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## Temporal associations between spouse criticism/hostility and pain among patients with chronic pain: A within-couple daily diary study

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### Abstract

Chronic musculoskeletal pain can strain marriages, perhaps even to the point of engendering spouse criticism and hostility directed toward patients. Such negative spouse responses may have detrimental effects on patient well-being. While results of cross-sectional studies support this notion, we extended these efforts by introducing expressed emotion (EE) and interpersonal theoretical perspectives, and by using electronic diary methods to capture both patient and spouse reports in a prospective design. Chronic low back pain (CLBP) patients and their spouses (N = 105 couples) reported on perceived spouse behavior and patient pain 5 times/day for 14 days using Personal Data Assistants (PDAs). Concurrent and lagged within-couple associations between patient's perceptions of spouse criticism/hostility and patient self-reported pain and spouses' observations of patient pain behaviors revealed that 1) patient perceived spouse criticism and hostility were correlated significantly with pain intensity, and spouse observed patient pain

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behavior was related significantly with patient perceived hostility at the same time point; 2) patient perceived spouse hostility significantly predicted patient pain intensity three hours later, and spouse observed pain behaviors significantly predicted patient perceived spouse hostility three hours later. Results support both EE and interpersonal models, and imply that a comprehensive model would combine these conceptualizations to fully illustrate how spouse criticism/hostility and patient pain interact to produce a negative spiral. Given that marital interactions are amenable to clinical intervention, improved insight into how spouse behavior and patient pain are tightly linked will encourage productive translational efforts to target this neglected area.

## Keywords

Chronic low back pain; spouse criticism/hostility; patient pain behavior; electronic diary methods; lagged effects

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For some people who suffer from persistent pain, the quality of the marital relationship may decline (6,28,35,44). Long-term pain, coupled with lifestyle changes caused by pain, may not only undermine support but may also increase the likelihood of spouses responding in unhelpful ways to patients (36). High levels of negative marital interactions may actually inhibit patient adjustment to chronic pain. In particular, spouse criticism, punishment and hostility have been shown to be related to elevated patient pain intensity (1,4,7,8,9,16,23,27,43).

Despite robust effects in this emerging literature, most studies are not based on well-articulated theories of interpersonal interaction, making it difficult to derive testable hypotheses and to interpret results. Moreover, extant studies have largely been cross-sectional which leaves temporal sequences ambiguous. We propose that the nature of the relationship between spouse criticism/hostility and patient pain may be illuminated by two theoretical perspectives that differ in their temporal sequencing of interpersonal events and pain: expressed emotion (EE) and interpersonal theory. EE theory explains how family environments high in criticism and hostility exacerbate or maintain a variety of illnesses by interacting with patient vulnerability to stress (14), leading to perpetuation of symptoms (19,20). Indeed, relationships between EE and psychiatric relapse are strong (5,19,46). Expanding this model to patients with chronic pain, spouse criticism/hostility may aggravate and perpetuate symptoms of chronic pain, such as patient pain intensity and pain behaviors.

Just as aversive spouse reactions might contribute to poor patient adjustment, the reverse causal pathway may also exist, as described in interpersonal models of depression (12). Interpersonal models hold that depressed patients behave in ways that engender rejection from others and that this rejection in turn perpetuates depression (13). Like spouses of depressed patients (10), spouses of chronic pain patients may become frustrated when pain does not remit and adverse lifestyle changes become seemingly permanent (34). Because patient pain intensity and pain behaviors may provide reminders to spouses of the negative impact of the pain condition, hearing patients speak of pain intensity and witnessing pain behavior may elicit critical and hostile behavior from spouses toward patients (36).

In the present study, we evaluated the degree to which EE and interpersonal models explain connections between spouse criticism/hostility and patient pain behaviors and pain intensity using longitudinal daily diary methodology. Chronic low back pain (CLBP) patients and their spouses were prompted to report on perceived spousal behavior and patient pain 5 times/day for 14 days using Personal Data Assistants (PDAs). Concurrent and lagged within-couple associations between patient's perceptions of spousal criticism/hostility and patient self-reported pain and spouses' observations of patient pain behaviors were examined. If the EE model is valid, then patient perception of criticism/hostility from spouses would predict patient self-report of pain and spousal observations of patient pain behavior concurrently and in the three hours following perceptions of criticism. If the interpersonal model is valid, then spousal observations of patient pain behaviors would predict patient perceptions of spousal criticism/hostility concurrently and in the next three hours.

## Method

### Participants

Participants were 105 married couples recruited primarily through referrals from staff at the pain control centers of Rush University Medical Center in Chicago, IL, Duke University Medical Center in Durham, NC, and Memorial Hospital in South Bend, IN. In order to obtain additional participants and to increase the diversity of the sample we also recruited through advertisements placed in local newspapers and through flyers provided at various health care agencies. Couples received \$300 for participation in the study. The protocol was approved by the Institutional Review Boards at Rush University Medical Center, Duke University Medical Center, and University of Notre Dame.

Inclusion criteria for patients were: a) musculoskeletal pain of the lower back stemming from degenerative disk disease, spinal stenosis, or disk herniation (radiculopathy subcategory), or muscular or ligamentous strain (chronic myofascial pain subcategory); b) pain duration of at least 6 months with an average intensity of at least 3/10 (with 0 being “no pain” and 10 “the worst pain possible”); and c) age between 18 and 70 years. The inclusion criterion for spouses was age between 18 and 70 years.

Exclusion criteria for both patients and spouses were: a) current alcohol or substance abuse problems, or a history of psychotic or bipolar disorders; b) inability to understand English well enough to complete questionnaires; c) acute suicidality; d) psychotic symptoms; e) meeting criteria for substance abuse or dependence (within the past 12 months); f) meeting criteria for depression of postpartum subtype; g) meeting criteria for any type of bipolar disorder; and h) meeting criteria for obsessive-compulsive disorder or posttraumatic stress disorder within the past 2 years. A further exclusion criterion for patients was if their pain complaint was due to malignant conditions (e.g., cancer, rheumatoid arthritis), migraine or tension headache, fibromyalgia, or complex regional pain syndrome. A further exclusion criterion for spouses was if they reported currently suffering from a condition that caused episodes of acute pain (i.e., migraine headaches) or reported a history of chronic pain within the past 12 months.

Inclusion and exclusion criteria were assessed by a detailed medical and psychosocial history, including administration of the Mood Disorder, Psychotic Screening, and Substance Use Disorders modules of the Structured Clinical Interview for DSM-IV Axis I Disorders - Non-Patient Edition (SCID-IV/NP; 15). The medical history assessed general health as well as low back pain.

Initially, we recruited 121 couples, but eight couples declined to participate in the diary portion of the study, three couples started the diary study but did not finish, four couples lost data due to PDA malfunctions, and one couple's data were lost due to failure to upload it from the PDA at an appropriate time. Thus, the final sample included 105 couples. Women patients comprised 48.6% of the sample ( $n = 51$ ). Demographic characteristics of couples not included in this investigation did not differ significantly from those who were included. See Table 1 for sample descriptive information.

### Electronic Diary

Electronic diaries signaled participants to complete five assessments each day, starting at 8:50 am and occurring every three hours until 8:50 pm. Such frequent assessments can help minimize retrospective bias in ratings (42). Daily diary data obtained in this manner also appear to suffer little from reactivity effects that are sometimes cause by monitoring (11,24). Variability in ratings within the day is also captured well by this method (29,41). Studies also have provided support for the reliability, validity, and compliance with electronic diary strategies when used to assess pain, affect, and behavior (11,24,29,42). Electronic diaries with timestamped entries also enable one to accurately assess when ratings were made, something that cannot be done with paper diary methods (24). Finally, the software we used to program PDAs allowed us to include branching algorithms to reduce participant burden. We used the branching algorithms to assess whether participants interacted with their spouse or if spouses observed patients in the past three hours. If participants did interact with their spouse, they would be asked questions about perceived criticism/hostility, but if they did not interact with their spouse, then those questions would be skipped. If spouses reported observing patients, they would be directed to questions asking about pain behaviors they observed in the patient, but if they did not observe the patient, they would not be asked these questions.

Both patients and spouses completed electronic diary measures of pain, behavior and perceived criticism and hostility for 14 consecutive days. The Experience Sampling Program (ESP; 3) was used for this study. For data collection participants were given handheld Palm@ Zire 22 PDAs, running the Palm OS platform. This device provided a high resolution screen that allowed adequate questionnaire readability. All data were stored in nonvolatile memory to prevent data loss in the event of total battery discharge. Participants were instructed to keep the Palm Pilot on a charger during sleeping hours.

### Measures

**Patient Perceived Spouse Criticism and Hostility**—We treated criticism and hostility as separate variables. This separation is used in the EE literature (19), and reflects a desire to specify more precisely which factor is important etiologically and which factor(s)

may be the best target(s) of intervention. In the instructions given to participants, we asked patients to indicate the average amount of criticism over all of the interactions they had with their spouse during the previous 3 hours. We defined hostility for patients as any negative or attacking remark, no matter how mild, especially remarks about the patient in general that are not intended to be helpful, corrective, or supportive in some way. These remarks by the spouse included those that are rejecting or that express dislike of the patient. Although correlated  $r = .60$  in this sample (see Table 2), we analyzed them as separate variables and not as a composite.

At the time of each entry, patients and spouses were asked, “Did you interact with your spouse during the last 3 hours?” If they responded, “yes,” then they were prompted to answer questions about the encounter. For the purposes of the current study, we only analyzed patient reports of their perception of the encounter. Patient perceived criticism was assessed with a variation on the Hooley and Teasdale (22) item, asking “How critical of you was your spouse during the past 3 hours?” Similar to this criticism item, patients were asked to rate how hostile their spouse was during the past three hours. Responses were made on 9-point scales with anchors at 0 (*not at all*), 2 (*somewhat*), 4 (*much*), 6 (*very much*), and 8 (*extremely*).

**Patient Pain Intensity**—At each assessment, patients completed an item asking “During the past three hours, how intense was your pain?” using the same 9-point rating scale as described above for the criticism and hostility items.

**Spouse Observed Patient Pain Behavior**—At each assessment, spouses were asked, “Did you observe your spouse during the past 3 hours?” If they responded, “yes,” then spouses responded to the following item about the patient's behavior: “How many ‘pain behaviors’ (complaining, grimacing, etc) did you hear or see?” “Pain behaviors” were defined for spouses as “anything spoken (complaining, sighing, groaning, etc.) or physically gestured (facial grimace, rubbing, limping, bracing against something, etc.) that tell you your spouse was in pain.”

**Patient Marital Adjustment**—The widely-used, 32-item, Dyadic Adjustment Scale (DAS; 40) measured patients’ perceived marital adjustment at the start of the daily diary study. Scores range from 0 to 151 with higher scores indicating greater marital adjustment. Reports indicate that the scale shows acceptable levels of reliability and validity (18,25,40). The Chronbach's alpha for patients in this sample was .94. The DAS was used in analyses to control for confounding effects of variability in marital adjustment on patient reports of spouse criticism and hostility.

## Procedure

Patients and spouses who inquired about participation underwent screening procedures over the telephone. These procedures included a preliminary determination of whether inclusion and exclusion criteria were likely to be met. Eligible patients and spouses became part of a larger study that involved two laboratory sessions in which they undertook a videotaped marital discussion, a Structured Pain Behavior Task, and completed standard self-report

questionnaires, including the DAS. At the end of the second visit, 7-10 days after the first, patients and spouses signed consent forms to participate in the present electronic diary study. Patient and spouses were instructed to carry the Palm Pilots with them throughout the day for 14 consecutive days. Participants were given definitions of terms contained in the PDA items. For instance, the term “pain behaviors” was explicitly defined for spouses. Participants were also given printed versions of these instructions for later reference and were asked to phone the research assistants with any problems or questions.

Starting at 8:50 am, and then again every three hours until 8:50 pm, participants were alerted by the PDA alarm to complete assessments. Participants had a 15 minute time-frame in which to respond to the PDA and to give ratings of pain and behavior. After the initial alarm, the PDA would emit a signal every 30-seconds until participants responded. Participants were also given the option to tap the screen to dismiss the alarms and delay the signal as long as they completed the assessment within 15 minutes. If participants did not respond in any way within 15 minutes of the original prompt, the time period was coded as missing data. Each assessment session's data was time stamped. At the end of the second week's data collection, participants returned the PDA, data were downloaded, and participants were debriefed.

### **Data Preparation, Analyses and Power**

Data were cleaned so that all item responses submitted past the 15-minute response interval were discarded. After deleting these responses, out of the 7350 possible total responses, there were 80.01 - 87.06% complete data for the various measures in the study. This amount of missing data is in the range typically observed in other electronic diary studies involving pain patients (37,39).

Patients were prompted to answer questions about perceived spouse criticism and hostility only if they first responded positively to a question asking if they had spoken with their spouse in the past three hours. Patients reported speaking to their spouses in 73.2% of the time intervals assessed. Out of those intervals, patients reported perceiving criticism 28.5% of the time and hostility 13.6% of the time. Because data for perceived criticism and hostility were highly skewed, due to a high frequency of 0's, 1's, and 2's on the 9-point scale, we dichotomized perceived criticism and hostility to represent the presence or absence of criticism or hostility. Turning to pain, on 87.5% of intervals patients reported pain intensity above zero. Spouses reported observing patients on 50.6% of intervals, and out of those time points, spouses reported observing at least one pain behavior from patients 72.3% of the time. On average patients reported “somewhat” to “much” pain, whereas spouses observed an average “some” pain behavior on each interval (see Table 2). Zero order correlations averaged across each of the 70 time points for each person are also shown in Table 2. The aggregate concurrent correlations revealed that patients who reported greater pain intensity tended to report greater perceived hostility, and their spouses also observed more frequent patient pain behavior than patients reporting less pain intensity. In contrast, the aggregate concurrent correlations between perceived criticism, pain intensity and pain behavior were nonsignificant.

Proceeding to the main analyses, two-level hierarchical linear models were tested. These models take into account the dependency among scores over time, and they model within-person changes. For all analyses we used the HLM 6 software program (31). To account for autocorrelation of the dependent variable (DV) over time, we controlled for DV values assessed three hours prior. To control for reactive effects during the study, linear effects of time were controlled, which was measured in hours since the beginning of the study. This procedure accounted for the unequal spacing of time points due to the overnight lag between the 8:50 pm and 8:50 am assessments. In each model Time was centered at the first time point of the study. Additionally, we centered all other IV's using person mean centering. As a consequence of this centering algorithm, parameters represent a person's deviance from his or her own average over the course of the study. Parameters, therefore, represent within-subjects effects. Finally, all of the parameters at level-2 were specified as random to allow for variability between subjects, and we report robust standard errors for all parameter estimates to protect against heterogeneity of variance.

We fit two basic models, one for concurrent effects and one for lagged effects. A representative level-1 model testing the EE framework for concurrent effects (i.e., all variables are measured at the same time point) is:

$$\text{Pain Intensity}_{ij} = \pi_{0ij} + \pi_{1ij} (\text{Perceived Criticism}) + \pi_{2ij} (\text{Pain Intensity at } t - 1) + \pi_{3ij} (\text{Time}) + r_{ij},$$

where  $i$  represents the “ $t$ ”th time point and  $j$  represents the “ $j$ ”th person. Time is measured in hours since the start of the study and is centered at 0 so that the intercept,  $\pi_0$ , represents patient pain intensity at the first time point of the study. Perceived Criticism is the person's deviation in perceived criticism from his or her average perceived criticism scores across the study. The DV, Pain Intensity, is the deviation of the person's present pain intensity from their average pain intensity across the study. Pain Intensity at  $t-1$  represents the score of the DV at the prior time point (viz., three hours earlier).

The basic lagged effects model was similar to the concurrent effects model except that all of the predictor variables (IV's) were lagged. In other words, the IVs were assessed at the prior time point, three hours earlier. Thus, a representative level-1 model of perceived spousal criticism and pain intensity according to the lagged EE framework is:

$$\begin{aligned} \text{Pain Intensity}_{ij} = & \pi_{0ij} + \pi_{1ij} (\text{Perceived Criticism at } t - 1) \\ & + \pi_{2ij} (\text{Pain Intensity at } t - 1) \\ & + \pi_{3ij} (\text{Time}) + r_{ij}. \end{aligned}$$

We focused on relatively short, 3 hour lags rather than the longer lags often featured in extant literature – evening of Day 1 to evening of Day 2, for instance. Shortening the assessment window would allow us to capture acute effects of immediate spouse and patient behaviors that might be lost over longer periods. In all, we analyzed two different kinds of models corresponding to either an EE framework or an interpersonal framework. In each case we analyzed four concurrent models and four lagged models. The following four models corresponded to the EE framework; (1) patient perceived spousal criticism related to

patient pain intensity, (2) patient perceived spousal hostility related to patient pain intensity, (3) patient perceived spousal criticism related to spouse observed pain behavior, and (4) patient perceived spousal hostility related to spouse observed pain behaviors. We then tested similar models corresponding to the lagged models where prior patient perceived spousal criticism or hostility predicted patient pain intensity or spouse observed pain behavior in the next three hours.

For the interpersonal framework we tested four concurrent and four lagged models in which patient perceived spousal criticism and patient perceived spousal hostility were the DVs and either patient pain intensity or spouse observed pain behaviors were the main IVs. Because the DVs in these models were dichotomous, we used hierarchical regression models in which the outcome was specified as a Bernoulli distribution. As well, in such models the level-1 model is a non-linear model with an identity link function. Specifically, we analyzed the following concurrent models corresponding to the interpersonal framework; (1) patient pain intensity related to perceived spousal criticism, (2) patient pain intensity related to perceived spousal hostility, (3) spouse observed pain behavior related to patient perceived spousal criticism, and (4) spouse observed pain behaviors related to patient perceived spousal hostility. We then tested similar models corresponding to the lagged models where prior patient pain intensity or spouse observed pain behavior predicted patient perceived spousal criticism and hostility in the next three hours.

Secondary analyses focused on whether patient sex had main effects on DVs, and on whether differences in within-person associations depended on patient sex. Finally, we reran primary analyses to evaluate possible confounding effects of marital adjustment by controlling for between-person differences in DAS scores.

## Results

### Concurrent Models

**EE framework**—Concurrent EE models were those in which either patient perceived spousal criticism or hostility (IV) was related to patient pain intensity or spouse observed pain behavior (DV) at the same time while controlling for prior pain intensity or observed pain behavior. Results revealed that patient perceived spousal criticism was related to patient pain intensity at the same time point while controlling for prior pain intensity,  $b = .12$ ,  $SE = .06$ ,  $t(103) = 2.08$ ,  $p < .05$ . Similarly, patient perceived spousal hostility was also associated with patient pain intensity at the same time point while controlling for prior pain intensity,  $b = .16$ ,  $SE = .06$ ,  $t(103) = 2.46$ ,  $p < .05$ . In contrast, however, neither patient perceived spousal criticism or hostility were significantly related to spouse observed pain behaviors at the same time point while controlling for prior observed behaviors. Thus, if patients perceived more criticism or hostility from spouses than their average level of perceived criticism or hostility, then they also reported higher levels of pain intensity. Deviations from average levels of perceived spousal criticism and hostility were not related significantly to spouse reports of observed pain behaviors at the same time.

**Interpersonal framework**—Concurrent interpersonal models tested whether patient pain intensity or spouse observed pain behavior (IV) were related to patient perceived spousal



criticism or hostility (DV) at the same time point while controlling for prior patient perceived criticism/hostility. Pain intensity was not significantly related to patient perceived spousal criticism or hostility. However, there was a trend toward spouse observed pain behavior relating to patient perceived spouse criticism,  $b = .06$ ,  $t(103) = 1.92$ ,  $p = .058$ ,  $OR = 1.06$ , and spouse observed pain behaviors were significantly related to patient perceived spousal hostility,  $b = .13$ ,  $SE = .04$ ,  $t(103) = 3.19$ ,  $p < .01$ ,  $OR = 1.14$ . In other words, when spouses reported the level of patient pain behavior to be one point greater than their average, patients were 6% and 14% more likely to report perceiving spousal criticism or hostility at that time.

### Lagged Models

**EE framework**—Lagged EE models tested whether patient perceived spousal criticism or hostility predicted patient pain intensity or spouse observed pain behavior three hours later while controlling for prior pain intensity or observed pain behavior. Patient perceived spousal criticism did not significantly predict later pain intensity. However, patient perceived spousal hostility did significantly predict patient pain intensity in the three hours following the hostility,  $b = .13$ ,  $SE = .06$ ,  $t(104) = 1.98$ ,  $p = .05$ . Neither patient perceived criticism nor hostility predicted later spouse observed pain behaviors. In sum, only when patients reported perceiving higher than average spousal hostility did they report greater pain intensity in the next three hours.

**Interpersonal framework**—Lagged interpersonal models reverse the direction of the EE models. Results revealed that patient pain intensity negatively predicted perceived spousal criticism in the three hours following the pain,  $b = -.09$ ,  $SE = .03$ ,  $t(103) = -2.55$ ,  $p < .05$ ,  $OR = .92$ , meaning that if patients reported their own pain intensity to be one point higher than their average pain intensity, they were 8% *less* likely to report perceiving criticism from their spouse in the next three hours. Patient pain intensity, however, did not significantly predict patient perceived hostility in the next three hours. Unlike patient self-reported pain intensity, spouse observed pain behavior did not significantly predict patient perceived spousal criticism in the next three hours. However, unlike patient pain intensity, spouse observed pain behaviors did significantly predict patient perceived spousal hostility in the next three hours,  $b = .11$ ,  $SE = .04$ ,  $t(103) = 3.13$ ,  $p < .01$ ,  $OR = 1.12$ . That is, when spouses reported observing pain behavior that was 1-point higher than their average, patients were 12% *more* likely to report spousal hostility toward them in the next three hours.

### Tests of Patient Sex Differences

We also ran separate models to test for main effects of sex on DVs, and whether within-person associations between IVs and DVs differed depending on patient sex. There were no significant main effects of sex on any DVs. All Sex  $\times$  IV interactions were also nonsignificant.

### Controlling for Marital Satisfaction

We evaluated the possibility that variability in marital satisfaction may confound associations between perceived criticism/hostility and patient pain intensity and observed pain behaviors. We reran analyses with DAS scores controlled. Results of primary analyses

remained largely unaltered with the exception that a previous trend became nonsignificant (i.e., observed pain behavior was no longer related to perceived criticism at the same time point,  $b = .05$ ,  $SE b = .03$ ,  $t(103) = 1.65$ ,  $p = .10$ ). Primary findings remained significant despite DAS scores showing significant main effects for perceived criticism and perceived hostility. Higher levels of marital satisfaction were related to lower levels of perceived criticism ( $r = -.49$ ;  $p < .05$ ) and hostility ( $r = -.36$ ;  $p < .05$ ). See Table 2. DAS main effects for pain intensity and observed pain behaviors were nonsignificant.

## Discussion

Chronic musculoskeletal pain persisting for months or years, and the attendant lifestyle changes imposed on spouses by this condition, can strain marriages, perhaps even to the point of engendering negative spouse responses toward patients. In research on marital discord, criticism and hostility during interactions between spouses has proved harmful to individual mood and relationship quality (22,30,32,38). For couples coping with chronic pain, a number of cross-sectional findings also suggest negative spouse responses may undermine adjustment among patients (1,4,7,8,9,16,23,27,33). Here, we built on these findings by adapting EE and interpersonal theoretical perspectives to examine and interpret associations between spouse criticism/hostility and patient pain intensity/behavior, and by using electronic diary methods to capture patient and spouse reports in a prospective design. Results provide support for both the EE and interpersonal frameworks.

EE theory describes how critical and hostile family environments can exacerbate or maintain a wide variety of illnesses (2,45,46). Hooley (19) posits that EE is maintained by attributions spouses make regarding patient control over their adverse, illness-related behavior. Highly critical spouses of depressed patients make attributions that reflect their belief that patients exert some control over, and therefore have some responsibility for, disliked and displeasing behaviors (2,21). Also, research among patients with physical illness (eg asthma) suggests that the power of spouse criticism/hostility to predict relapse may be related to whether the spouse acknowledges a valid “medical explanation” for the illness (46). Chronic pain conditions are characterized by symptoms that persist beyond what is expected given a direct pathway between original injury and continued report of pain (44). Thus, spouses of chronic pain patients may believe they have grounds to critically question persisting “symptoms,” complaints and what the patient is doing to “get better.” Consistent with EE theory, results from concurrent analyses suggest that patient perceptions of spouse criticism and hostility are related to elevated pain severity during the same assessment epoch, controlling for prior pain severity. For example, perceptions of criticism and hostility at 12:00 pm were related to greater than average pain severity at 12:00 pm while controlling for prior pain severity. Results of lagged analyses go further, suggesting that patient perceptions of spouse hostility predict patient elevations in pain severity above their own average three hours later even while controlling for prior pain severity. That is, patient perceptions of spouse hostility at 9:00 am predicted patient pain severity at 12:00 pm. Although both concurrent and lagged effects support the EE framework prediction that spouse criticism and hostility worsen patient symptoms, the significant lagged relationship provides the first evidence of a prospective relationship between initial spouse hostility perceived by patients and subsequent pain severity. Patient pain increases when critical/

hostile exchanges occur, and patient pain increases in the hours following especially hostile exchanges. Thus, consistent with an EE conceptualization, the stress of being criticized and rejected by the spouse may have immediate effects on patient adjustment, and the most severe spouse behavior (e.g., hostility) may have additional delayed detrimental effects on patient well-being.

Just as aversive spouse reactions might contribute to poor patient adjustment in the manner anticipated by EE theory, the reverse causal pathway may also operate, as might be predicted by interpersonal theory (17). Results for concurrent analyses suggest that spouse reports of the frequency of patient pain behavior were related to elevated patient reports of both perceived spousal criticism and hostility during the same assessment epoch, controlling for these factors during the prior epoch. For instance, the frequency of pain behaviors observed by the spouse at 12:00 pm was related to greater than one's own average perceived spouse criticism and hostility at 12:00 pm while controlling for prior criticism and hostility. Results of lagged analyses further supported the interpersonal model. Patient pain behavior observed by the spouse predicted elevated patient perceived spouse hostility three hours later, even while controlling for prior hostility. That is, pain behaviors observed by the spouse at 9:00 am predicted patient perceived spouse hostility at 12:00 pm. Again, both concurrent and lagged effects support this framework, but the lagged relationship provides evidence for the first time of a prospective relationship between initial spouse observations of patient pain behavior and later patient perceptions of spousal hostility. Thus, spouse observations of patients' grimacing, groaning and bracing pain behavior are related to immediate increased patient perceptions of spouse criticism and hostility *during* interactions, and predict delayed effects on patient perceptions that the spouse is hostile toward them.

In sum, results provide support for both EE and interpersonal model expectations about the relationship between spousal criticism/hostility and patient pain. This dual support provides an opportunity to view these two models not as independent but as complementing each other. That is, repeated pain behavior may precipitate critical and hostile spouse responses – per the interpersonal model - while subsequent pain intensity may be worsened by the stress of a critical and hostile spouse - per the EE model. Conceptually, spouse and patient interactions featuring high criticism and hostility may be better understood in terms of dual factors that emanate from both spouse (i.e., criticism of patient behavior believed to be partly under his/her control) and patient (i.e., increased pain intensity).

One significant finding supported neither the EE nor the interpersonal model. Namely, elevations in patient pain intensity were related to later decreases in patient perceptions of criticism. This result is consistent with views of social interactions among medically ill people and their family rooted in the social support literature. There, focus is almost exclusively placed on phenomena in which patient pain is met with responses from others that are intended to be positive. In this case, however, our result is also consistent with recent findings indicating that low levels of invalidation are related to favorable adjustment among patients with chronic pain (7,26). That is, low levels of a spouse response perceived by patients as negative, akin to diminished levels of perceived criticism, appears related to good patient responses. Such findings may help direct research efforts toward considering the roles not only of high levels of positive and negative spouse responses, but on the effects

the absence or reduction of negative responses may exert on both patient and spouse mood and behavior.

Some limitations need be delineated. First, significant findings for the EE model were confined to patient self-reported pain severity. The null findings for spouse reported patient pain behaviors limit support for the EE model in that we did not find evidence that patient perceived criticism/hostility had *observable* effects on their functioning. Second, in contrast to the EE model, effects for the interpersonal framework were almost exclusively limited to spouse observations of patient pain behaviors and may be seen as limiting support for this model. In this case, however, insofar as changes in patient pain severity may not be communicated or otherwise revealed to spouses, observations by spouses of patient pain behaviors may be the most appropriate independent variable for this model. Spouse observations of repeated grimacing, groaning and bracing by patients may represent – as per the interpersonal model – exactly the kind of stimuli most likely to provoke critical and rejecting responses toward patients. Third, as is common with daily diary methods, especially when frequent assessments are made, we used single items to tap key constructs (e.g., perceived criticism). From the standpoint of psychometrics, this is certainly not ideal, and some caution must be used in interpreting findings based on such few items.

One goal in assessing patient and spouse factors at relatively short intervals was to increase the likelihood that such factors were recorded accurately and not forgotten over a longer time period (e.g., once daily). A second goal was to increase the likelihood that we could capture effects of hour-by-hour fluctuations in spouse critical/hostile responses to patients and patient pain and pain behavior. While vehement conflictual exchanges may be memorable and have detectable impact on once-per-day diary ratings, these may be relatively infrequent except in the most discordant marriages. However, less emotionally charged and short-lived episodes of spousal criticism/hostility may go undetected in a daily assessment format, and thus the potentially cumulative albeit smaller effects would go unappreciated. While infrequent but large arguments may certainly sour the marital environment, chronic but low-level critical exchanges may set the stage for a particularly unpleasant environment, producing snowballing detrimental effects. Oft-repeated small “injuries,” which may go undetected with less frequent assessments, may be of great importance in slowly eroding pain patient function and relationship quality.

In sum, spousal criticism/hostility may be a factor contributing to the maintenance and even the worsening of chronic pain. Future research must further elucidate our understanding of marital interaction processes that may maintain chronic pain and undermine optimal adjustment. Conceptual models such as the EE and interpersonal frameworks might fruitfully guide this research in ways that also permit extrapolations to established intervention principles and techniques. In light of these conceptualizations of pain and marital interactions, therapists may be better able to ferret out how spousal criticism functions to increase patient pain for a given couple and how patient pain behaviors function to intensify spousal criticism. To the substantial degree that marital interactions are amenable to clinical intervention, improved insight into how spousal behavior and patient adjustment are linked will encourage productive translational efforts to target this relatively neglected area.

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Please note that some of the data collected in this study were used by the second author (K.P.) for her doctoral dissertation. The dissertation study was not focused on pain or pain behaviors, and addressed different theoretical models. Still, the method sections of this manuscript describing the sample, measures, diary method and analyses are, by necessity, closely related to those of the dissertation project.

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### Summary

In this within-couple diary study of chronic low back pain patients and spouses, we found that patient perceived criticism/hostility from their spouse was related to patient pain concurrently, and that spouse observations of patient pain behaviors predicted patient perceived hostility in the next 3 hour period. Spouse criticism and hostility directed toward patients may adversely affect the latter's well-being.

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**Table 1**

## Demographic Characteristics

	Patient	Spouse
Gender (female)	48.6% (n=51)	51.4% (n=54)
Age in years (M,SD)	46.30 (12.1)	45.96 (13.2)
Hispanic	4.8% (n=5)	5.7% (n=6)
African American	15.2% (n=16)	18.1% (n=19)
Caucasian	80.0% (n=84)	76.2% (n=80)
Employed	40.0% (n=42)	63.8% (n=67)
Disability Insurance	34.3% (n=36)	13.3% (n=14)
Length of Marriage (M,SD)	14.30 (14.0)	---
Pain Duration (M,SD)	9.04 years (7.8)	---
Dyadic Adjustment Scale(M,SD)	105.05 (22.51)	---

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**Table 2**

Zero-Order Correlations, Means and Standard Deviations of Aggregated Variables

	1.	2.	3.	4.	5.	<i>M</i>	<i>SD</i>
1. P Perceived Criticism	--					.29	.25
2. P Perceived Hostility	.60**	--				.14	.16
3. P Pain Intensity	.14	.23*	--			3.09	1.63
4. S Observed Pain Behaviors	.08	.11	.56**	--		2.08	1.44
5. P Sex	-.08	-.11	-.06	-.11	--	--	--
6. P DAS	-.49***	-.36***	-.04	.08	-.03	105.05	22.51

*Note.* P Perceived Criticism = patient perceived criticism. P Perceived Hostility = patient perceived hostility. P Pain Intensity = patient pain intensity. S Observed Pain Behaviors = spouse frequency of observed patient pain behaviors. Gender is coded as "0" for males and "1" for females. P DAS = patient Dyadic Adjustment Scale. *N* = 105 couples.

\*  
*p* < .05.

\*\*  
*p* < .001.