The .05 significance level (two tailed) was adopted for all analyses. For consistency, and to emphasize the importance of marital dissatisfaction, all findings will be presented in terms of predicting decreases in marital satisfaction.

Predicting Decreases in Marital Satisfaction

Affect and affect reciprocity. Several affect variables proved to be good predictors of changing levels of couples' marital satisfaction. On the basis of affect rating data obtained during the events of the day interaction in 1980, decreases in marital satisfaction over the ensuing 3 years were predicted by (a) less

¹ These inventories were included to obtain pilot data on the procedure of having each spouse rate the other spouse's physical health (to help control for the tendency of male subjects to underreport their own health problems). Using these data, the more the marital satisfaction had declined between 1980 and 1983, the lower the husbands', $r(16) = .42$, and wives', $r(16) = .62$, 1983 health was. The potential importance of this kind of relation between marital dissatisfaction and declining physical health has caused us to include a more systematic follow-up of these very interesting preliminary findings in our ongoing longitudinal studies.

² The 19 couples constituting the follow-up sample had nonsignificantly higher marital satisfaction levels in 1980 (1980 $M = 111.7$) than the 11 couples who did not participate in the follow-up (1980 $M = 102.2$), $t(28) = 1.89$.

³ In intact couples there is reason to expect a regression toward the mean in marital satisfaction over time; thus it made sense to control for the original satisfaction level by using a partial correlation technique. To make sure that our findings were not in any way artifacts of this decision, all correlations between predictor variables and change in satisfaction were recomputed without partialing out the 1980 satisfaction levels. Naturally, the magnitudes of individual correlations were somewhat different between the two analyses; however, the pattern of significant correlations was essentially unaltered.

Table 1
Means for Physiological Predictor Variables and Rating Dial Position

Content	Husband					Wife				
	IBI ^a	PTT ^a	SCL ^b	ACT ^c	RAT ^d	IBI ^a	PTT ^a	SCL ^b	ACT ^c	RAT ^d
Events of day										
Baseline	809	229	12.0	0.62	4.4	770	217	12.6	0.72	4.3
Interaction	785	231	14.4	1.26	4.4	753	214	17.2	1.29	4.5
Conflict area										
Baseline	842	235	14.5	0.69	4.1	806	212	23.2	0.67	4.2
Interaction	814	232	16.6	1.53	3.9	785	206	25.0	1.49	3.8

Note. IBI = heart rate, interbeat interval; PTT = pulse transmission time; SCL = skin conductance level; ACT = general somatic activity; RAT = rating dial.

^a In ms. ^b In μ mhos. ^c In units. ^d Range = 1-9.

positive affect by the husband, $r(16) = .54$; (b) more positive affect by the wife, $r(16) = -.43$; and (c) less reciprocity of the wife's negative affect by the husband in the same 10-s rating period, $r(16) = .40$. On the basis of affect rating data obtained during the conflict area interaction in 1980, decreases in marital satisfaction over the ensuing 3 years were predicted by (a) less negative affect by the husband, $r(16) = .53$; (b) greater reciprocity of the husband's negative affect by the wife in the same rating period, $r(16) = -.61$; and (c) greater reciprocity of the husband's negative affect by the wife in the following rating period, $r(16) = -.75$.

Our exploratory analysis, in which change in each spouse's satisfaction was treated separately, produced results that were generally similar to those derived from analysis of changes in the couple's satisfaction. Only one new significant correlation emerged (during the events of the day, decrease in the wife's marital satisfaction was predicted by less reciprocity of her negative affect by the husband in the following rating period, $r(16) = .52$), and the directions of all correlations that had been significant in the analysis of couples' satisfaction remained the same. However, this spousal analysis revealed an important aspect of the relation between affect reciprocity and change in marital satisfaction. Those affect reciprocity measures that had successfully predicted changes in the couple's satisfaction level (and the additional significant correlation revealed in the spousal analysis) were found to be significantly predictive

of changes in the wife's satisfaction, but not of changes in the husband's satisfaction. For events of the day, $r(16) = .41$ for the wife and $r(16) = .13$ for the husband for less reciprocity of the wife's negative affect by the husband in the same rating period; $r(16) = .52$ for the wife and $r(16) = .17$ for the husband for less reciprocity of the wife's negative affect by the husband in the following rating period. For conflict area, $r(16) = -.78$ for the wife and $r(16) = -.25$ for the husband for more reciprocity of the husband's negative affect by the wife in the same rating period; $r(16) = -.96$ for the wife and $r(16) = -.31$ for the husband for more reciprocity of the husband's negative affect by the wife in the following rating period.

Physiological variables. A number of physiological variables proved to be potent predictors of changing levels of marital satisfaction. In Table 2, the correlations between change in marital satisfaction and physiological averages during the baselines and interactions are presented. Fourteen of the 32 correlations were significant. Several aspects of the pattern of correlations merit noting. Significant correlations were found for (a) both baseline ($n = 7$) and interaction ($n = 7$); (b) both the events of the day ($n = 7$) and the conflict area ($n = 7$) segments; (c) both the husband ($n = 9$) and the wife ($n = 5$); (d) all four physiological variables—IBI ($n = 4$), PTT ($n = 2$), SCL ($n = 7$), and ACT ($n = 1$). Several of the significant correlations were quite large in magnitude, including some above .90.

Table 2
Physiological Predictors of Changing Marital Satisfaction

Content	Husband				Wife			
	IBI	PTT	SCL	ACT	IBI	PTT	SCL	ACT
Events of day								
Baseline	.77**	.71**	-.39	-.21	.02	-.27	-.50*	-.34
Interaction	.80**	.76**	-.56*	.10	.08	-.16	-.62*	-.26
Conflict area								
Baseline	.92**	.37	-.49*	-.22	.01	.23	-.58*	-.53*
Interaction	.92**	.48	-.48*	.08	-.11	.40	-.76**	-.02

Note. IBI = heart rate, interbeat interval; PTT = pulse transmission time; SCL = skin conductance level; ACT = general somatic activity.

* $p < .05$. ** $p < .001$.

Particularly striking was the consistency of the physiological meaning of these correlations. If an "arousal" metaphor⁴ is adopted to characterize directional changes in each of the physiological variables (i.e., greater arousal = shorter IBIs, shorter PTTs, higher SCLs, and higher ACTs), then all significant correlations can be accounted for with a single statement: The more aroused the subjects were in 1980, the more their marital satisfaction declined between 1980 and 1983.

The exploratory analysis that separately treated changes in each spouse's satisfaction level further strengthened this finding. All 14 of the correlations that significantly predicted decreases in the couple's satisfaction were found to significantly predict decreases in that spouse's satisfaction. (The directions of significant correlations were the same in both analyses.) In addition, three more indicators of greater physiological arousal on the part of the wife—that is, higher ACT during events of the day baseline, $r(16) = -.52$; shorter PTTs during conflict area baseline, $r(16) = .41$; and interaction, $r(16) = .54$ —significantly predicted decline in her marital satisfaction. Thus, in comparison with the analysis of couples' satisfaction, the number of significant correlations in the analysis of each spouse's satisfaction was more equal for husbands ($n = 9$) and for wives ($n = 8$).

Although we had found the measure of physiological linkage during the conflict area to be predictive of 1980 marital satisfaction in our earlier work (Levenson & Gottman, 1983), neither it nor the measure of linkage

during the events of the day was significantly predictive of changes in satisfaction over the 3 ensuing years.

Discussion

This research program has to date produced two different kinds of findings. First, in our earlier article (Levenson & Gottman, 1983), we reported being able to account for a sizable portion of the variance in current levels of marital satisfaction by combining information from physiological measures obtained during conversational interaction with information from affective measures obtained while spouses viewed a videotape of their interactions. Second, the present results show that we are able to use the same set of measures to account for most of the variation

⁴ Shorter IBIs (i.e., faster heart rates), shorter PTTs (i.e., greater cardiac contractility and/or faster pulse wave velocities), higher SCL (i.e., more sweat gland activity), and higher ACT (i.e., more voluntary muscle mediated movement) would be viewed by most psychophysiologicals as indicative of a state of greater arousal. In terms of the underlying autonomic nervous system activity, these changes in PTT and SCL imply greater sympathetic nervous system action, whereas the changes in IBI indicate greater sympathetic and/or reduced parasympathetic drive. The increased ACT levels similarly implicate greater action on the part of the voluntary somatic nervous system. The measures used in the present study were selected to provide a broad sampling of physiological systems; thus higher activity levels in all measures indicate a broadly based physiological arousal. Levenson (1983) provides a discussion of the limitations and utility of the arousal construct when applied to psychophysiological research.

in change in marital satisfaction levels over a 3-year period. We were quite encouraged with the first findings, insofar as they demonstrated a strong interrelation or concurrence between physiology, affect, and the subjective evaluation of relationship satisfaction. Furthermore, the strength of this interrelation was stronger than had previously been found between observable behavior and marital satisfaction. The second findings are even more encouraging because they indicate that we could use one class of measures (physiology and affect) to successfully predict changes in the other measure (marital satisfaction) over a 3-year period.

Affect Findings: Some Interesting Sex Differences

Amount of positive and negative affect. Our results indicate that the amount of positive and negative affect and certain patterns of negative affect reciprocity were predictive of changing levels of relationship satisfaction. What is striking about these results are the sex differences that emerge. In terms of amount of positive affect during the events of the day segment, decline in marital satisfaction is predicted by less positive affect on the part of the husband and, surprisingly, by more positive affect on the part of the wife. In terms of amount of negative affect during the conflict area segment, decline in marital satisfaction is predicted by less negative affect on the part of the husband and is not predicted by the amount of negative affect on the part of the wife. We cannot look to the experimental literature for precedents to evaluate these findings. In the only other study that used affect ratings obtained during interaction as a predictor of marital satisfaction (Markman, 1979, 1981), the ratings of the wife and husband were combined. Obviously, we will need to replicate these findings, but in the meantime some speculation as to their bases can be offered.

There is some evidence that, in dissatisfied marriages, husbands are more likely to withdraw emotionally than wives. Terman, Buttenweiser, Ferguson, Johnson, and Wilson (1938) found this pattern in marital grievances; it was only the wives who complained that their spouses withdrew and did not show

affection. Similarly, Locke (1951) observed that in unhappy marriages men withdraw in terms of the demonstration of affection, whereas women do not. In Komarovsky's (1962) study of blue-collar couples, she wrote that when "confronted with a marriage conflict, a greater proportion of the husbands than the wives withdraw" (p. 193). Building on this base and on our own observations of married couples, we think that among married couples who are moving along the pathway toward declining marital satisfaction, it is likely for the husband to withdraw emotionally much earlier than the wife. Our data indicate that this emotional withdrawal on the part of the husband is quite pervasive, because lower levels of husbands' negative and positive affect were associated with subsequent declines in marital satisfaction. Our finding of greater positive affect on the part of the wife in marriages that declined in satisfaction may reflect her initial response to her husband's emotional withdrawal, which was to increase her own level of positive affect. This may represent her attempt to coax him back into the emotional life of the marriage and may serve to compensate for his lack of emotional behavior and thus temporarily preserve the marriage (i.e., avoid divorce), albeit at a lower level of marital satisfaction.

Negative affect reciprocity. In this instance the differences between husbands and wives were expected and confirmatory of hypotheses we have been developing concerning sex differences in the affective qualities of marriage. Combining the results across interaction segments, decline in marital satisfaction was predicted by more reciprocity of the husband's negative affect by the wife, and by less reciprocity of the wife's negative affect by the husband. We think this reflects a desire on the part of men to be able to vent their negative feelings in a marriage and then to be left alone. In contrast, we think that women find it more satisfying to have their negative feelings responded to and find it particularly punishing to have these feelings ignored. Of course, these hypotheses are still speculative, but the present results must be considered supportive.

The studies by Terman et al. (1938), Locke (1951), and Komarovsky (1962) all support

the pattern of greater affective responsivity on the part of wives as compared to husbands in dissatisfied marriages. Our exploratory analysis of changes in each spouse's satisfaction level suggests that wives may be more finely attuned to the quality of emotional interchange in a marriage than are husbands, at least insofar as patterns of negative affect reciprocity are concerned. Because declines in the wife's satisfaction are predicted both by her husband's failure to reciprocate her negative affect and by her reciprocating his negative affect, the basis for a very vicious cycle is established. As marital satisfaction declines, husbands and wives may produce exactly those behaviors that will further decrease marital satisfaction (i.e., emotional withdrawal on the part of the husband, making the wife less satisfied; increased affect and increased negative affect reciprocity on the part of the wife, making the husband less satisfied). If these speculations are true, there is a clear challenge to those who wish to intervene in the process of marital dissolution to develop new kinds of interventions that take these gender differences into account.

Physiological Findings

As we indicated in the presentation of results, there was a unified pattern to all of the physiological findings. This pattern was evidenced across spouses, interaction segments, baselines, and physiological measures: The more physiologically aroused the subjects were in 1980, the more their marital satisfaction declined over the ensuing 3 years. The finding was even stronger when changes in husbands' and wives' satisfaction levels were analyzed separately. A finding that is so pervasive produces a unique set of interpretive difficulties. Clearly, we had conceptualized the experimental procedure as having a great deal of specificity in terms of baseline versus conversational periods, events of the day versus conflict area discussion, and husbands versus wives. Similarly, our physiological measures were chosen to afford some degree of specification in terms of underlying biological processes (e.g., cardiovascular vs. electrodermal vs. somatic). Because none of these distinctions dominated the outcome, our thinking has been forced in a more global

direction. A common element is implicated, one that cuts across all of these factors, affecting them uniformly. We believe that this factor is the couple's past affective experience with interaction, compiled and summarized over the history of the relationship.

Let us begin by discussing the finding that physiological levels during the preinteractional baseline were strongly predictive of changing levels of marital satisfaction. Initially we were surprised by this finding. It suggested the possibility that we had uncovered a physiological trait of hyperarousal that characterized couples who were destined to become more dissatisfied with their marriages. Although appealing in its simplicity, and with full realization that our correlational design precludes a definitive rejection, we think this possibility is unlikely. Instead we now believe that our baseline segments were not well structured for determining basal or resting physiological levels. Observation of the video records of these segments reveals that these were not periods of neutrality and inactivity. Rather, as the couple sat facing each other, there was a great deal going on. Couples made and broke eye contact, they pantomimed messages, and they reacted without words to the experimental setting and to each other. Furthermore, and we think most crucially, they knew that they would soon be interacting with each other. Thus the baseline segment became another period of interaction, albeit silent, and a period of expectation of interaction. We think the observed physiological levels were reflective of these ongoing behavioral and affective processes and not of the spouse's true basal levels.⁵ Viewed in this way, the baseline and interaction segments can all be subsumed under the single rubric of *marital interaction*.

Interaction seems to us to be the litmus test of a marriage. On a day to day basis, the quality of interaction defines the quality of a marriage. The intensity of the interaction and of the concomitant affect may be heightened when external issues such as money, in-

⁵ A better procedure for determining basal levels would be to measure physiological levels during a period of inactivity in a separate session in which no interaction or viewing of video records was to occur, and when each spouse was alone in the laboratory.

laws, and careers impinge or when more internal issues such as sex, fidelity, child-rearing, and affection are addressed. In marriages that are working well, the couple's interactive style is constructive, affirming, and enjoyable. In unhappy marriages, the interactive style may be destructive, defeating, and dismal. Over time, a couple develops a set of expectations about the prospect of interacting that is grounded in their past interactive experience. In happy marriages, there may be an expectation of pleasure and a sense of optimism that becomes associated with the anticipation of interaction, whether it is sharing the events of the day after a period of separation or working on a problem that needs to be solved. In unhappy marriages, an expectation of displeasure, dread, and pessimism may evolve because past interactions, whether they be over mundane or profound issues, have been experienced as highly punishing. We believe that it is these pleasurable or unpleasurable expectations that account for the arousal differences we have observed during baseline periods when couples sit facing each other for 5 min in silence, knowing that they will soon be engaged in interaction. These expectations are then carried over into the interactions themselves, which our subjects have consistently indicated are prototypical of the kind of interactions they have experienced in the past.

This perspective leads us to propose several distinguishing characteristics of the couples observed in 1980 whose marital satisfaction declined most over the next 3 years. We believe that these couples would have had the most punishing interactions in the past and that they would have the least hope of improving these interactions in the future. For them, the interaction required by our experimental procedures would have been troublesome, then unsettling, and ultimately, highly arousing. Although we do not know what specific emotions these couples were experiencing, we expect that they were predominantly the negative affects of fear, anger, and sadness—fear of the impending interaction, anger toward each other, and sadness about the bleak prospects for their marriage. If these affects predominated, then the heightened physiological arousal that they evidenced would be consistent with past and recent

studies of the physiology of specific emotions. For example, Ekman, Levenson, and Friesen (1983) recently reported that the emotions of fear, anger, and sadness were all associated with increases in heart rate.

Physiological Assessment Versus Behavioral Observation

At first glance, it might seem preposterous to assert that observing physiology can tell us more about marital satisfaction than observing behavior. At this point, such an assertion would admittedly be based on preciously little data. Empirically, we can only point to the larger magnitude of correlations found in our work compared with those using behavioral coding—and in the case of longitudinal prediction, there have been very few studies. Clearly, behavioral observation will always be superior to physiological measurement when one wants to answer the question, "What happened in the interaction?" Nonetheless, we do not expect that behavioral observation will ever be able to account for as much of the variance in marital satisfaction as will physiological measurement. There is some research evidence that supports this belief. Both trained coders (Gottman, 1979) and naive observers (Royce & Weiss, 1975) have been shown to be able to predict current levels of marital satisfaction from observation of marital interaction at better than chance levels. Neither group, however, has been as successful as we have been using physiological measures (Levenson & Gottman, 1983). There have been no empirical studies of trained observers' ability to predict changes in marital satisfaction, but our informal observations suggest that the predictions of even our most experienced colleagues have been uniformly poor. With the advantage of hindsight, we think we can identify some potential sources of errors made by all observers of marital interaction, whether they are naive, trained coders, or experienced professionals.

When observers view brief marital interactions, they are in effect applying a normative metric to that which they observe. In the case of empirically derived coding systems, these norms will derive from previously obtained group data. In the case of more casual observation, the normative metric will derive

from past personal experiences and subjective opinions concerning what makes for a good marriage, or more to the point, what makes for a good marital interaction. Of course, the observer's metric may be totally inappropriate for the couple being observed. Many professionals place a high value on lively, responsive, spirited, and even argumentative interaction (or at least they place a high value on this when viewing the interactions of others). When they see a marriage in which partners do not engage each other in this manner, when they see distance, low affect, uninvolved, or separateness, they assume the couple is dissatisfied. However, in the culture of that marriage, given their history and their values, that couple might be highly satisfied. For them, a spirited, argumentative interaction might be highly unpleasant.

Compared with having an observer code or a professional rate marital satisfaction on the basis of a couple's behavior, the inherent advantage of our measurement of the couple's physiology while they interact and of our (and Markman's, 1979) having the couple provide affect ratings derives from a simple and perhaps obvious fact. The only observers who we can be certain are applying the appropriate normative metric to a couple's marital interaction are the husband and wife themselves. The physiological measures and affect ratings we obtain from that husband and wife are resultants of their application of that metric, of their ongoing appraisal of the interaction, and of the emotions and behaviors that the interaction brings forth.

Concluding Comments

Our work to date has provided indication of the promise of using physiological and affective measurement in research on marital interaction in particular and on social interaction in general. Much of the variance in marital satisfaction—both current levels and future changes—appears to be encoded in the patterns of physiology and affect that occur during interaction. Physiological measurement seems to be particularly powerful in this regard. Measures of physiological linkage during interaction were found to account for over 60% of the variance in current levels of marital satisfaction (Levenson & Gottman,

1983), and now single simple measures of physiological functioning (e.g., heart rate) have been found to account for over 80% of the variance in satisfaction change over a 3-year period. There has been an intriguing but baffling specificity in these findings: Physiological linkage is a better predictor of current levels of marital satisfaction than are measures of mean physiological levels; measures of mean physiological levels are better predictors of future levels of marital satisfaction than is physiological linkage. In some ways this is an encouraging difference, indicating that the more difficult analysis of the interrelation between two individuals' physiological responding over time can tell us different things than more simple single-person/single-response averages. We do not as of yet understand the basis for this specificity, but hopefully we will come to understand it as we continue to work with this data set and with a recently collected data set obtained from a new cohort of 80 couples. With this new and larger data set, we should also be able to cross-validate and extend what we have found so far.

We are hopeful that other investigators, encouraged by our findings to date, will use our methods as tools for studying a wider range of social interactive phenomena so that the pace of progress in understanding the relations among physiological, affective, and behavioral processes in social interaction will be quickened.

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