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Daily Verbal and Nonverbal Expression of Osteoarthritis Pain and Spouse Responses

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Abstract

The current study applied a model of pain communication [10] to examine the distinction between verbal and nonverbal pain expression in their prediction of punishing, empathic, and solicitous spouse responses to patient pain. It was hypothesized that on days when patients engaged in more nonverbal expression spouses would respond more positively (i.e., with less punishing, and more solicitous and empathic behavior). The same pattern was predicted for verbal expression. In addition, it was expected that associations between patient nonverbal pain expression and positive spouse responses would be strengthened, and that the association with punishing responses would be weakened, on days when levels of verbal pain expression were higher than usual, regardless of daily pain severity. In a 22-day diary study, 144 individuals with knee osteoarthritis and their spouses completed daily measures of pain expression, spouse responses, health, and affect. The predicted positive main effect of nonverbal expression on empathic and solicitous responses was supported by the data, as was the positive main effect for verbal pain expression. Results from moderation analyses partially supported our hypothesis in that a) patients' nonverbal pain expression was even more strongly related to empathic and solicitous spouse responses on days of high verbal pain expression, and b) patients were buffered from spouse punishing responses on days when both nonverbal and verbal expression were high. These findings suggest that pain expression in both verbal and nonverbal modes of communication is important for positive and negative spousal responses.

Keywords

Pain expression; spouse responses; osteoarthritis; daily

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Introduction

Research on the relationship between pain expression and spousal responses has often focused on how sequences of nonverbal pain expression (e.g. grimacing, bracing, groaning) and solicitous responses lead to greater patient pain and disability in chronic pain disorders [22,34,36-39]. However, whether nonverbal and verbal expression of disease-related pain independently and interactively predict a variety of spouse responses has not been examined. Using a sample of individuals diagnosed with osteoarthritis and their spouses, the current study assessed the covariation of daily nonverbal and verbal pain expression with daily spouse responses. We also examined the degree to which daily verbal pain expression enhanced positive and buffered negative effects of nonverbal pain expression on spouse responses.

In the few studies that have measured nonverbal and verbal pain expression as separate constructs, patient verbal disclosure has supported relationship intimacy, and holding back from disclosure has been related to spouse criticism [3,30,31]. Nonverbal expression has most consistently been associated with more solicitous and, in a few cases, punishing spousal responses, most often in patients with chronic pain disorders [36–40,42]. According to a pain communication model [6,9,10], pain is a message to be transacted—a message that may elicit an empathic, benevolent response from the listener when it is clearly understood, under certain favorable conditions. Nonverbal pain expression, less governed by executive function than verbal acts, can be identified by observers and may be especially likely to be interpreted as genuine, particularly in disease-related pain [9,33]. Further, the clarifying, specific quality of verbal expression may supplement nonverbal cues to produce an even more interpretable and directive pain message. The complementarity of nonverbal and verbal pain expression seems clear, yet the interactive contributions of these distinct communication channels to spouse responses have not been investigated.

In this study of osteoarthritis patients and their spouses, our first hypothesis was that greater patient nonverbal pain expression on a given day as reported by the spouse would be associated with more empathic and solicitous responses as well as fewer punishing responses from the spouse on that day, independent of verbal pain expression on the same day. Greater verbal pain expression on a given day was also expected to relate to more empathic and solicitous responses, and fewer punishing responses on that day, independent of that day's nonverbal pain expression. Our second hypothesis was that daily verbal pain expression would strengthen the associations between daily nonverbal pain expression and spouse responses because, extending the pain communication perspective, each form of expression clarifies the pain experienced and together they generate a thorough pain message. Specifically, the associations between daily nonverbal pain expression and spouse responses (positive for empathic and solicitous, and negative for punishing responses) were expected to be stronger on days when the patient verbally disclosed pain more than usual, as compared to days when the patient disclosed his or her pain less than usual. Same-day associations were examined because our interest was in pain on a given day, its expression, and spouse responses to that day's pain.

Method

Study Design

Data presented in this report are from a study of patients diagnosed with knee osteoarthritis (OA) and their spouses that combined in-person interviews conducted over an 18-month period (i.e., T1, T2 at a 6 month follow-up, and T3 at an 18 month follow-up) with a 22-day assessment of daily experiences immediately after the T1 interview. During the daily assessment protocol, patients and spouses used a handheld computer to answer questions

regarding health and affect three times per day (i.e., beginning-of-day, afternoon, and end-of-day), and questions regarding marital and pain-related interactions at end-of-day. The current report utilizes data from the T1 interviews and end-of-day diary assessments.

Participants

To be eligible for the study, patients had to be diagnosed with knee OA by a physician, experience usual knee pain of moderate or greater intensity, be at least 50 years of age, and be married or in a long-term relationship (self-defined) in which they shared a residence with their partner. Exclusion criteria were a comorbid diagnosis of fibromyalgia or rheumatoid arthritis, use of a wheelchair, or a plan to have hip or knee surgery within the following six months. Couples were excluded from the study if the spouse reported arthritis pain of moderate or greater intensity, used a wheelchair, or required assistance with personal care activities. Both partners were required to be cognitively functional as indicated by the accuracy of their answers to questions regarding the current date, weekday, their age, and birthdate. Both partners also had to be free of any major hearing, speech, or language problems that would interfere with the comprehension and completion of data collection conducted in English. [25]

Primary sources of recruitment were research registries for rheumatology patients and older adults interested in research in the Pittsburgh, PA, area; flyers distributed to University of Pittsburgh staff and faculty; and word of mouth. A total of 606 couples were screened for eligibility. Of these, 221 couples declined to participate, and the most frequent reasons were lack of interest ($N = 87$) or illness in the family ($N = 55$). A total of 233 couples were not eligible, and the most frequent reasons were lack of OA in the knee ($N = 55$) or knee OA pain that was mild ($N = 47$). The total enrolled sample was comprised of 152 couples [i.e., 304 individuals). A total of 145 couples completed the diary assessment component of the study, and 144 couples provided sufficient diary data to be included in analyses. Table 1 provides background information for these patients and their spouses. Both patients and spouses reported high levels of marital satisfaction on average ($M_{\text{Patient}} = 39.61$, $SD_{\text{Patient}} = 6.26$; $M_{\text{Spouse}} = 38.94$, $SD_{\text{Spouse}} = 6.47$) using the established 10-item dyadic satisfaction subscale (range = 0 to 50) of the Dyadic Adjustment Scale (11). Using the 24-item Western Ontario and McMaster Universities Osteoarthritis Index [1] scaled 0 to 100, patients reported an average osteoarthritis severity of 36.54 ($SD = 15.42$), close to the cutoff score of 39 determined by Hawker and colleagues [13] as potentially eligible for arthroplasty.

Data Collection Procedure

Trained staff interviewed patients and spouses separately in each home. Following the interviews, couples were trained to use the handheld computer (i.e., the Palm TX) and familiarized with the format and content of the diary questions. The handheld computer and questionnaire were designed for easy use by older adults and people with minimal computer experience; accessible features included large font size and an oversized stylus for registering responses. Each patient and spouse was provided with a handheld computer that was clearly labeled with his or her name, and the importance of completing diary assessments independently was emphasized. Surveys were intended to be completed in the morning, afternoon, and evening. More specifically, participants were instructed to answer questions: 1) within 60 minutes of rising in the morning, 2) between 2:00 and 4:00 P.M., and 3) upon retiring at night. The current study focused on end-of-day assessments because ratings of nonverbal and verbal pain expression as well as spouse responses were collected only at the end of each day.

Completion and compliance rates were examined for the diary data. Out of a potential 6380 end-of-day observations (290 individuals in 145 couples $\times$ 22 days), a total of 5863 were

completed (92%). Compliance with the requested timing of the end-of-day assessment was evaluated by comparing the time of the handheld computer entries with participants' written log of daily bedtimes. End-of-day assessments that were completed more than 120 minutes before bedtime were excluded from analysis. Using this criterion, 5327 of the 5863 completed observations were included in analysis (i.e., 92% of the completed observations, or 83% of the total possible observations). [25]

Measures

Nonverbal pain expression—Patient nonverbal pain expression was reported by the spouse at the end of each day with the following question developed for this study: “Today, did your spouse show how much pain he/she was experiencing with facial expressions, noises, changes in mood, or the way he/she moved around?” (1 = not at all, 2 = somewhat, 3 = very much). The average of nonverbal pain expression across the 22 days was 1.59 ($SD = 0.63$).

Verbal pain expression—Patient verbal pain expression was reported by the spouse at the end of each day with the following question developed for this study: “Today, to what extent did your spouse describe his/her pain to you?” (1 = not at all, 2 = somewhat, 3 = very much). Across all study days, verbal pain expression averaged 1.58 ($SD = 0.61$).

Spouse responses to patient pain—Spouse responses to patient pain were reported by the patient at the end of each day with 9 Likert-type items (1 = not at all, 2 = somewhat, 3 = very much).

Punishing spouse responses: Three items were adapted from the West Haven-Yale Multidimensional Pain Inventory [14] to assess daily punishing behaviors—ignoring, acting frustrated, and seeming irritated. An example includes “Today, your spouse got frustrated with you when you seemed to be in pain.” Between-person reliability of the punishing response scale was .79, as measured by Cronbach's alpha. With a range of 3 to 9, punishing spouse responses were close to the bottom of the scale on average ($M = 3.25$, $SD = 0.69$).

Solicitous spouse responses: Solicitous items were also adapted for the daily level from the West Haven-Yale Multidimensional Pain Inventory and measured excessively helpful spouse behaviors such as offering food or drink, taking over tasks, and encouraging rest (e.g. “Today, your spouse took over your jobs or duties to help you avoid pain”). Cronbach's alpha was .88. Solicitous responses spanned the scale but averaged just below the mid-point at 4.48 ($SD = 1.64$).

Empathic spouse responses: The remaining three items were adapted from a scale assessing spouse emotional support in response to patient pain [42]. Items refer to showing affection, understanding patient feelings about the pain, and providing attention (e.g. “Today, your spouse tried to just be there for you when you seemed to be in pain, by giving you his/her undivided attention). Cronbach's alpha was .94, and the average fell slightly above the mid-point of the scale ($M = 5.17$, $SD = 0.63$).

Multilevel exploratory factor analysis: Multilevel factor analysis is a dimension-reduction method that takes into account the nesting of one level of data within another—for our study, the nesting of days within people [21,26,27]. An extension of classical factor analysis, multilevel factor analysis provides distinct item groupings (i.e. factor structures) and factor loadings for the within-person and between-person variance components—differentiating the way items travel together across time from the way they cluster together across individuals, respectively [21,26,27]. A two-level multilevel exploratory factor analysis was

conducted to examine the within-person, across-day (i.e. Level 1) factor structure of the nine items. As expected, the unrotated three-factor solution represented the best fit ($RMSEA = 0.01$, $CFI = 0.99$) and a significant improvement upon the fit of the two-factor solution in a chi-square difference test ($X^2(16) = 186.7$, $p < .05$), though there were cross-loadings between empathic and solicitous items. Three factors were also extracted at the between-person level, but these were not used in the analysis and will not be discussed in detail. The three-factor within-person solution, with three items loading on each factor, was chosen as the final one due to the optimal fit. It was consistent with conceptual precedent, with each factor representing a well-established theoretical construct and consonant with the way the items were designed. For example, the three items of *ignoring*, *acting irritated*, and *seeming frustrated* all loaded onto a single factor that may be described as *punishing* [14].

Covariates—Covariates were chosen on a conceptual basis and included patient reports of spouse responses on the previous day, and both partners' same-day reports of patient pain severity, their own negative affect, and marital enjoyment and tension. The lagged spouse responses (i.e., from the previous day) were included in each model to allow us to conclude that same-day pain expressions and spouse responses were related above and beyond stability in responses across days [18]. Reports of patient pain were included as covariates because patients' experience of pain may color their perceptions of spouse responses. Moreover, spouses' judgment of patient pain is likely related to patients' pain expression. For example, Stephens and colleagues [42] found that patients experienced a high level of pain and also expressed it verbally had spouses who responded with less emotional support. Patient pain severity was assessed with one item at end-of-day in the daily diary: "How would you describe your [spouse's] overall arthritis pain today?" The scale ranged from 0 (none) to 3 (severe).

End-of-day negative affect of both patient and spouse was included to account for any negative response biases in the reporting of patient pain expression and spouse responses, as recent negative emotion may lead to negative interpretation of events [23]. End-of-day negative affect was assessed with regard to five emotions: feeling depressed or blue, frustrated, angry or hostile, unhappy, and worried or anxious (e.g., "To what extent have you felt [unhappy] over the past 30 minutes?") Responses ranged from 0 to 6 (not at all to extremely), and all 5 items were summed to create a scale with potential scores of 0 to 30 ($M_{\text{Patient}} = 2.43$, $SD_{\text{Patient}} = 4.33$; $M_{\text{Spouse}} = 2.07$, $SD_{\text{Spouse}} = 4.19$).

Because relationship quality may be a generalized lens through which illness-specific marital interactions are viewed [15,44], both partners' daily marital interaction quality—tension and enjoyment—were included as covariates. Patient and spouse completed one item for both tension and enjoyment at end-of-day on a scale of 1 to 3 (not at all, somewhat, very much): "Overall, how [tense / enjoyable] were your interactions with your spouse today?" On average, patients and spouses reported high enjoyment of their daily marital interactions ($M_{\text{Patient}} = 2.44$, $SD_{\text{Patient}} = 0.61$; $M_{\text{Spouse}} = 2.42$, $SD_{\text{Spouse}} = 0.57$) and low daily tension ($M_{\text{Patient}} = 1.21$, $SD_{\text{Patient}} = 0.46$; $M_{\text{Spouse}} = 1.23$, $SD_{\text{Spouse}} = 0.46$).

Analysis Plan

Our interest was in same-day, rather than lagged (i.e., across-day), associations of pain, its expression, and spouse responses to that day's pain. The analytic approach reflects this conceptual framework [2,4,20].

In preparation for data analysis, all daily predictors and covariates were person-mean centered. A series of multilevel models were estimated using PROC MIXED in SAS 9.2 for three outcomes—punishing, empathic, and solicitous spouse responses. All models included a random intercept.¹ For each outcome, the empty model was estimated for the purpose of

calculating the intraclass correlation coefficient. Next, covariates were entered. Then the main effects of daily nonverbal and verbal pain expression were added to the model. The next model added the interaction term of daily nonverbal and verbal pain expression. The ESTIMATE command in SAS 9.2 was used to probe significant interactions in the final models.

Results

Pearson *r* and Intraclass Correlations

Table 2 provides within-person correlations between pain expression and spouse response variables. The within-person correlation of verbal and nonverbal pain expression was .52, indicating consistent covariation in the two modes of pain expression at the daily level ($p < .0001$). As expected from the EFA solution, solicitous and empathic responses shared a very robust, positive correlation ($r = .70, p < .0001$). Their daily correlations with punishing responses were of small magnitude ($r_{\text{Empathic}} = -.14, p < .0001$; $r_{\text{Solicitous}} = -.06, p < .001$). Correlations of verbal and nonverbal pain expression with empathic and solicitous responses were moderately strong [$r_s = .21$ to $.32, ps < .0001$], whereas correlations of verbal and nonverbal pain expression with punishing responses were negligible in magnitude ($r_{\text{Verbal}} = .02, p > .05$; $r_{\text{Nonverbal}} = .10, p < .0001$).

The intraclass correlation (ICC) is a value that allows us to parse out variance attributed to within-person and between-person differences. The amount of within-person variation can be calculated by subtracting the ICC from 1. Within-person differences accounted for 63% of the variance in verbal pain expression, 53% in nonverbal pain expression, 61% in punishing responses, 34% in empathic responses, and 35% in solicitous responses.

Multilevel Models

The final predictive model for punishing, empathic, and solicitous responses included all covariates, main effects and interaction of verbal and nonverbal pain expression, and a random intercept. As depicted in Tables 3, 4, and 5, all random intercepts were statistically significant, such that some spouses were on average more punishing, empathic, and solicitous than others in response to patient pain ($\chi^2_{u0, \text{Punishing}} = 0.16, \chi^2_{u0, \text{Empathic}} = 2.26, \chi^2_{u0, \text{Solicitous}} = 1.74, ps < .05$). Covariates increased the fit of all three models, indicated by a reduction in fit statistic values of $-2LL$ and AIC.

Punishing spouse responses—Estimates for the punishing spouse response model can be found in Table 3. As hypothesized, on days when patients verbally described their pain more, spouses were less punishing ($B = -0.05, SE = 0.02, p < .05$). However, we did not find support for the prediction that on days when patients nonverbally expressed their pain more spouses would respond in a less punishing way ($p > .05$). Our finding regarding the interaction between nonverbal and verbal expression was significant and partially consistent with our hypothesis ($B = -0.08, SE = 0.04, p < .05$; Figure 1). Rather than enhancing a negative relationship between nonverbal expression and punishing responses, verbal pain expression buffered the positive relationship between nonverbal pain expression and punishing spouse responses. That is, on days when patients nonverbally displayed their pain more yet verbally expressed their pain less than usual, spouses responded in a more punishing way ($B = 0.07, SE = 0.03, p < .05$). In contrast, on days when patients nonverbally

¹Random effects of verbal and nonverbal expression on spouse responses were tested in all three models. For punishing, empathic, and solicitous responses, the effect of verbal expression varied significantly across couples ($ps < .05$). However, the effect of nonverbal expression did not vary significantly across couples for any of the three spouse responses ($ps > .05$). The random effect of the verbal X nonverbal pain expression interaction was also evaluated and was found to be non-significant for all three spouse responses.

showed their pain more and verbally shared their pain more than usual, spouses were not more punishing ($p > .05$).

Empathic spouse responses—As shown in Table 4, verbal and nonverbal patient pain expression also emerged as significant predictors of empathic spouse responses. The hypothesis was supported that on days when spouses perceived patient verbal pain expression to occur more than usual, patients reported spouses as more empathic in response to their pain ($B = 0.35$, $SE = 0.05$, $p < .05$). Consistent with the prediction of a positive main effect for nonverbal expression, on days when spouses reported more frequent nonverbal pain expression from patients, they were perceived as more empathic ($B = 0.16$, $SE = 0.06$, $p < .05$). This effect was qualified by an interaction between nonverbal and verbal pain expression ($B = 0.19$, $SE = 0.08$, $p < .05$; Figure 2). Consistent with our second hypothesis, on days when patients verbally shared their pain more than usual, greater nonverbal expression was associated with more empathic responses ($B = 0.28$, $SE = 0.06$, $p < .0001$). On days when patients verbally disclosed pain less than usual, nonverbal pain expression was not related to empathic reactions ($p = .56$).

Solicitous spouse responses—As displayed in Table 5, both verbal and nonverbal pain expression arose as significant predictors of solicitous responses. In support of our hypothesis, on days when patients expressed more pain verbally, spouses acted more solicitously in response ($B = 0.19$, $SE = 0.06$, $p < .05$). Also as expected, on days when patients nonverbally displayed their pain more, spouses were perceived as responding more solicitously to pain ($B = 0.21$, $SE = 0.05$, $p < .05$). This effect was qualified by an interaction between nonverbal and verbal pain expression in the final model ($B = 0.18$, $SE = 0.08$, $p < .05$; Figure 3). Consistent with our second hypothesis, on days when patients shared much pain verbally, expressing more pain nonverbally was related to more solicitous spouse responses ($B = 0.29$, $SE = 0.06$, $p < .0001$). On days when patients verbally described their pain less than usual, the positive association between nonverbal pain expression and solicitous responses was marginally significant ($p = .09$).

Discussion

Pain-related exchanges of individuals with osteoarthritis and their spouses were conceptualized in the current study as transactions wherein messages about pain are received with varying degrees of clarity and accuracy, and when understood, may often be responded to by the partner in an empathic, help-oriented way [8]. Unlike many studies of pain expression and spouse response, the current study distinguished between nonverbal and verbal channels of pain communication (cf. [45]; exceptions include [37,38]). The degree of daily fluctuation in verbal and nonverbal pain expression and various spouse responses were explored. Indeed, almost two thirds of variability in verbal pain expression and more than half in nonverbal pain expression were due to within-person, across-day changes. Likewise, more than half of variance in punishing responses, as well as one third in empathic and solicitous responses, was attributed to daily fluctuations.

Findings showed that the two modes of pain expression were positively related to empathic and solicitous responses, and negatively related to punishing ones, as hypothesized. Also as expected, the interaction of nonverbal and verbal pain expression significantly predicted empathic, solicitous, and punishing responses. The two modes of pain expression seemed to wield a synergistic effect, such that high levels of both nonverbal and verbal cues corresponded to the most empathic and solicitous spouse reactions and protected patients from elevated punishing responses. Conversely, without high levels of verbal disclosure, increases in nonverbal pain expression encouraged more punishing responses and failed to elicit more empathic and solicitous responses. Thus, a central notion implied in the pain

communication model was supported in the disease-related chronic pain of osteoarthritis: nonverbal and verbal pain expression supplement and enhance one another to generate what may be a comprehensive pain message that, on average, promotes helping spouse responses and mitigates punishing ones. The model also allows for listeners to respond in a hostile way, however, and even a sample of highly satisfied spouses, indeed, grew more punishing on days when verbal expression did not accompany nonverbal expression.

The positive, independent contributions of daily nonverbal and verbal pain expression to within-person, across-day fluctuation in spouse behaviors support previous work and align with the pain communication model [6,9,10]. Nonverbal pain expression has been conceptualized as a relatively automatic process and often, not always, less governed by personal intention [6,7,9,32]. As such, past studies have shown that observers assign great weight to nonverbal cues as believable signals of pain, particularly when it is substantiated by a known disease process such as osteoarthritis [9,29,41]. Verbal pain expression, on the other hand, is conceived of as driven by executive function (with exceptions such as paralinguistic vocalizations), and has the capacity to produce easily decoded pain messages [9], also considered legitimate by spouses when pain is disease-related [41]. Further, on days when spouses receive this clear message of pain via nonverbal or verbal expression, they are likely to respond more empathically, consistent with past studies that have shown such supportive behavior from those who share a close relationship with the pain sufferer and feel no immediate threat to their own well-being [8]. Nonverbal and verbal pain expression may elicit help-oriented responses from spouses and dampen irritated ones by enhancing partner understanding of patient pain [24,28].

Nevertheless, the interaction between nonverbal and verbal channels revealed even more nuanced patterns, as predicted. On days when patients verbally expressed pain more than usual, their nonverbal expression was related to more empathic and solicitous spouse responses. However, on days when patients verbally expressed pain less than usual, their nonverbal expression was not associated with either empathic or solicitous reactions. Indeed, the most caring spouse behaviors were seen by patients on days when they expressed pain in both communication channels more than average. Because of their distinct qualities—the seemingly involuntary, basic, believable nature of nonverbal expression and the relatively more thoughtful, measured, and potentially more directive attributes of verbal expression [9,10]—these two means of communication appear to complement each other so as to create a thorough, multidimensional pain message that is likely to be met with help-oriented responses.

As for punishing spouse responses, a buffering effect, rather than an enhancing one, was found. That is, on days of low verbal pain expression, patients' greater nonverbal expression was related to more punishing responses, consistent with the pain communication model. Patients were protected from hostile spouse reaction on days when they nonverbally expressed pain and also verbally described their pain more than usual. Though nonverbal expression has often been perceived as involuntary, genuine, and reliable, it may also be that verbal expression is more easily interpreted and acted upon than is nonverbal expression even when pain is disease-related.

Nevertheless, it is well documented that patients often engage in protective buffering—for example, holding back disclosure of pain—to shield spouses from their distress [5,16,30,31,43]. Concealing pain may have evolved both to protect the pain sufferer from potential environmental danger [45] and may serve to safeguard the resources of caring others whose help attempts cannot assuage the pain of a persistent disease. Despite explicit attempts to hide pain, individuals cannot fully suppress its display, such that “nonverbal leakage”—e.g., involuntary activation of certain facial muscles—can reveal its presence to

observers [29,32,35,45]. These failed attempts to hold back pain from the spouse may account for spouse perceptions of simultaneously high nonverbal and low verbal expression as well as subsequent confusion and frustration.

Further, when pain sufferers experience language deficits or are otherwise not given an opportunity to describe their pain with words (i.e., older adults with dementia, children), pain is often underestimated [10–12,17]. In turn, reactions to pain are more likely to be inadequate, invalidating, or even hurtful, as the pain communication model suggests. Indeed, Lehman and colleagues [19] found that patients perceived more problematic responses from spouses who underestimated their pain.

In previous studies, nonverbal and verbal pain expression have most often been examined as a single construct [34,39,41], but the current findings suggest that the two routes of expression are only moderately correlated and interact to predict spouse responses at the daily level. The communications model of pain [9,10] implies that both verbal and nonverbal channels of expression feed into the clarity of the pain message which, in turn, leads to varying degrees of prosocial and punishing spouse behavior. However, the finding that daily verbal and nonverbal modes of expression work in tandem to relate to more benevolent and less punishing spouse responses has not been explicitly articulated or empirically demonstrated in previous research, to our knowledge. Moreover, this study extended the model in specific ways, providing evidence that these dynamics occur in the fleeting interactions of everyday life, in a sample of patients with disease-related chronic pain. The tests of hypotheses about same-day relationships between the two kinds of pain expression and spouse responses were rigorous, accounting for the prior day's spouse responses and both partners' perceptions of same-day pain, negative affect, and marital quality. Another strength of our study is that predictors and outcomes were reported by different partners, such that findings could not be attributed to shared reporter variance. This approach also captured the central notion of pain *transaction*, such that patients reported on the spouse behaviors they perceived, and spouses gave their perceptions of the nonverbal and verbal pain expression communicated by patients.

The current study has a number of limitations. First, conclusions about same-day associations were strengthened by accounting for yesterday's level of empathic, solicitous, and punishing responses, but temporal ordering could not be established. Second, the sample was limited primarily to couples who were highly satisfied with their marriage and had been coping with patients' osteoarthritis for many years. Couples who are less satisfied in the relationship may be more vulnerable to hostile or abusive pain transactions. The sample was also restricted to individuals with disease-related pain; those with chronic pain disorders such as fibromyalgia may engage in different patterns. Also, the data represent patient and spouse perceptions of daily behavior, and independent observer ratings might reveal different patterns. Further, measures of solicitous and punishing responses originated in the context of an operant framework targeted at phenomena of chronic pain disorders. However, we applied the scales to a sample with disease-related chronic pain using a communication framework. Observational data would be required to draw strong conclusions about operant processes—that is, the degree to which pain behaviors are more or less likely to recur given certain spouse responses.

To conclude, our study provides fine-grained, ecologically valid evidence for the importance of daily pain communication in the lives of disease-related chronic pain sufferers in a way that supports and extends the principles of a communications model of pain. The current study speaks to not only the interplay between modes of pain communication, but also the dynamic nature of expression-response patterns in everyday life that benefits from the application of intensive repeated measures designs. Future research should address the role

of daily spouse responses in the prediction of later patient disability and investigate the development of these processes across the course of the illness.

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Summary

A daily diary study of osteoarthritis patients and their spouses suggests that nonverbal and verbal channels of pain expression together promote help-oriented spouse responses and mitigate punishing ones.

Figure 1.

Interaction of verbal and nonverbal pain expression on punishing spouse responses. *Low* (dotted line) indicates one standard deviation below the within-person mean, and *high* (solid line) denotes one standard deviation above the within-person mean.

Figure 2. Interaction of verbal and nonverbal pain expression on empathic spouse responses. *Low* (dotted line) indicates one standard deviation below the within-person mean, and *high* (solid line) denotes one standard deviation above the within-person mean.

Figure 3.

Interaction of verbal and nonverbal pain expression on solicitous spouse responses. *Low* (dotted line) indicates one standard deviation below the within-person mean, and *high* (solid line) denotes one standard deviation above the within-person mean.

Table 1

Demographic Characteristics of Patients and Spouses (N = 144)

Variable	Patients	Spouses
	<i>M (SD) or N%</i>	<i>M (SD) or N%</i>
Age	65.6 (9.8)	65.3 (11.5)
Male gender	43%	58%
White race	88%	86%
Years of education	16.1 (2.0)	15.9 (2.1)
Full-time employment	33%	33%
Duration of knee OA (years)	12.6 (11.3)	
Household income	\$40,000-59,000	
Years married/in relationship	34.3 (16.6)	
Marital satisfaction	39.61 (6.26)	38.94 (6.47)

Note. Full-time employment status was defined as typically working 30 hours or more per week. Marital satisfaction was assessed with the 10-item dyadic satisfaction subscale of the Dyadic Adjustment Scale, whose scores range 0 - 50 (Spanier, 1976). OA = osteoarthritis. *M*= mean. *SD*= standard deviation.

Table 2

Within-Person Correlations between Key Study Variables

Predictors, Outcomes	1	2	3	4	5
1.Verbal Expression	--				
2.Nonverbal Expression	.52 *	--			
3.Empathic Response	.32 *	.21 *	--		
4.Sollicitous Response	.29 *	.27 *	.70 *	--	
5.Punishing Response	.02	.10 *	-.14 *	-.06	--

Note. Correlations reflect within-person, across-day relationships. Pt = patient. Sp = spouse. The potential number of observations reached up to 3168 (144 couples across 22 days)

* $p < .0001$.

Table 3**Multilevel Models of Punishing Spouse Responses**

Estimates	Empty	Covariates	Pain Expressions	Interaction
Fixed effects				
Intercept	3.22 [*] (0.03)	3.27 [*] (0.05)	3.27 [*] (0.05)	3.27 [*] (0.05)
Punishing responses (lag)		0.00 (0.02)	0.00 (0.02)	0.00 (0.02)
Patient gender		−0.07 (0.07)	−0.07 (0.07)	−0.07 (0.07)
Patient pain (pt)		0.04 (0.02)	0.04 (0.02)	0.05 [*] (0.02)
Patient pain (sp)		0.03 (0.02)	0.04 (0.02)	0.05 (0.02)
Pt negative affect		0.02 [*] (0.00)	0.02 [*] (0.00)	0.02 [*] (0.00)
Sp negative affect		−0.01 [*] (0.00)	−0.01 [*] (0.00)	−0.01 [*] (0.00)
Pt marital tension		0.27 [*] (0.03)	0.27 [*] (0.03)	0.27 [*] (0.03)
Pt marital enjoyment		−0.06 [*] (0.03)	−0.05 (0.03)	−0.05 (0.03)
Sp marital tension		0.02 (0.03)	0.01 (0.03)	0.01 (0.03)
Sp marital enjoyment		−0.06 [*] (0.03)	−0.06 [*] (0.03)	−0.06 [*] (0.03)
Nonverbal pain expression			0.03 (0.03)	0.04 (0.03)
Verbal pain expression			−0.05 [*] (0.02)	−0.05 [*] (0.02)
Verbal X Nonverbal				−0.08 [*] (0.04)
Random intercept	0.15 [*] (0.02)	0.16 [*] (0.02)	0.16 [*] (0.02)	0.16 [*] (0.02)
Residual variance	0.24 [*] (0.01)	0.20 [*] (0.01)	0.22 [*] (0.01)	0.22 [*] (0.01)
−2LL	3623	2856	2860	2861
AIC	3627	2860	2864	2865

Note. Unstandardized estimates and standard errors. Model based on 22 occasions nested within 144 participants for a total of up to 3168 observations. *AIC* = Akaike Information Criterion; *−2LL* = *−2* Log Likelihood, relative model fit statistics. Pt = patient. Sp = spouse.

^{*}
 $p < .05$.

Table 4**Multilevel Models of Empathic Spouse Responses**

Estimates	Empty	Covariates	Pain Expressions	Interaction
Fixed effects				
Intercept	5.17 [*] (0.13)	5.16 [*] (0.17)	5.16 [*] (0.20)	5.12 [*] (0.17)
Empathic responses (lag)		0.19 [*] (0.02)	0.18 [*] (0.02)	
Patient gender		0.00 (0.26)	0.01 (0.26)	0.02 (0.26)
Patient pain (pt)		0.33 [*] (0.05)	0.29 [*] (0.05)	0.28 [*] (0.05)
Patient pain (sp)		0.30 [*] (0.04)	0.10 (0.05)	0.12 [*] (0.05)
Pt negative affect		−0.01 (0.01)	−0.01 (0.01)	−0.01 (0.01)
Sp negative affect		0.00 (0.01)	0.00 (0.01)	0.01 (0.01)
Pt marital tension		−0.19 [*] (0.07)	−0.22 [*] (0.07)	−0.25 [*] (0.07)
Pt marital enjoyment		0.36 [*] (0.06)	0.33 [*] (0.06)	0.35 [*] (0.06)
Sp marital tension		0.13 (0.07)	0.11 (0.07)	0.05 (0.06)
Sp marital enjoyment		0.19 [*] (0.06)	0.16 [*] (0.06)	0.16 [*] (0.05)
Nonverbal pain expression			0.19 [*] (0.06)	0.15 [*] (0.06)
Verbal pain expression			0.35 [*] (0.05)	0.35 [*] (0.05)
Verbal X Nonverbal				0.19 [*] (0.08)
Intercept	2.26 [*] (0.28)	2.32 [*] (0.29)	2.34 [*] (0.29)	2.33 [*] (0.29)
Residual variance	1.16 [*] (0.04)	0.96 [*] (0.03)	0.92 [*] (0.03)	0.92 [*] (0.03)
−2LL	7401	6168	6093	6087
AIC	7405	6172	6097	6091

Note. Unstandardized estimates and standard errors. Model based on 22 occasions nested within 144 participants for a total of up to 3168 observations. *AIC* = Akaike Information Criterion; *−2LL* = −2 Log Likelihood, relative model fit statistics.

^{*}*p* < .05.

Table 5**Multilevel Models of Solicitous Spouse Responses**

Estimates	Empty	Covariates	Pain Expressions	Interaction
Fixed effects				
Intercept	4.49 [*] (0.11)	4.41 [*] (0.17)	4.40 [*] (0.17)	4.39 [*] (0.17)
Solicitous responses (lag)		0.13 [*] (0.02)	0.12 [*] (0.02)	0.12 [*] (0.02)
Patient gender		0.11 (0.23)	0.11 (0.23)	0.11 (0.23)
Patient pain (pt)		0.28 [*] (0.05)	0.25 [*] (0.05)	0.24 [*] (0.05)
Patient pain (sp)		0.25 [*] (0.04)	0.09 (0.05)	0.09 (0.05)
Pt negative affect		0.00 (0.01)	0.00 (0.01)	0.00 (0.01)
Sp negative affect		-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)
Pt marital tension		-0.17 [*] (0.07)	-0.20 [*] (0.06)	-0.20 [*] (0.06)
Pt marital enjoyment		0.24 [*] (0.06)	0.21 [*] (0.06)	0.22 [*] (0.06)
Sp marital tension		0.10 (0.06)	0.09 (0.06)	0.08 (0.06)
Sp marital enjoyment		0.09 (0.05)	0.06 (0.05)	0.06 (0.05)
Nonverbal pain expression			0.23 [*] (0.05)	0.21 [*] (0.05)
Verbal pain expression			0.20 [*] (0.05)	0.19 [*] (0.05)
Verbal X Nonverbal				0.18 [*] (0.08)
Intercept	1.78 [*] (0.22)	1.79 [*] (0.22)	1.79 [*] (0.23)	1.79 [*] (0.23)
Residual variance	0.96 [*] (0.03)	0.84 [*] (0.03)	0.83 [*] (0.03)	0.82 [*] (0.03)
-2LL	6998	5931	5882	5881
AIC	7002	5935	5887	5885

Note. Unstandardized estimates and standard errors. Model based on 22 occasions nested within 144 participants for a total of up to 3168 observations. *AIC* = Akaike Information Criterion; *-2LL* = -2 Log Likelihood, relative model fit statistics.

^{*}
 $p < .05$.