Pain 131 (2007) 202–213

PAIN

www.elsevier.com/locate/pain

One day at a time: The impact of daily satisfaction with spouse responses on pain, negative affect and catastrophizing among individuals with rheumatoid arthritis

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Received 21 November 2006; received in revised form 27 March 2007; accepted 9 April 2007

Abstract

The majority of research on pain catastrophizing has focused on its negative consequences for adjustment to chronic pain, with few investigations of factors that influence catastrophizing or its detrimental effects. Using a daily process methodology, the current study examined, first, the extent to which a supportive social environment plays a role in reduced catastrophizing, and second, the extent to which support might protect against the detrimental effects of catastrophizing on well-being. Sixty-nine married individuals with rheumatoid arthritis took part in an initial background interview, followed by twice daily telephone interviews (regarding pain intensity, negative affect, catastrophizing and satisfaction with spouse responses) for 1 week. Multi-level modeling indicated several pathways through which satisfaction with spouse responses disrupts the vicious cycle of pain, negative affect and catastrophizing. Consistent with past research, catastrophizing was associated with increases in pain and negative affect. However, when individuals reported increases in satisfaction with spouse responses they were less likely to experience increases in negative affect due to catastrophizing. Satisfaction with spouse responses also reduced the likelihood of feeling overwhelmed and helpless in dealing with daily pain. The relationship between pain and catastrophizing was attenuated in the context of increases in satisfaction with spouse responses. Negative affect was associated with increases in catastrophizing, but only when individuals reported decreases in satisfaction with spouse responses. Overall, findings were consistent with a model in which satisfaction with spouse responses serves as a coping resource, and suggests the importance of involving close others in treatments to reduce pain and catastrophizing.

Keywords: Social support; Pain catastrophizing; Chronic pain; Rheumatoid arthritis; Daily process methodology

1. Introduction

Psychosocial factors play a significant role in the experience of chronic pain, and catastrophizing has been identified as among the most important of these (Sullivan et al., 2001). There is clear indication that catastrophizing can result in a range of negative outcomes, from psychological distress (Severeijns et al., 2001) to increased pain intensity (Tan et al., 2001). Although there is some evidence that catastrophizing reflects a stable way of responding to pain (Sullivan et al., 1995), recent research suggests that individuals vary in the extent to which they catastrophize on a day-to-day basis and these fluctuations cannot be accounted for by pain alone (Grant et al., 2002; Turner et al., 2004). Surprisingly, few studies have investigated factors that influence catastrophizing over time.

Biopsychosocial models of chronic pain highlight the importance of the social environment in shaping the pain experience (Keefe and France, 1999). Cross-sectional and longitudinal research suggests that individuals with chronic pain who report higher satisfaction with support

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0304-3959/$32.00
doi:10.1016/j.pain.2007.04.005

tend to report fewer depressive symptoms (Suurmeijer et al., 2005) and lower pain (Evers et al., 2003). Furthermore, the negative consequences of maladaptive coping may be reduced when individuals feel well supported (Marin et al., in press).

The impact of the social environment on catastrophizing has only recently been considered. This research has focused on the extent to which solicitous responses to pain behaviors may reinforce exaggerated expressions of pain and distress (communal coping model; Sullivan et al., 2001); we still know very little about how *satisfaction* with supportive responses may help reduce catastrophizing and its effects. Preliminary evidence comes from a cross-sectional study by Cano (2004), who found, among those with longer pain durations, higher perceived support was associated with less catastrophizing. However, Keefe and colleagues (2003) found a correlation between perceived instrumental (but not emotional) support and *higher* catastrophizing.

Unfortunately, research on the social context of catastrophizing, and catastrophizing in general, has relied heavily on retrospective, cross-sectional designs. The current study is the first to employ a daily process methodology to investigate the relations among catastrophizing, satisfaction with spouse responses, and well-being as they unfold over the day. Twice daily assessments for 1 week allowed for an examination of processes closer to their real-time occurrence and clarification of the temporal ordering of variables (Tennen et al., 2006). First, we investigated the direct effects of catastrophizing and satisfaction with spouse responses on well-being. Higher catastrophizing and lower satisfaction were expected to be related to greater pain and negative affect, concurrently and across the day. Second, we examined the direct effects of satisfaction with responses on catastrophizing, with the expectation that greater satisfaction would be related to lower catastrophizing, concurrently and across the day. Third, we tested our hypothesis that satisfaction with responses would attenuate the detrimental lagged effects of morning catastrophizing on evening pain and negative affect. Finally, based on the buffering model of support (Cohen and Wills, 1985), the lagged effects of morning satisfaction on evening catastrophizing were expected to be greatest at higher levels of pain and negative affect.

2. Methods

2.1. Sample and recruitment

Participants were recruited as part of a larger prospective study on psychosocial factors influencing adjustment among community-dwelling patients with rheumatoid arthritis (RA). RA is an incurable autoimmune disease that affects approximately 1% of the western population and is associated with a variety of debilitating symptoms, including chronic pain of variable duration and intensity, stiffness and inflammation of the joints, fatigue, and frequent mood changes (Smith and Wallston, 1992; Evers et al., 1998). Only those procedures and measures used in the current study will be discussed here. A list of potential study participants was randomly selected from a database of patients registered with the Mary Pack Arthritis Society, a local organization that offers treatment and education to arthritis sufferers across the province of British Columbia, Canada. Individuals who were over the age of 18 and living outside the Lower Mainland in British Columbia were mailed an initial contact letter describing the study and requesting participation. Interested participants contacted our research office and were screened over the telephone to ensure that they had been diagnosed with RA, experienced pain due to RA during the past month, and were able to read, write, and speak English. Participants in the current sample were also required to be living with a spouse or common law partner. With their permission, individuals who contacted our research office regarding participation in our study were entered in a draw for $1000.[1] In addition, upon completion of the initial telephone interview, all participants were mailed a small gift, valued at $10.

The final sample consisted of 69 patients diagnosed with RA. Study participants were predominantly female (84%) and Caucasian (86%), ranging from 29 to 82 years of age (mean = 59, SD = 10.9).[2] Participants had been married (96%) or cohabitating (4%) with an opposite sex partner for a mean of 30 years (SD = 14.9), ranging from less than 1 to 59 years. The average number of years since being diagnosed with RA was 17 (SD = 12.7), ranging from 1 to 50 years. The majority of participants had completed at least a high school education (86%). Twenty-eight percent were employed at the time of the study (74% of these individuals were employed outside the home, 58% were working full-time, and 95% had paid employment). The remainder of participants were either retired (36%), on disability (16%), on sick leave (10%), homemakers (7%), or temporarily laid off (1%). The modal family income was between $25,000 and $50,000 (Canadian dollars).

2.2. Attrition

Initial contact letters were mailed to 800 individuals with arthritis. Of the 188 patients diagnosed with RA who contacted our research office, 28 declined to participate prior to additional eligibility screening.[3] Of the 160 who agreed to participate in additional eligibility screening, 71 (44%) met the

[1] The initial draw was for $300. However, due to a low response rate, the draw value was increased to $1000 approximately half way through the recruitment phase.

[2] The higher percentage of women in the current study is consistent with the greater prevalence of RA among women (i.e., the overall ratio is 3:1; Anderson et al., 1985).

[3] Over the course of the recruitment phase of the study, 85 initial contact letters were returned due to an incorrect mailing address. We were also informed that six of the individuals on our mailing list were deceased, and 14 had never been diagnosed with RA. Unfortunately, we have no way of knowing why the remainder of patients did not respond (i.e., did not receive our letter, were not diagnosed with RA, were deceased, or were not interested in participating). Twenty-eight individuals declined to participate prior to additional eligibility screening due to: having been in too many studies ($n = 1$), being too ill ($n = 3$), being too busy ($n = 9$), or for an unspecified reason ($n = 15$).

additional inclusion criteria and completed both the background interview and daily interviews. Two of these 71 participants were dropped from the final analyses due to low compliance with daily interviews (i.e., less than 60% of daily interviews completed). Of the 69 respondents who were screened and did *not* meet criteria for the current study, 17 were excluded because they had not experienced RA pain in the past month and 52 were excluded because they were not married or living with a common law partner. Of the 20 respondents who met the additional inclusion criteria but subsequently declined to participate, two indicated they were too sick, two said they were too busy or it was a bad time, and the remaining 16 did not provide a reason.

2.3. Procedure

Daily process researchers are increasingly relying on hand held electronic diaries (e.g., palm pilots) to collect daily data. However this can be extremely costly and may not be suitable across all study populations (Tennen et al., 2006). The acceptability of electronic diaries may be particularly low among older adults, due to small display screens on hand held devices (e.g., Embi, 2001) and lack of previous computer experience (e.g., Bernhardt et al., 2001). Participants suffering from RA may also have difficulty grasping the writing stylus and entering data due to pain and stiffness in the wrist and finger joints. Although more time and labor intensive for research staff than paper or electronic diaries, the current study employed telephone diaries, which combine the advantage of being able to verify participant response times with the opportunity to ask more in-depth open-ended questions, and strengthen participant motivation and engagement (Hoppe et al., 2000).

Following a screening interview and once eligibility was determined, participants engaged in a structured background telephone interview lasting approximately 30 min, followed by brief structured telephone interviews administered twice daily for 1 week. The daily interview period was limited to 1 week in order to minimize the burden placed on participants. Daily interviews were scheduled for approximately 6 and 12 h after participants woke up in the morning and lasted approximately 10 min each. Twice daily interviews allowed for the examination of fluctuations among study variables within participants, from morning to evening. Participants were asked to find a place in which they were able to talk privately during each interview. Trained female undergraduate and graduate research assistants conducted all interviews. In order to build rapport, participants were assigned the same interviewer for both the initial and daily interviews.[4]

Interview sessions were tape recorded with the permission of participants to allow for responses to open-ended questions to be transcribed, and ensure that interviewers followed standardized protocol. At the beginning of data collection, between four and five tapes were reviewed from each interviewer (or until no problems were noted with protocol adherence). Interviewers were provided with detailed feedback based on tape review and attended bi-monthly meetings with the research team to discuss relevant issues. For the remainder of the data collection period, tapes were reviewed on a random basis to ensure continued adherence to study protocol.

2.3.1. Initial interview measures

2.3.1.1. Demographics and disease status. Participants were asked to provide demographic and disease status information. Functional disability was operationalized as difficulties performing a range of daily activities on a scale from 1 (without any difficulty) to 4 (unable to do). Items were drawn from a modified version of the Health Assessment Questionnaire (Pincus et al., 1983), which is used frequently in rheumatic disease populations and has demonstrated good reliability and validity in past research (Odegard et al., 2005). Participants reported an average level of functional disability of 1.78 (SD = 0.53). Two key dimensions of RA-related fatigue (timing and intensity) were assessed (Belza, 1995). Patients indicated how often they experienced fatigue during the past week, using a scale from 1 (never) to 5 (all the time). Average fatigue frequency in the current sample was 3.43 (SD = 1.05). Intensity of fatigue was assessed by asking patients to rate how fatigued they were during the past week on a scale from 0 (no fatigue) to 10 (fatigue as bad as it could be). Participants reported an average fatigue intensity of 5.26 (SD = 2.21). These items were combined to form a single index of fatigue [mean (SD) = 6.02 (2.02)].

2.3.2. Twice daily interview measures

The following measures were included in the twice daily telephone interviews. During the first interview of the day, participants were asked to reflect on their experiences *so far that day*. During the second interview of the day, participants were asked to reflect on their experiences *since they last spoke to their interviewer*. Most of the measures used in the daily interviews represent brief, modified versions of the original scales. This is common practice among daily process studies, as it reduces the otherwise prohibitive burden placed on participants and increases the number of constructs researchers can assess within a single study protocol (Bolger et al., 2003).

2.3.2.1. Pain intensity. Patients indicated RA pain intensity on a numerical rating scale (NRS) ranging from 0 (no pain) to 10 (pain as bad as it could be). The NRS has demonstrated good validity in previous research, displaying positive and significant associations with other measures of pain intensity (Jensen et al., 1986; Wilkie et al., 1990). The NRS has also demonstrated sensitivity to treatments that are expected to influence pain intensity (Paice and Cohen, 1997).

2.3.2.2. Pain catastrophizing. Whereas Rosenstiel and Keefe (1983) have conceptualized catastrophizing predominantly in terms of feelings of helplessness and the inability to cope

[4] Interviewers received intensive training in the administration of semi-structured research interviews (Singer and Presser, 1989) and were monitored to ensure they responded to participants in a neutral manner. To examine whether twice daily interviews might have inadvertently influenced participant satisfaction with spouse responses, supplementary analyses tested for the presence of systematic trends in levels of satisfaction with the spouse over the study period. This was tested first, using a day-of-study-period predictor variable (i.e., values ranged from 1 to 7) and second, using six day-of-study-period dummy contrasts. Neither of these sets of analyses revealed systematic (upward or downward) trends in morning or evening levels of satisfaction over the study period ($P > 0.05$ for all tests).

effectively with pain, Sullivan and colleagues (2001) have defined catastrophizing as a unitary construct comprised of three related but distinct factors: helplessness, rumination, and magnification. The current study focused on the helplessness dimension of catastrophizing for two main reasons. First, limiting the number of subscales in the daily interviews reduced participant burden. Second, there is some evidence to suggest that helplessness (versus rumination and magnification) is more strongly related to the pain experience (Sullivan et al., 2005) and specifically, the most relevant dimension of catastrophizing among those suffering from long-term chronic pain conditions (Vienneau et al., 1999; Sullivan et al., 2002). Thus, pain catastrophizing was assessed using three items from the Helplessness Subscale of the Pain Catastrophizing Scale (PCS; Sullivan et al., 1995). These items were originally drawn from the Catastrophizing Subscale of the CSQ (Rosenstiel and Keefe, 1983). Items with the highest item-total correlations in past research (Sullivan et al., 1995) were selected for the present scale (e.g., "It was awful and I felt that it overwhelmed me"). The full version of the Catastrophizing Subscale has previously been demonstrated to have good reliability and validity (Robinson et al., 1997; Sullivan et al., 2005). Participants were asked to indicate the extent to which each statement described how they thought or felt about their pain "so far today/since we last spoke" on a 5-point Likert scale (0 = does not apply, 1 = not at all, 2 = a little, 3 = somewhat, 4 = a lot). For all analyses, "0" and "1" responses were collapsed into a single category. Cronbach's α for this scale was 0.82, ranging from 0.65 to 0.93 across time points.

2.3.2.3. Negative affect. Negative affect was assessed using the depression and anxiety subscales of the Affects Balance Scale (Derogatis, 1975), which has been shown to have good internal consistency in previous research (Northouse and Swain, 1987). Participants were asked to indicate the extent to which each word described how they felt "so far today/since we last spoke" on a 5-point Likert scale (0 = does not apply, 1 = not at all, 2 = a little, 3 = somewhat, 4 = a lot). For all analyses, "0" and "1" responses were collapsed into a single category. Given the high significant correlations between depression and anxiety subscales (average r across time points was 0.69, ranging from 0.53 to 0.89), the two subscales were combined to form a single index of negative affect. Cronbach's α for this index of the negative affect was 0.89, ranging from 0.82 to 0.94 across time points.

2.3.2.4. Satisfaction with spouse responses. In order to assess overall satisfaction with spouse responses during each time period, participants were asked, "To what extent were you satisfied with the way in which your (husband/wife) responded to you (so far today/since we last spoke)." Responses were provided using a 5-point Likert scale (0 = does not apply, 1 = not at all, 2 = a little, 3 = somewhat, 4 = a lot). For all analyses, "0" and "1" responses were collapsed into a single category. The role of significant other responses specifically to patient pain behaviors has also received attention in past research (e.g., Giardino et al., 2003; Boothby et al., 2004). However, these measures fail to tap into patient satisfaction with responses, which has been shown to be more predictive of health outcomes than actual gestures themselves (e.g., De Leeuw et al., 2000). The spouse as a source of support was of particular interest in the current study, given previous research demonstrating the unique and powerful impact of support (or lack thereof) from the spouse (Coyne and DeLongis, 1986; Revenson, 1994). In contrast to measures used to test the operant model of pain and support, this measure assessed satisfaction with general supportive responses and not necessarily those specific to pain and pain-related issues.

3. Results

3.1. Daily interview completion and descriptive statistics

The response rate for the daily interviews was high. Of a possible 966 daily interviews, participants in the final sample (i.e., after dropping the two participants with less than 60% compliance) completed 99% of those interviews. Of the 69 participants, 90% ($n = 62$) completed all 14 daily interviews, 9% ($n = 6$) was missing one interview, and 1% ($n = 1$) was missing four interviews. The initial background interviews lasted an average of 40 min (SD = 10), ranging from 20 to 70 min. Daily interviews lasted an average of 10 min (SD = 4), ranging from 2 to 30 min. Unfortunately, data regarding interview length were available for only 62% of the initial and 46% of the daily interviews, calling into question whether these data represent a random sampling of interview times.[5] Means and standard deviations were calculated for Level 1 (daily interview) study variables, aggregated across all time points (Table 1). Participants reported an average level of pain intensity of 4.05 (SD = 2.34) in the morning and 3.83 (SD = 2.32) in the evening. Average scores for negative affect were

[5] The wide range of interview times is due to several factors. First, on days when participants did not experience any pain and did not see or speak to their spouse, the number of questions in the daily interview was substantially reduced. Second, some of the variability in interview length was due to differences in participant responses to several open-ended questions included in the initial and daily interviews. However, these data were not used in the present study. It should be noted that one daily interview was recorded at 42 min. This particular interview consisted of the participant's first daily interview, *as well as* several measures that the participant had not completed during the initial background interview. Given that we were unable to isolate the specific length of the daily interview, this value was omitted from the analyses regarding interview length.The extent to which interview length was related to study variables was examined. Individuals who had been living with RA for a longer period of time took significantly longer to complete the daily interviews. It is possible that these individuals felt more comfortable talking about their disease and had more to share about their experiences than those who had been more recently diagnosed. Interview length was not significantly related to any of the other between-person factors examined, including gender, age, fatigue, functional disability, marital satisfaction, depressive symptoms and neuroticism. Further, interview length was not significantly associated with morning or evening levels of pain or catastrophizing ($P > 0.10$ for all tests). Longer evening (but not morning) interviews were associated with greater levels of negative affect ($P < 0.05$). However, interview length was not a significant predictor independent of other variables in the models presented here ($P > 0.10$).

Table 1
Means and standard deviations for daily interview variables

Variable[a]	Mean (SD)
Pain Intensity (0–10)	
AM pain	4.05 (2.34)
PM pain	3.83 (2.32)
Negative affect (1–4)	
AM negative affect	1.27 (0.42)
PM negative affect	1.22 (0.39)
Pain catastrophizing (1–4)	
AM pain catastrophizing	1.41 (0.60)
PM pain catastrophizing	1.38 (0.60)
Satisfaction with spouse responses (1–4)	
AM satisfaction with spouse responses	3.36 (0.87)
PM satisfaction with spouse responses	3.40 (0.82)

Note. $N = 69$.
[a] Values for each study variable were aggregated for each participant, across all time points.

1.27 (SD = 0.42) in the morning and 1.22 (SD = 0.39) in the evening, while morning and evening ratings of pain catastrophizing were 1.41 (SD = 0.61) and 1.38 (SD = 0.60), respectively. Participants reported an average morning level of satisfaction with spouse responses of 3.36 (SD = 0.87) and evening level of 3.40 (SD = 0.82). Paired *t*-tests comparing morning and evening levels of study variables revealed that both pain intensity and negative affect were significantly higher in the morning, $t(474) = 3.482$, $P < 0.001$ and $t(473) = 3.575$, $P < 0.001$, respectively. No significant differences were found between morning and evening levels of catastrophizing and satisfaction with spouse responses, $t(440) = 1.394$, $P > 0.10$ and $t(405) = -0.892$, $P > 0.10$, respectively.

3.2. Multi-level regression analyses

Multi-level regression analyses were conducted using hierarchical linear modeling (HLM) software (v6.0; Raudenbush et al., 2004). This approach offers numerous benefits, including its ability to successfully deal with missing data, as well as to take into account the dependence in the data, which arose from taking repeated measures of the same variables for each participant. Using HLM, within-person variation is modeled at Level 1 and between-person variation is modeled at Level 2, allowing for the simultaneous examination of the two sources of variation. In the Level 1 specification of within-person variation, separate regression slopes and intercepts are estimated for each person. In the Level 2 specification of between-person variation, the Level 1 regression parameters are used to estimate average parameter estimates across all subjects as well as the amount of variation around this average.

In the current study, repeated measures data collected in the twice daily interviews (e.g., pain intensity, satisfaction with spouse responses) were added at Level 1. Measures that were collected at one time point during the initial interview, and represent individual difference variables (e.g., gender, functional disability), were added at Level 2. A random intercept model was employed for all analyses (i.e., intercepts for each dependent variable were left free to vary).[6] Each Level 1 predictor variable was centered around the mean of each individual's average score during the study, which eased parameter estimation by reducing correlations among slopes and intercepts (Nezlek, 2001). Given the use of person centered Level 1 predictors, slope coefficients can be interpreted as the increase or decrease in the dependent variable, at average levels of any other variables in the model (Raudenbush and Bryk, 2002). This type of centering also allowed us to examine, for example, the impact on levels of pain, negative affect, and catastrophizing, when an individual feels more or less satisfied with their spouse than they normally do. Robust estimates of standard errors (which provide valid estimates, even when the error structure has been misspecified) were obtained for all analyses.[7]

The first stage of the multi-level analyses was to run a null model (a model with no covariates) for each dependent variable (i.e., evening pain intensity, negative affect, and pain catastrophizing; Nezlek, 2001). This helped determine the proportion of between- and within-person variability present in each outcome variable. The null model for evening pain intensity indicated that significant between-person variability existed among intercepts (β_{0j}'s) in evening pain. That is, participants varied significantly in their average level of evening pain across the study period. The intraclass correlation coefficient (ICC) was calculated based on this model, and revealed that 72% of the variance in evening pain intensity was between individuals, and 28% of the variance was within individuals. The other two outcome variables also demonstrated significant between-person variability.

[6] Both intercepts and slopes were initially modeled as random. However, in order to get models to converge, it was necessary to fix the slope coefficients (Nezlek, 2001). Fixing the slopes was also the most parsimonious solution, given that deleting random parameters did not produce significant changes in the overall fit of the model (as evidenced by the deviance statistic) and the generally low reliability of the random parameters.

[7] Given that repeated measures data can contain cyclical components (West and Hepworth, 1991), day of week and weekday/weekend effects on evening pain, negative affect, and pain catastrophizing were also examined in a set of preliminary analyses. No evidence was found for these effects on evening negative affect and pain catastrophizing ($P > 0.05$ for all tests). A weekday/weekend effect and a trend for a day of week effect were initially found for evening pain intensity, such that patients reported lower levels of pain on weekend evenings ($P < 0.05$) and higher levels of evening pain on Tuesdays ($P < 0.08$). However, once other study variables were entered into the model, these effects became non-significant ($P > 0.25$). Therefore, weekday/weekend and weekday variables were dropped from all analyses presented here.

The proportion of within-person variance for evening negative affect was 40%, and for evening pain catastrophizing was 50%. These results suggested it was appropriate to model both between- and within-person variance in study outcomes.

Prior to specifying the effects of Level 1 variables on study outcomes, the independent effects of Level 2 demographic and medical status variables (gender, age, years since diagnosis, fatigue, functional disability) on the intercept of each outcome variable were examined. Fatigue and functional disability were found to be significantly positively related to evening pain intensity. Fatigue was also significantly positively related to evening pain catastrophizing. Contrary to previous findings (e.g., Keefe et al., 2000), males reported greater levels of pain catastrophizing in the current sample. No Level 2 variables were significantly related to evening negative affect. Consistent with recommended multi-level model specification, the insignificant effects were dropped and significant variables were retained as control variables in subsequent analyses predicting evening outcomes (Snijders and Bosker, 1999).

3.2.1. Do pain catastrophizing and satisfaction with spouse responses have direct effects on concurrent and lagged levels of pain intensity and negative affect?

First, a concurrent model was specified predicting evening pain intensity that included evening pain catastrophizing and evening satisfaction with spouse responses, controlling for morning pain intensity. Preliminary analyses showed that negative affect was not a significant predictor of concurrent or lagged pain intensity, and was therefore dropped from subsequent models. Based on the analyses discussed above, fatigue and functional disability were added as controls at Level 2. The final model can be expressed as

Level 1: $Y_{ij}(\text{PM pain intensity}) = b_{0j} + b_{1j}(\text{AM pain intensity}) + b_{2j}(\text{PM pain catastrophizing}) + b_{3j}(\text{PM satisfaction with spouse responses}) + r_{ij}$

Level 2: $b_{0j} = \gamma_{00} + \gamma_{11}(\text{fatigue}) + \gamma_{12}(\text{functional disability}) + u_{0j}$

$b_{1j} = \gamma_{10}$

$b_{2j} = \gamma_{20}$

$b_{3j} = \gamma_{30}$

At level 1, evening pain severity on any given day [Y_{ij}(PM pain intensity)] is a function of one's average evening pain intensity across all days (b_{0j}), the main effects of morning pain intensity (b_{1j}), evening pain catastrophizing (b_{2j}), evening satisfaction with spouse responses (b_{3j}) and that day's deviation from the average (r_{ij}). At Level 2, the Level 1 intercept (b_0) for any person (i) is a function of the average intercept (mean pain intensity) across persons (γ_{00}), fatigue, functional disability, their respective regression coefficients (γ_{11}, γ_{12}) and a random component (u_{0i}). Results indicated that when participants reported increases in evening pain catastrophizing, they also reported increases in evening pain intensity, $b = 0.99$, $t(406) = 7.72$, $P < 0.001$, whereas increases in satisfaction with spouse responses were related to decreases in evening pain intensity, $b = -0.19$, $t(406) = -1.98$, $P < 0.05$.

A concurrent model was then specified predicting evening negative affect that included evening pain catastrophizing and evening satisfaction with spouse responses, controlling for morning negative affect. Preliminary analyses showed that pain intensity was not significantly associated with either concurrent or lagged levels of negative affect, and this variable was therefore not included in subsequent analyses. Findings from this model revealed that evening pain catastrophizing was associated with greater evening negative affect, and evening satisfaction with spouse responses were associated with lower evening negative affect, $b = -0.23$, $t(408) = 5.41$, $P < 0.001$ and $b = -0.04$, $t(408) = -0.04$, $P < 0.05$, respectively.

Next, a lagged model was specified predicting evening pain intensity that included morning pain catastrophizing and morning satisfaction with spouse responses, controlling for morning pain severity (to capture residualized change in pain severity from morning to evening; see Table 2). Again, average fatigue and functional disability were controlled at Level 2. Findings revealed that increases in pain catastrophizing in the morning was associated with increases in pain intensity over the course of the day, $b = 0.23$, $t(394) = 2.07$, $P < 0.05$. A trend towards greater morning satisfaction with spouse responses predicting decreased evening pain intensity over the day also emerged, $b = -0.22$, $t(394) = -1.93$, $P < 0.06$.

Finally, the lagged model predicting evening negative affect revealed that higher levels of pain catastrophizing in the morning were related to increases in negative affect over the course of the day, $b = 0.07$, $t(394) = 1.99$, $P < 0.05$. However, morning satisfaction with spouse responses was not significantly associated with changes in evening negative affect, $b = -0.04$, $t(394) = -1.62$, $P > 0.10$.

3.2.2. Does satisfaction with spouse responses have a direct effect on concurrent and lagged levels of pain catastrophizing?

First, the concurrent relations among evening satisfaction with spouse responses and evening pain catastrophizing were examined, controlling for evening pain intensity, evening negative affect, and morning pain catastrophizing. Based on the results discussed above, gender and fatigue were also controlled at Level 2. Findings indicated that evening satisfaction with spouse responses was not significantly related to evening pain

Table 2
Multi-level regression analyses: lagged relations of morning pain catastrophizing, pain intensity, negative affect, and satisfaction with spouse responses predicting evening outcomes

Effect	PM pain intensity		PM negative affect		PM pain catastrophizing			
					Model 1		Model 2	
	b	SE	*b*	SE	*b*	SE	*b*	SE
AM pain intensity	0.44***	0.09	–	–	.13*	0.06	0.04*	0.02
AM negative affect	–	–	0.18*	0.07	–	–	0.72**	0.25
AM catastrophizing	0.23*	0.11	0.36*	0.14	0.38***	0.10	0.37***	0.09
AM satisfaction with spouse responses	−0.22[t]	0.11	0.08	0.05	0.10	0.07	0.30**	0.09
AM satisfaction with spouse responses × AM pain catastrophizing	–	–	−0.09*	0.04	–	–	–	–
AM satisfaction with spouse responses × AM pain intensity	–	–	–	–	−0.03[y]	0.02	–	–
AM satisfaction with spouse responses × AM negative affect	–	–	–	–	–	–	−0.23**	0.07

Note. [t]$P < .06$, [y]$P < .09$,
* $P < 0.05$.
** $P < 0.01$.
*** $P < 0.001$.

catastrophizing, $b = -0.03$, $t(401) = -1.16$, $P > 0.10$. Next, a lagged model was specified to include morning satisfaction with spouse responses, controlling for morning pain intensity and pain catastrophizing. Morning negative affect failed to have significant effects on evening pain catastrophizing in preliminary analyses and was therefore dropped from this model. Similar to the concurrent model, morning satisfaction with spouse responses did not have significant effects on pain catastrophizing over the course of the day, $b = -0.01$, $t(386) = -0.30$, $P > 0.10$.

3.2.3. Does satisfaction with spouse responses buffer the detrimental effects of pain catastrophizing on pain intensity and negative affect?

Lagged models were specified to investigate whether the detrimental effects of morning pain catastrophizing on evening pain severity and negative affect were attenuated at higher levels of morning satisfaction with spouse responses. The use of lagged models helped tease apart the causal ordering of variables. First, the cross-product of (centered) morning satisfaction with spouse responses and morning catastrophizing was calculated (Aiken and West, 1991). Next, two models predicting (1) evening pain severity and (2) evening negative affect were specified to include morning satisfaction with spouse responses, morning catastrophizing, and the cross-product term reflecting the interaction between morning satisfaction and morning catastrophizing, controlling for morning outcome. Findings indicated that morning levels of satisfaction with responses did not interact significantly with morning pain catastrophizing to predict evening pain intensity, $b = -0.05$, $t(392) = -0.40$, $P > 0.10$. Therefore, the interaction term was dropped from the model. However, morning satisfaction with spouse responses did significantly interact with morning pain catastrophizing to predict evening negative affect, $b = -0.09$, $t(394) = -2.00$, $P < 0.05$ (Table 2). This interaction was plotted (Aiken and West, 1991) and, as shown in Fig. 1, morning catastrophizing was associated with greater evening negative affect at lower levels of satisfaction with the spouse (i.e., one standard deviation below the mean), $b = 0.21$, $t(394) = 3.52$, $P < 0.01$. However, when participants reported higher levels of satisfaction with the spouse, morning catastrophizing was not significantly related to evening negative affect, $b = 0.03$, $t(394) = 0.59$, $P > 0.10$.

3.2.4. Does satisfaction with spouse responses buffer the effects of pain intensity and negative affect on pain catastrophizing?

Lagged models examined whether morning satisfaction with spouse responses moderated the relationship between morning pain intensity and negative affect, and evening catastrophizing. Interaction terms were

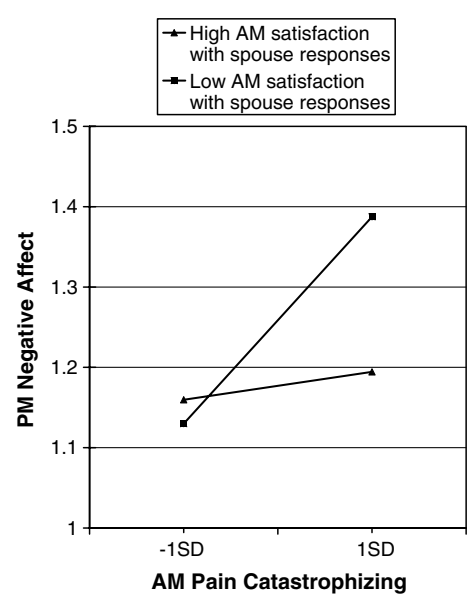

Fig. 1. Evening negative affect as a function of morning pain catastrophizing and morning satisfaction with spouse responses.

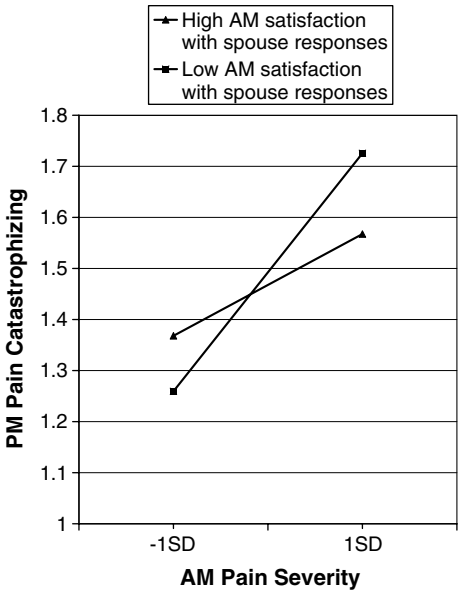

Fig. 2. Evening pain catastrophizing as a function of morning pain intensity and morning satisfaction with spouse responses.

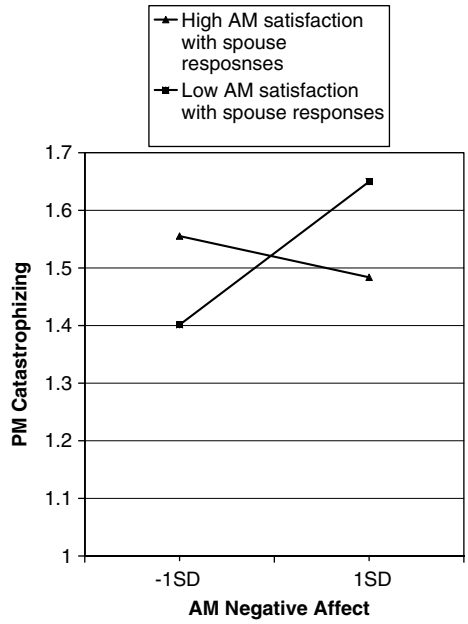

Fig. 3. Evening pain catastrophizing as a function of morning negative affect and morning satisfaction with spouse responses.

computed using the cross-product of (centered) predictors (morning satisfaction with responses × morning pain intensity, morning satisfaction with responses × morning negative affect; Aiken and West, 1991). Due to power constraints, interaction effects were tested in two separate models. The first model included morning satisfaction with spouse responses, morning pain intensity, and the interaction between morning satisfaction with spouse responses and morning pain intensity, controlling for morning pain catastrophizing. A second model was specified that included morning satisfaction with responses, morning pain intensity, morning negative affect, and the interaction between morning satisfaction with responses and morning negative affect, controlling for morning pain catastrophizing. Morning satisfaction with spouse responses was found to moderate the effects of morning pain intensity (trend) and morning negative affect on evening pain catastrophizing, $b = -0.03$, $t(385) = -1.75$, $P < 0.09$ (Table 2; Model 1) and $b = -0.23$, $t(384) = -3.37$, $P < 0.01$ (Table 2; Model 2). As shown in Fig. 2, the relationship between morning pain intensity and greater evening pain catastrophizing was attenuated at higher versus lower levels of morning satisfaction with spouse responses, $b = 0.04$, $t(385) = 3.00$, $P < 0.01$ versus $b = 0.10$, $t(385) = 3.69$, $P < 0.001$. The interaction between satisfaction with spouse responses and negative affect is depicted in Fig. 3. Among those who reported increases in satisfaction with spouse responses in the morning, negative affect in the morning was not predictive of increased pain catastrophizing in the evening, $b = -0.10$, $t(384) = -1.08$, $P > 0.10$. However, when satisfaction with spouse responses decreased, negative affect in the morning was associated with significant increases in pain catastrophizing over the course of the day, $b = 0.29$, $t(384) = 2.79$, $P < 0.01$.

4. Conclusions

The primary focus of the current study was to examine ways in which supportive social relationships may disrupt the vicious cycle of chronic pain, negative affect, and catastrophizing. Using a daily process methodology, increases in pain catastrophizing were found to be associated with subsequent increases in negative affect and pain intensity over the course of the day, even after controlling for prior levels of negative affect and pain. This is consistent with a growing number of studies indicating that high levels of catastrophizing can lead to poorer adjustment to chronic pain over time (Granot and Ferber, 2005; Pavlin et al., 2005). However, our findings also suggest that changes in day-to-day satisfaction with spouse responses can influence this process through several distinct, but related, pathways.

We found evidence of a synergistic effect of satisfaction with spouse responses and catastrophizing on levels of negative affect. That is, when participants' satisfaction with their spouses decreased, the effects of catastrophizing on negative affect tended to persist throughout the day. However, when participants' satisfaction increased, catastrophizing had no significant lasting effects on negative affect. These results are consistent with past research suggesting that positive responses from others can attenuate the detrimental effects of maladaptive coping (Marin et al., in press). Further, Puterman and colleagues (under review) found that social

support protected married couples from the otherwise negative effects of daily rumination. Taken together, these findings suggest that although patients may at times feel overwhelmed and unable to cope with their pain, feeling supported by others may help individuals disengage from a pattern of negative thoughts and feelings and encourage the use of more adaptive coping strategies (Holtzman et al., 2004).

While there is some evidence that social support can buffer the negative effects of maladaptive coping on mood (Griffin et al., 2001), even fewer studies have examined effects on pain outcomes (Holtzman et al., 2004). Contrary to our hypothesis, increases in morning catastrophizing were related to increases in evening pain intensity, *regardless* of the degree to which individuals were satisfied with spouse responses. One possible explanation for these findings is that catastrophizing may lead to greater pain intensity and affective changes via different pathways, and perhaps the association between catastrophizing and negative affect may be more easily manipulated through social or cognitive means. Catastrophizing may increase the sensory flow of pain signals, leading to the sensitization of central neural mechanisms (Melzack, 1990), and over time this may lead to a self-perpetuating cycle of catastrophizing and heightened nociceptive processing that is less under psychological control (Sullivan et al., 2001).

Despite a failure to buffer the harmful effects of catastrophizing on later levels of pain, increases in satisfaction with spouse responses were related to decreases in concurrent levels of pain. Such increases in satisfaction were also slightly, but not significantly, associated with decreases in pain over the course of the day. These findings are consistent with existing theory and research suggesting that higher levels of satisfaction with support are related to lower pain (Savelkoul et al., 2000; Evers et al., 2003). While some studies have found an association between support and *greater* pain, these studies typically assessed support in terms of frequency or amount of support received in response to patient expressions of pain (Schwartz et al., 1996; Kerns et al., 2002). The two previous daily studies that examined the relationship between perceived support and pain (Feldman et al., 1999; Holtzman et al., 2004) aggregated across sources of support, and findings have been mixed. Our study suggests the utility of independently examining satisfaction with support from different sources (Felton and Berry, 1992), and that aggregate measures may have diluted the effects of spouse support in previous studies.

Despite the wealth of literature demonstrating harmful effects of catastrophizing, little is known about factors that might lead individuals to respond to pain in an exaggerated negative manner. Not surprisingly, our results suggest that increases in pain are predictive of increases in catastrophizing, both concurrently and over the course of the day. This is consistent with past cross-sectional research demonstrating that when individuals report greater pain, they are more likely to catastrophize (Sullivan et al., 2005). The current study also revealed that satisfaction with spouse responses in the face of pain and negative affect can reduce the likelihood of catastrophizing. Specifically, the relationship between morning pain and evening catastrophizing was attenuated when individuals reported increases in satisfaction with spouse responses. When participants reported decreases in satisfaction, negative affect was significantly related to subsequent increases in catastrophizing over the day. However, on days when participants reported *increases* in satisfaction, the relationship between morning negative affect and evening catastrophizing was non-significant. These findings are consistent with past research demonstrating that a supportive environment can lead individuals to feel less threatened by, and better able to cope with, stressful situations (Bova, 2001). Results are also in line with the stress-buffering model of social support, which anticipates that support will play a more important role at higher levels of stress (Cohen and Wills, 1985). Finally, these findings may be viewed as support for the communal coping model (Sullivan et al., 2001), in that feeling satisfied with spouse responses may have reduced the "need" or motivation for individuals to catastrophize as a means of garnering attention and support.

The recruitment method used in the current study precluded calculation of formal response rates. However, the relative size of the final sample suggests this may not be a representative sample of community-dwelling individuals with RA and raises some concern regarding the generalizability of study findings. The extent to which our findings are generalizable to other chronic pain populations, and, given the small number of males in our sample, to predominantly male samples, also remains to be seen. Interestingly, males in our study reported greater catastrophizing than did females. This finding is at odds with some past research suggesting that women are more likely to catastrophize (Jensen et al., 1994; Keefe et al., 2000). However, not all studies have found a gender difference (Unruh et al., 1999; Edwards et al., 2004). Another study limitation is a reliance on self-report data, as data are reported only from the patient's perspective. It is unclear how well satisfaction with spouse responses would have mapped onto spouse ratings of how they responded. Lack of data regarding interview length is also a limitation. Interview length may reflect factors not examined here, including response uncertainty, satisficing, and participant rapport (Holbrook et al., 2003). Future research is needed to examine how these factors may influence study findings. Finally, this study is limited in its focus on negative dimensions of affect, a single dimension of pain

experience, and the use of a single item to assess satisfaction with spouse responses.

The daily process methodology used here may represent an ecologically valid means of obtaining data on pain catastrophizing and related processes across time. Previous research (Dixon et al., 2004) has reported only a small relationship between retrospective reports of general tendencies to catastrophize and reports of catastrophizing obtained immediately after a (lab-induced) painful experience, suggesting the need for alternative methodologies. The interview compliance rate obtained in the current study was as high or higher than that reported in past electronic diary studies (Mohr et al., 2003). This likely reflects strong rapport built through regular telephone contact.

In sum, our findings provide further evidence that individuals fluctuate in the extent to which they catastrophize about their pain and that these fluctuations can lead to worsening levels of pain and negative affect over the course of the day. Consistent with current views of social support as a coping resource (Severeijns et al., 2004; DeLongis and Holtzman, 2005), the present study suggests that day-to-day satisfaction with spouse responses can help reduce catastrophizing and protect against its detrimental effects.

The majority of past research has examined ways in which spouse responses to pain behaviors may positively reinforce catastrophizing, with mixed results (Giardino et al., 2003; Boothby et al., 2004). However, in order to gain a more comprehensive understanding of how the social environment may both reinforce *and* reduce catastrophizing, our findings suggest the need to assess the type and frequency of spouse responses to pain and distress, as well as patients' *satisfaction* with these responses. Investigation into factors that influence ratings of satisfaction with support is also warranted, including those that fluctuate on a day-to-day basis (e.g., pain, negative affect), as well as those that remain relatively stable over months (e.g., relationship quality) and years (e.g., personality). At a microanalytic level, the spouse emerged as a coping resource. However, longitudinal research is needed to examine the extent to which spouses can protect against the long-term consequences of catastrophizing, or conversely, whether a repeated pattern of patient catastrophizing may actual erode supportive relationships, and interfere with both patient *and* spouse well-being (Cano, 2004). Finally, emerging research suggests that cognitive behavior therapy can improve adjustment to chronic pain, and that reductions in catastrophizing may help mediate treatment gains (Turner et al., 2007). Our results suggest the potential utility of involving close others in attempts to reduce patient catastrophizing and helping to maintain treatment gains over time.

Acknowledgements

This research was supported by fellowships to the first author from the Canadian Institutes for Health Research and Michael Smith Foundation for Health Research and grants to the second author from the Social Science and Humanities Research Council of Canada. The authors would like to express their gratitude to Drs. Esdaile and Chalmers and their colleagues at the Mary Pack Arthritis Center for their help in participant recruitment. The authors would also like to thank Drs. Gregory Miller, Dan Perlman, and Jeremy Biesanz for their helpful comments on a previous draft, Natasha Yule, Susan Steeves, Mark Lam, and our undergraduate research assistants for their assistance in conducting participant interviews.

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