ONE DAY AT A TIME:
THE INFLUENCE OF DAILY SPOUSE SUPPORT ON PAIN, NEGATIVE AFFECT, AND
CATASTROPHIZING AMONG INDIVIDUALS WITH RHEUMATOID ARTHRITIS

by

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ABSTRACT

Using a daily process methodology, the current study sought to gain a more comprehensive understanding of the mechanisms through which day-to-day spouse support may influence well-being among individuals with rheumatoid arthritis (RA). Social support was operationalized as perceptions of positive and negative responses from the spouse, as well as levels of satisfaction with these responses. In addition to investigating the direct effects of spouse support on pain and negative affect, the current study examined whether support influences pain catastrophizing and protects against its detrimental effects on well-being.

Sixty-nine married individuals with RA took part in an initial background interview, followed by twice daily telephone interviews (regarding pain intensity, negative affect, catastrophizing and spouse support) for one week. Multi-level modeling indicated several pathways through which spouse support, particularly satisfaction with spouse responses, impacts the vicious cycle of pain, negative affect and catastrophizing. Consistent with past research, catastrophizing was associated with increases in pain and negative affect concurrently, and over the course of the day. However, when participants 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 morning pain and evening catastrophizing was attenuated when participants reported increases in satisfaction with spouse responses. Negative affect was also associated with increases in catastrophizing across the day, but only when participants reported decreases in satisfaction with spouse responses. An important role of negative spouse responses also emerged. For example, morning perceptions of spouse complaints were associated with increases in pain over the course of the day. However, perceptions of spouse avoidance did not influence day-
to-day well-being in the current study. Overall, findings are consistent with a model in which spouse support can both help and hinder individuals as they attempt to cope with daily pain, and suggests the importance of involving close others in treatments to reduce pain and catastrophizing.
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INTRODUCTION

Over the past 30 years, research has demonstrated beneficial effects of social support on the psychological and physical well-being of individuals suffering from chronic illness (e.g., Cheng & Boey, 2000; Helgeson & Cohen, 1996; Uchino, Cacioppo, & Kiecolt-Glaser, 1996). However, despite an overwhelming number of studies on the importance of social support among chronically ill populations, we still know very little about the mechanisms through which support influences well-being (Thoits, 1995). Social support has been conceptualized as a coping resource that influences how individuals interpret and respond to stressful situations (DeLongis & Holtzman, 2005; Lazarus & Folkman, 1984; Schreurs & de Ridder, 1997;Thoits, 1986). Although widely accepted in theory, this hypothesis has seldom been tested through empirical research.

The potentially therapeutic role of social support has been of interest to researchers studying individuals with chronic pain for many years. Although biomedical factors seem to instigate the initial report of pain, over time psychosocial factors may play a significant role in the disease course of various chronic pain conditions (Turk & Melzack, 2001). Similar to the social support literature more broadly, studies examining the social context of chronic pain have typically investigated whether individuals who are more satisfied with their social networks report greater psychological and physical well-being than those who are less satisfied. Through a daily process approach, the current study sought to gain a more comprehensive understanding of day-to-day supportive processes among individuals diagnosed with rheumatoid arthritis. Given past research demonstrating the unique and powerful effects of intimate relationships, this study focused specifically on perceptions of support from the spouse (Coyne & DeLongis, 1986).
Social support was operationalized as perceptions of day-to-day positive and negative responses from the spouse, as well as levels of satisfaction with these responses. In addition to examining the direct effects of spouse support on pain intensity and negative affect, the current study addressed recent calls in the literature to examine how close relationships may influence the way in which individuals interpret and respond to health-related stressors (Romano, Jensen, Turner, Good, & Hops, 2000; Stanton, Collins, & Sworowski, 2001). Of particular interest was the interplay between perceptions of social support and pain catastrophizing. Pain catastrophizing has been identified as one of the most important psychosocial factors that can influence adjustment to chronic pain (Sullivan et al., 2001). However, the potential impact of the social environment on levels of catastrophizing and the extent to which support might attenuate the detrimental effects of catastrophizing on well-being has received very little attention in past research.

**Satisfaction with Social Support and Chronic Pain**

In the pain literature, the majority of studies that have examined the effects of perceived social support on well-being have focused on the relationship between perceived support and depressive symptoms. Findings from cross-sectional research have generally indicated that individuals who report higher levels of satisfaction with or availability of social support tend to suffer from fewer symptoms of depression and lower negative mood (e.g., Doeglas et al., 1994; Ferreira & Sherman, 2007; Franks, Cronan, & Oliver, 2004; Goodenow, Reisine & Grady, 1990; Klapow et al., 1995; Kraaimaat, van Dam-Baggen, & Bijlsma, 1995; Nicassio, Radojevic, Schoenfeld-Smith, & Dwyer, 1995; Romano, Turner, & Jensen, 1997; Suurmeijer et al., 2005; Trief & Carnrike, 1995; Tsai, 2005; for an exception see Curtis, Groarke, Coughlan, & Gsel, 2004). Among the limited number of longitudinal studies that have addressed this question, some studies have found an association between higher
satisfaction with support and lower levels of psychological distress (e.g., Brown, Wallston, & Nicassio, 1989). However, others have failed to find significant effects (e.g., Evers, Kraaimaat, Geenen, & Bijlsma, 1997; Smith & Wallston, 1992). Outside the pain literature, among studies of individuals coping with other chronic health conditions, the large majority suggest that high baseline levels of satisfaction with support are predictive of better psychological functioning over time (for a review, see Penninx, Kriegsman, van Eijk, Boeke, & Deeg, 1996).

Fewer studies have investigated the relationship between satisfaction with social support and pain-related outcomes among patients with chronic pain, and results have been mixed. Several investigators have found evidence for concurrent and lagged effects of perceived support on pain outcomes (Jamison & Virts, 1990; Savelkoul, Post, de Witte, & van den Borne, 2000; Weinberger, Hiner, & Tierney, 1986). For example, in a cross-sectional study of patients with rheumatic diseases, including both RA and osteoarthritis, satisfaction with supportive exchanges was associated with lower levels of pain frequency and intensity (Savelkoul et al., 2000). In a study by Jamison and Virts (1990), patients with chronic pain reported their perceptions of family support prior to entering an outpatient pain program. One year following the completion of the program, patients who initially reported having supportive and encouraging families reported significantly less pain intensity. Evers and colleagues also found beneficial lagged effects of perceived support (Evers, Kraaimaat, & Geenen, 2003). Specifically, greater perceived availability of emotional and instrumental support at the time of diagnosis with RA was associated with better functional status and lower pain at a three- and five-year follow-up, controlling for baseline personality, clinical status, and medication use. Despite substantial evidence for a direct relationship between satisfaction with social support and pain intensity, an association between these variables has
not always been found (Affleck, Tennen, Urrow, & Higgins, 1994; Gil, Keefe, Crisson, & Van Dalfsen, 1987; Holtzman, Newth, & DeLongis, 2004; Lauver & Johnson, 1997; Smith & Wallston, 1992; Taal, Rasker, Seydel, & Wiegman, 1993).

**Received Support and Chronic Pain**

When social support is conceptualized as received support, the association between support and well-being becomes much less clear. Received support is typically operationalized as an individual’s *perceptions* of the frequency or amount of support they received from others during a discrete period of time (e.g., during the past week, past month), and often includes an assessment of different types of support, including emotional (i.e., expression of caring, sympathy, listening), instrumental (i.e., practical assistance with tasks, provision of material aid), and informational (i.e., provision of advice, suggesting alternative ways of looking at a situation) support (House, 1985). In the pain literature, a subset of studies has focused specifically on the impact of “solicitous” gestures from significant others (i.e., emotional or instrumental support *specifically* in response to patient pain behaviors, such as guarding, wincing, rubbing afflicted areas). Several of these studies have found an association between more frequent solicitous spouse responses and greater levels of pain (e.g., Fillingim, Doleys, Edwards, & Lowery, 2003; Schwartz, Slater, & Birchler, 1996) and disability (e.g., Romano, Turner, & Jensen, 1995). However, not all studies have found a significant relationship (e.g., Jensen et al., 2002). Solicitous gestures that occur specifically in response to patient expressions of pain are thought to impact well-being via operant conditioning mechanisms, whereby support reinforces expressions of pain and inactivity (Gil et al., 1987). Given that the focus of the current investigation is on supportive gestures that are not necessarily contingent on patient pain behaviours, the following review will be limited to studies that have conceptualized support in a non-pain-contingent manner.
The majority of studies examining the direct relationship between received support and psychological well-being among individuals with chronic pain conditions have been cross-sectional in nature, and the findings have been mixed (Doeglas et al., 1994; Penninx et al., 1998; Riemsma et al., 2000; Suurmeijer et al., 2005). In a study of patients with RA, greater frequency of supportive gestures across the social network were related to lower levels of depressive symptoms (Riemsma et al., 2000). Similarly, Doeglas and colleagues (1994) found that greater frequency of emotionally supportive interactions were associated with higher concurrent ratings of psychological well-being among patients with RA. However, others have found greater frequency of received support from network members to be associated with higher levels of depression among those suffering from arthritis and other chronic health conditions (e.g., De Leeuw et al., 2000). Longitudinal research on the relationship between received support and well-being among patients with chronic pain is sparse. In the one study that could be identified, Revenson (1990) followed patients with RA over 4 months and found that perceptions of positive support from family and friends were associated with increases in depression over time. In the broader social support literature, longitudinal investigations of the effects of received support on psychological well-being typically fail to find significant effects (Cranford, 2004; Pagel, Erdly, & Becker, 1987; Rook, 2001). For example, in a caregiver study of couples in which one had been diagnosed with Alzheimer’s disease, perceptions of helpful support from one’s social network were not a significant predictor of depression over the 10 month study period (Pagel et al., 1987). Frequency of received support from the spouse was also found to be unrelated to changes in depressive symptoms over a one month period among a community sample of married couples (Cranford, 2004).
Even fewer studies have employed a daily process design to test the impact of day-to-day supportive exchanges on psychological well-being. Findings from these studies provide evidence for beneficial (Cutrona, 1986; DeLongis, Capreol, Holtzman, O’Brien, & Campbell, 2004; Feldman, Downey, & Shaffer-Neitz, 1999), harmful (Bolger, Zuckerman, & Kessler, 2000) and null effects (Cutrona, 1986; Rook 2001). Feldman and colleagues (1999) conducted a study on individuals diagnosed with complex regional pain syndrome in which participants completed a daily structured record on mood, pain, and perceived receipt of support for 28 consecutive days. Ratings of support were aggregated across sources of support and included perceived receipt of emotional and instrumental support. Receipt of social support was found to predict decreases in negative mood on the following day. In a daily study of undergraduate psychology students, Cutrona (1986) found that more frequent helping behaviours (across sources of support) were associated with lower same day, but not next day, depressed mood. In contrast, a daily diary study of couples in which one was preparing for the bar exam found that when participants reported receiving support from their partner, they were more likely to report increases in same and next day levels of depressed mood (Bolger et al., 2000).

Evidence has been found for a beneficial role of received support on physical functioning among chronically ill populations, but again, findings are mixed and there are few studies from which to draw reliable conclusions. In the study by Feldman and colleagues (1999) described above, receipt of support was related to decreases in pain severity on the following day, even after controlling for previous day’s pain and negative mood. Weinberger and colleagues (1990) found a relationship between greater receipt of esteem support and lower levels of functional disability among patients with OA. Studies on the relationship between received support and physical well-being among other chronically ill populations...
have also found evidence for both positive and negative effects of received support. For example, received emotional support, but not instrumental support, was found to be associated with lower functional disability among older adults with vision loss (Reinhardt, Boerner, & Horowitz, 2006). Another study of older adults found an association between higher frequency of received support (emotional, instrumental, informational) and greater disability (Jang, Haley, Mortimer, & Small, 2003).

Although both the main effects and stress buffering hypotheses (Cohen & Wills, 1985) predict that receiving support from a loved one will have beneficial effects, an accumulating number of null findings, as well as findings suggesting a relationship between received support and worse outcomes, cannot be ignored. One possible reason for a failure to find an effect of received support may be that many of the studies reviewed here used measures of support that aggregated across multiple sources. Given research showing the unique and potent impact of the marital relationship as a source of support (Coyne & DeLongis, 1986), these aggregate measures may be diluting the effects of support specifically from the spouse. The majority of longitudinal and prospective daily studies have examined whether the effects of receiving support persist over the course of months and days. Given that supportive exchanges may have beneficial, but relatively transient, effects on well-being (Holtzman et al., 2004), the effects of support may not have been captured using these extended time lags. A failure to find a significant association between received support and well-being might also suggest that received support impacts well-being indirectly, by influencing how an individual appraises or copes with stress (Schreurs & de Ridder, 1997; Thoits, 1986). For example, reminding a loved one of previous instances when they have persevered in the face of adversity may not in itself lead to improved mood and adjustment, but it may help steer that
individual towards more active ways of coping, and enhance their sense of control and self-efficacy in facing current stressors.

The majority of studies that have found an association between greater levels of received support and lower well-being have been cross-sectional in nature. Therefore, it is possible that this relationship indicates that individuals who are more distressed are more likely to elicit greater levels of support from their networks (i.e., reverse causation; Seidman, Shrout, & Bolger, 2006). It has also been suggested that these findings may be due to a third variable, such as stressful life events, which serve to increase both distress and received support (Barrera, 1986; Bolger, Foster, Vinokur, & Ng, 1996). Other explanations for an association between received support and negative outcomes will be discussed below, and include dissatisfaction with well-intended support, and negative social interactions, such as criticism and avoidance.

The Down Side of Social Support

Support attempts that fail. Well-meaning attempts to provide support may not always be perceived as helpful by the recipient (Lehman & Hemphill, 1990). Among patients suffering from chronic pain, dissatisfaction or disappointment may arise when gestures of support involve pity or over solicitousness (Affleck, Pfeiffer, Tennen, & Fifield, 1988). Past studies have examined how support attempts may backfire and have a detrimental impact on patient well-being. For example, in a longitudinal study of older women suffering from osteoarthritis (Martire, Stephens, Druley, & Wojno, 2002), participants were asked how often their husbands helped them with a series of activities of daily living (ADL). These women were also asked to rate the extent to which they felt incompetent in completing these activities as a result of this support, and whether they felt they had control or choice over spousal assistance. Findings indicated that initial feelings of incompetence as a result of instrumental
support predicted increased levels of depressive symptomatology and decreased life satisfaction at six-month follow-up. Similarly, a study by Newsom and Schulz (1998) found that among a sample of physically impaired older adults (22% of whom reported arthritis as the primary cause for impairment), mental or emotional strain in response to receiving help with ADL predicted greater levels of depression at one-year follow-up.

**Criticism and avoidance.** Another detrimental aspect of the support process is the presence of negative or punishing responses from support providers. These responses may include the expression of anger, frustration or irritation towards the patient, criticism, or avoidant behaviour. Although these responses generally occur less frequently than well-intentioned gestures, they are often as potent, if not more potent, in predicting well-being (e.g., Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001; Pagel et al., 1987; Rook, 1984; Rook & Pietromonaco, 1987; Schuster, Kessler, & Aseltine, 1990; Walen & Lachman, 2000).

Among individuals living with chronic pain, negative responses from support providers have been most consistently associated with increased psychological distress and depression (Boothby, Thorn, Overduin, & Ward, 2004; Cano, 2004; Kerns, Haythornthwaite, Southwick, & Giller, 1990; Papas, Robinson, & Riley, 2001; Revenson, Schiaffino, & Majerovitz, 1991; Romano, et al., 1997; Schwartz et al., 1996; Sherman, 2003; Turk, Kerns, & Rosenberg, 1992). For example, in a study of older adults with knee osteoarthritis, social strain was associated with higher levels of depressive symptoms, controlling for demographics and disease severity 30 months prior (Sherman, 2003). Daily diary studies that have examined within-day and lagged effects of conflictual interactions have found that detrimental effects on same-day mood may actually dissipate to non-significant levels by the following day (e.g., DeLongis et al., 2004; Stader & Hokanson, 1998).
The relationship between negative social interactions and patient reports of pain intensity has also been investigated. Most of these studies have used the punishing spouse response subscale on the West-Haven Yale multidimensional pain inventory (WHYMPI; Kerns, Turk, & Rudy, 1985) and have tended to find detrimental effects. This subscale asks patients to indicate how often their spouse responds to them with anger, frustration, irritability, or ignoring when the spouse knows the patient is in pain. Schwartz and colleagues (1996) found a significant association between spouse reports of their own punishing responses towards their partner and average levels of patient pain intensity. In a study by Papas and colleagues (2001), three distinct subgroups of pain patients were derived based on spouse responses to pain. One of those subgroups was the ‘negatively attentive’ subgroup, which was characterized by high levels of punishing responses and low levels of solicitous and distracting responses. Patients in this subgroup reported the highest level of pain intensity, depression, and interference due to pain. In another study of patients with chronic pain, spouse reports of punishing responses were correlated with greater levels of patient pain (Flor, Kerns, & Turk, 1987).

Most studies of critical or avoidant responses among chronic pain populations have employed a cross-sectional design. However, a small number of studies have looked at the influence of these responses on well-being over time. Stephens and colleagues followed a group of patients undergoing knee surgery for OA of the knee (Stephens, Druley, & Zautra, 2002). Patients completed a general measure of spousal conflict and criticism six weeks post-surgery. Patients who reported greater problematic support six weeks after surgery reported less improvement in pain at six months post-surgery. In a study of patients diagnosed with RA, subjects were asked to indicate the extent to which their spouses responded with criticism or avoidance while they were in pain or experiencing a severe flare-up in disease activity.
(Waltz, Kriegel, & van't Pad Bosch, 1998). More specifically, subjects were asked to indicate whether their spouses were irritable or unfriendly, didn't seem to notice, acted like nothing happened, or were overprotective. Greater levels of spousal criticism and avoidance at baseline predicted more severe ratings of pain one year later, controlling for disease severity. Grant and colleagues found that average daily increases in pain intensity were associated with greater overall frequency of spousal punishing responses to pain among women suffering from chronic low back pain (Grant, Long, & Willms, 2002). Despite studies suggesting an association between pain intensity and negative responses from the spouse, some studies have failed to find a significant relationship (Gil et al., 1987; Turk et al., 1992).

Social Support as a Coping Resource

When a beneficial effect of social support on well-being is found, it is often assumed that significant effects are due in part to the influence of support on the ways in which individuals interpret and cope with their illness (Schreurs & de Ridder, 1997). Indeed, among chronically ill populations, there is increasing evidence to suggest that individuals with high levels of perceived social support interpret their illness as less stressful and threatening. For example, in a study of adults with diabetes, perceptions of support availability were associated with lower levels of depression directly and indirectly, through lower levels of perceived threat of diabetes (Connell, Davis, Gallant, & Sharpe, 1994). Bova (2001) found similar results, such that the effects of social support on adjustment to HIV were mediated by more adaptive illness appraisals. In a study of individuals with RA, Smith and Wallston (1992) found that greater quality of emotional support was correlated with lower levels of perceived helplessness in dealing with arthritis-related events. However, this relationship was no longer significant once controlling for other study variables. High levels of perceived social support may also help individuals view their situations in a more positive light.
For example, in a daily process study of patients with RA, satisfaction with support was associated with increased daily use of cognitive reframing, a coping strategy associated with decreases in negative affect over the course of the day (Holtzman et al., 2004).

**Pain catastrophizing.** Among individuals suffering from chronic pain, there is strong and consistent evidence to support the idea that those who respond in an exaggerated negative manner to their pain and its potential consequences are more likely to experience a range of negative outcomes, including greater psychological distress (e.g., Geisser, Robinson, Keefe, & Weiner, 1994; Robinson et al., 1997; Severeijns, Vlaeyen, van den Hout, & Weber, 2001), functional disability (e.g., Severeijns et al., 2001, Sullivan, Stanish, Waite, Sullivan, & Tripp, 1998), and pain intensity (e.g., Grant, Long, & Willms, 2002; Keefe, Brown, Wallston, & Caldwell, 1989; Severeijns et al., 2001; Sullivan, Bishop, & Pivik, 1995; Sullivan et al., 1998; Tan, Jensen, Robinson-Whelen, Thornby, & Monga, 2001).

However, some have raised concerns that the relationship between pain catastrophizing and pain outcomes is confounded by other factors, such as depression, negative affectivity, and trait anxiety (Sullivan & D’Eon, 1990). Addressing this concern, several studies have found that pain catastrophizing predicts pain outcomes, even after controlling for these other variables (Flor, Behle, & Birbaumer, 1993; Geisser et al., 1994; Sullivan et al., 1995; Walsh, Smith, & McGrath, 1998). For example, Sullivan and colleagues (1995) found that in considering pain catastrophizing, fear of pain, negative affectivity, depression, and trait anxiety as predictors of pain, catastrophizing was the only variable that contributed unique variance to the prediction of pain. This is not always the case, however. In a daily diary study of patients with RA, the relationship between catastrophizing and pain
intensity was non-significant after controlling for depression (Affleck, Tennen, & Urrows, 1992).

A growing number of longitudinal and prospective studies suggest that catastrophizing can lead to poorer adjustment over time (Granot & Ferber, 2005; Keefe et al., 1989; Pavlin, Sullivan, Breund, & Roesen, 2005; Sorbi et al., 2006; Turner, Mancl, & Aaron, 2004; for an exception see Hanley, Jensen, & Edhe, 2004). For example, findings from a recent electronic daily process study of patients with temporomandibular disorders revealed that, within participants, greater catastrophizing was associated with greater subsequent activity interference and jaw use limitations, even when controlling for prior levels of the outcome variables (Turner et al., 2004). Catastrophizing was also associated with greater subsequent pain intensity and negative mood in this study, but these relationships were non-significant after controlling for prior levels of outcome variables. Two other daily process studies of individuals with chronic pain revealed that increases in catastrophizing in the morning were related to increases in evening pain (Grant et al., 2002) and negative mood (Grant et al., 2002; Keefe et al., 2004), even after controlling for morning levels of outcome variables. Taken together, these studies suggest that the association between pain catastrophizing and well-being is not merely due to a third variable, nor does it appear to reflect merely a reverse direction of causality whereby worse health leads to more catastrophizing (although this relationship is most likely bidirectional).

Social support and pain catastrophizing. Although there is some evidence that catastrophizing reflects a stable way of responding to pain (Sullivan et al., 1995), recent daily diary research suggests that individuals vary in the extent to which they catastrophize on a day-to-day basis and that these fluctuations cannot be accounted for by pain alone (Grant et al., 2002; Turner et al., 2004). Despite a widespread consensus that the social environment
plays an important role in shaping the pain experience (Keefe & France, 1999), its influence on pain catastrophizing and its detrimental effects has only recently been considered.

To date, the majority of this research has focused on the extent to which solicitous spouse responses to pain behaviours may reinforce exaggerated expressions of pain and distress, with mixed results (communal coping model; Sullivan et al., 2001). We still know very little about how the social environment may help reduce catastrophizing and its detrimental effects. Preliminary support for this idea comes from a cross-sectional study by Cano (2004), who found, among those with longer durations of chronic pain, higher perceived spousal support was correlated with less catastrophizing. Keefe and colleagues (2003), on the other hand, failed to find significant effects of perceived emotional support on pain catastrophizing among individuals with gastrointestinal cancer. In addition, higher perceived instrumental support was correlated with greater levels of catastrophizing in this study. The extent to which one can draw conclusions from these studies is limited by their cross-sectional nature. Furthermore, both studies failed to control for levels of pain intensity. As a result, one cannot rule out the possibility that the association between greater instrumental support and higher levels of catastrophizing was due to an underlying third variable (i.e., greater pain) or that pain catastrophizing elicited higher levels of instrumental support from caregivers.

A model in which social relationships influence levels of pain catastrophizing is also useful in addressing the mechanism through which negative social interactions impact well-being. For example, Keefe and colleagues (2003) found that more frequent critical (but not avoidant) caregiver behaviours were related to higher levels of catastrophizing. Boothby and colleagues (2004) found a significant relationship between catastrophizing and an aggregate measure of punishing spouse responses (which included critical and avoidant behaviours). However, Cano (2004) failed to find a significant relationship.
The extent to which a supportive social environment can protect individuals against the deleterious effects of maladaptive coping has also received some attention in the literature (Puterman, Pomaki, & DeLongis, 2007). For example, in a study of parents raising a child with a disability, the relationship between reproach coping (self-blame, confrontation, withdrawal) and psychological distress was attenuated among those who perceived positive responses from the spouse (Marin, Holtzman, DeLongis, & Robinson, in press). In a daily study of individuals with RA, increases in the use of distancing to cope with pain was associated with decreases in pain when individuals reported greater satisfaction with support, but increases in pain when helpful support was not perceived (Holtzman et al., 2004). In a longitudinal study of individuals with RA, coping by venting emotions was associated with greater negative affect and poorer disease status over a nine-month period, but only among those who reported high levels of punishing responses from close others (Griffin, Friend, Kaell, & Bennett, 2001). In a one-year longitudinal study of individuals with multiple sclerosis (MS), individuals who rated MS-related problems as highly threatening at baseline had better social adjustment at one-year follow-up if they reported high baseline levels of perceived social support (Pakenham, 1999). Taken together, these findings suggest that a supportive environment may help minimize the effects of pain catastrophizing on well-being.

Methodological Issues

Although social relationships appear to play an important role among patients dealing with chronic pain, it is difficult to draw firm conclusions regarding the specific nature and magnitude of the relationship between support and well-being. As was mentioned earlier, heterogeneity in the way in which social support has been conceptualized and operationalized has contributed to a lack of consensus in existing research. For instance, some studies have assessed support across the entire social network, while others have focused on a single
source of support (typically the spouse). It is also rare that satisfaction with support and perceptions of actual supportive gestures have been assessed within the context of the same study, precluding an examination of their relative contributions to well-being (Cohen, Lakey, Tiell, & Neely, 2005).

Another factor that appears to be clouding the picture is an over-reliance on cross-sectional studies in psychosocial pain research. For example, previous research on the social context of catastrophizing, and catastrophizing in general, has relied heavily on cross-sectional designs that ask participants to recall their general tendencies to catastrophize during past painful experiences. One must be cautious in interpreting the results of these cross-sectional studies for several reasons. For instance, it is possible to obtain a significant correlation between two variables when no individual in the sample displays this relationship (Epstien, 1983). Furthermore, correlational research impedes our ability to understand the temporal ordering of variables and draw causal inferences from the data.

Calls in the stress and coping literature have been made for the use of daily process methods involving intensive day-to-day monitoring in order to view support and coping processes close to their real-time occurrence (Tennen, Affleck, Armeli, & Carney, 2000). Multiple time-points are often necessary to create an appropriate test of the stability and magnitude of the relation between variables (Epstein, 1983). One method that has been used to examine the temporal patterning of support and coping processes is the structured daily record approach. Using this design, the validity and reliability of self-report data can be increased by decreasing recall error of various events and experiences. For example, previous research (Dixon, Thorn, & Ward, 2004) has reported a relatively low correlation 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. A further advantage of this methodology is that it allows a better mapping of methods onto conceptual models of social support and coping as dynamic processes (Lazarus, 2000).

Daily process researchers are increasingly relying on the use of hand held electronic diaries (e.g., palm pilots) to collect information on the day-to-day experiences of study participants. This method of data collection offers several potential advantages over traditional paper and pencil diaries, including the ability to verify the exact time of each diary entry (particularly when multiple assessments are taken per day), and a reduction in manual data entry (Tennen, Affleck, Coyne, Larsen, & DeLongis, 2006). Nonetheless, electronic diary studies can be extremely costly and may not be suitable across all study populations. 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. Another (less commonly used) alternative to paper diaries is telephone diaries, which use automated technology or live telephone interviews. Although much more time and labor intensive than paper or electronic diaries, this approach combines 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).

**Current Study**

The current study employed a daily process methodology to investigate the mechanisms underlying the relationship between social support and well-being among a community-dwelling sample of individuals diagnosed with RA. RA is an incurable
autoimmune disease that affects approximately 1% of the western population (Evers, Kraaimaat, Geenen, & Bijlsma, 1998). It is associated with a variety of distressing and debilitating symptoms including chronic pain, stiffness and inflammation of the joints, fatigue, and frequent mood changes (Smith & Wallston, 1992). Among these symptoms, pain of variable duration and intensity is the most significant and problematic symptom for patients with RA (Young, 1992). RA sufferers typically experience a wide range of daily stressors such as difficulties performing household chores, impaired ability to work or hold a job, difficulties engaging in leisure or social activities, and interpersonal tensions resulting from added burdens for friends and family members (Stenstrom, Lindell, Swanberg, Nordemar, & Harms-Ringdahl, 1992). Due to the lack of a cure, RA treatment focuses on the alleviation of symptoms and an attempt to maintain functional status (Evers et al., 1998). Thus, research regarding ways in which support networks may help patients deal with their pain is particularly valuable for this population.

Study participants completed an initial background telephone interview and took part in twice daily telephone interviews regarding perceptions of positive and negative responses from the spouse, levels of satisfaction with these responses, pain catastrophizing, negative affect, and RA pain intensity. Twice daily interviews, in the morning and evening, allowed for an examination of concurrent relations, as well as lagged relations from morning to evening. The influence of perceptions of positive and negative responses from the spouse, as well as levels of satisfaction with those responses, on RA pain intensity and negative affect were examined. An assessment of satisfaction with responses was particularly important, given research suggesting that well-intended responses can sometimes be perceived as unhelpful by the recipient (Martire et al., 2002). The spouse as a source of support was of particular interest in the current study, given previous research demonstrating the powerful
impact of support (or lack thereof) from the spouse, above all other sources (Coyne & DeLongis, 1986; Kiecolt-Glaser & Newton, 2001). In the chronic pain literature and beyond, the extent to which specific types of negative interactions have differing effects on well-being has received little attention. Interactions that involve overtly critical behavior (e.g., expressing frustration, irritation, complaining) or withdrawal (e.g., avoidance, ignoring) have been found to be particularly important predictors of distress among chronic pain populations (Kerns et al., 1985; Manne & Zautra, 1989), and chronically ill populations more generally (Manne, Taylor, Dougherty, & Kemeny, 1997). However, most studies have used measures that aggregate across these different types of negative support. Therefore, the current study sought to examine the independent effects of complaints and avoidance on study outcomes.

In addition to examining the direct effects of social support on pain intensity and negative affect, the current study also sought to investigate the impact of social support on levels of pain catastrophizing. While the majority of research on pain catastrophizing has focused on its consequences for well-being, very few studies have examined potential antecedents of this particular way of responding to pain. Finally, the moderating effects of social support on patient ratings of pain, negative affect, and catastrophizing were investigated. Specifically, the current study investigated the extent to which social support attenuated the expected detrimental effects of catastrophizing on pain and negative affect, as well as the extent that social support attenuated the expected negative effects of pain and negative affect on catastrophizing.

Hypotheses

Hypotheses regarding the link between social support (i.e., perceptions of positive and negative spouse responses, and satisfaction with spouse responses) and well-being were divided into four related sets of questions. These questions are depicted in Figure 1.
Figure 1. Hypothesized links between social support, pain intensity, negative affect, and pain catastrophizing.

Research Question 1. Does social support have a direct influence on concurrent and lagged levels of pain intensity and negative affect?

Satisfaction with social support has been proposed to have direct beneficial effects on both physical and psychological well-being (Lakey & Cohen, 2000). Indeed, studies of patients living with chronic pain have demonstrated an association between higher satisfaction with support and lower levels of pain intensity, both concurrently (e.g., Savelkoul et al., 2000) and over time (e.g., Jamison & Virts, 1990). However, a significant relationship has not always been found (e.g., Smith & Wallston, 1992; Taal et al., 1993). When examining negative affect and depressive symptoms as an outcome, findings are more consistent, with results across numerous cross-sectional (e.g., Sherman, 2003) and
longitudinal (e.g., Brown et al., 1989) studies demonstrating a pattern in which greater satisfaction with support is related to lower levels of negative affect and depressive symptoms. However, again, not all studies have found significant effects (e.g., Evers et al., 1997).

Although received support has also been posited to directly improve well-being, research in this area has been plagued by inconsistencies, with evidence for both beneficial (e.g., Riemsma et al., 2000) and detrimental (e.g., De Leeuw et al., 2000) effects of received support in cross-sectional research. Longitudinal studies that have examined the lagged effects of received support over a period of several months have typically failed to find significant effects (e.g., Cranford, 2004). Meanwhile, daily studies have also yielded inconsistent results, with some studies demonstrating beneficial effects of received support on next-day mood (e.g., Feldman et al., 1999), and others finding harmful effects (e.g., Bolger et al., 2000) or no effects at all (e.g., Cutrona, 1986; Rook, 2001). However, as was discussed earlier, null and detrimental effects found in past research may be due to a variety of methodological issues, including the use of aggregate measures of support, extended time lags, and a failure to control for past and present levels of distress.

In terms of the negative aspects of social relationships, numerous cross-sectional studies have found that individuals with chronic pain who report more frequent negative responses from support providers also report higher levels of negative affect and depressive symptoms (e.g., Cano, 2004; Sherman, 2003). Higher average baseline levels of negative responses also seem to have long-term effects on psychological well-being, across months and even years (e.g., Griffin et al., 2001; Stephens et al., 2002). However, daily diary studies that have examined more short-term effects suggest that the detrimental impact of negative
social interactions do not tend to extend into the following day (DeLongis et al., 2004; Stader & Hokanson, 1998).

**Hypothesis 1a.** It was expected that increases in satisfaction with spouse responses would be related to decreases in negative affect and pain intensity, both concurrently, and over the course of the day.

**Hypothesis 1b.** After controlling for prior levels of pain and negative affect, increases in perceptions of positive spouse responses were expected to be related to decreases in pain and negative affect, concurrently, and over the course of the day.

**Hypothesis 1c.** Perceptions of avoidance and complaints from the spouse were expected to be related to concurrent increases in pain intensity and negative affect. The effects of spouse avoidance and complaints on pain intensity and negative affect were not expected to persist over the course of the day.

**Research Question 2. Does social support have direct effects on concurrent and lagged levels of pain catastrophizing?**

The social context of pain catastrophizing has only recently been considered (Sullivan et al., 2001) and findings from a small number of cross-sectional studies have been equivocal (Boothby et al., 2004; Cano, 2004; Keefe et al., 2004). As a result, hypotheses regarding the relationship between social support and pain catastrophizing were drawn from broader theory and research suggesting that social support can help individuals feel less threatened by, and better able to cope with, chronic health-related stressors (O'Brien & DeLongis, 1997; Schreurs & de Ridder, 1997; Thoits, 1986). In fact, one reason for a lack of significant relationship between received support and well-being in past research may be that supportive gestures influence well-being more indirectly, via ways of coping (Holtzman et al., 2004; Manne & Zautra, 1989).
Hypothesis 2a. Increases in satisfaction with spouse responses were expected to be related to decreases in pain catastrophizing, both concurrently and over the course of the day.

Hypothesis 2b. It was hypothesized that increases in perceptions of positive spouse responses would be related to decreases in both concurrent and lagged levels of pain catastrophizing.

Hypothesis 2c. It was hypothesized that perceptions of spouse complaints would be related to increases in concurrent levels of pain catastrophizing, and a tentative hypothesis was put forth that perceptions of spouse avoidance would be related to concurrent increases in pain catastrophizing. Given theory and empirical research suggesting that harmful effects of negative interactions do not persist from one day to the next, spouse complaints and avoidance were not expected to have lagged effects on pain catastrophizing.

Research Question 3. Does pain catastrophizing have direct effects on concurrent and lagged levels of pain intensity and negative affect (3.1)? Does social support moderate the effects of pain catastrophizing on pain intensity and negative affect (3.2)?

Across a diverse range of chronic pain conditions, in cross-sectional and longitudinal research, pain catastrophizing has consistently been found to be related to higher ratings of pain intensity (e.g., Tan et al., 2001; Pavlin et al., 2005), as well as greater levels of negative mood and depressive symptoms (e.g., Granot & Ferber, 2005; Severeijns et al., 2001). Evidence for a role of pain catastrophizing in day-to-day fluctuations in pain and negative mood has also been found (Grant et al., 2002; Keefe et al., 2004). However, these findings
have not always held after controlling for prior levels of outcome variables (Turner et al., 2004).

In line with the buffering model of social support (Cohen & Wills, 1985), some research has found that the negative effects of maladaptive stress appraisals and coping may be attenuated among individuals who feel satisfied with their social networks (e.g., Pakenham, 1999). However, given the dearth of research examining this question, particularly among those with chronic pain, hypotheses regarding the moderating effects of social support on the relationship between pain catastrophizing and well-being were considered tentative.

**Hypothesis 3a.** It was hypothesized that increases in pain catastrophizing would be related to increases in pain intensity and negative affect, both concurrently and over the course of the day.

**Hypothesis 3b.** It was hypothesized that satisfaction with spouse responses would moderate the detrimental effects of pain catastrophizing on pain intensity and negative affect over the course of the day.

**Hypothesis 3c.** Perceptions of positive spouse responses were also expected to buffer the detrimental effects of pain catastrophizing on pain intensity and negative affect over the course of the day.

**Research Question 4.** Do pain intensity and negative affect have direct effects on concurrent and lagged levels of pain catastrophizing (4.1)? Does social support moderate the effects of pain intensity and negative affect on pain catastrophizing (4.2)?

Cross-sectional studies of pain catastrophizing suggest that higher levels of pain intensity and negative affect are related to higher levels of pain catastrophizing. However, prospective studies predicting pain catastrophizing are few and far between (Keefe et al.,
Furthermore, although one would expect that the beneficial effects of social support on pain catastrophizing would be greater at higher levels of pain and negative affect (based on the buffering theory of social support; Cohen & Wills, 1985), no studies could be identified to support or refute this hypothesis. Thus, again, hypotheses regarding buffering effects of support described below are to be considered tentative.

**Hypothesis 4a.** Increases in pain intensity and negative affect were expected to be related to increases in pain catastrophizing, concurrently and over the course of the day.

**Hypothesis 4b.** Satisfaction with spouse responses was expected to moderate the detrimental effects of pain intensity and negative affect on pain catastrophizing over the course of the day.

**Hypothesis 4c.** Perceptions of positive spouse responses were also expected to attenuate the detrimental effects of pain intensity and negative affect on pain catastrophizing over the course of the day.

**METHOD**

**Overview**

Data from the current study were drawn from a larger prospective study on individuals diagnosed with RA and their spouses. Patients and spouses each took part in an initial telephone interview, as well as brief, twice daily telephone interviews for seven days. Participants also completed a brief mail-in questionnaire. Only those procedures and measures used in the current study will be discussed here.

**Sample and Recruitment**

The final sample consisted of 69 individuals diagnosed with RA.² 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. Although some participants were not legally married, all significant others will be referred to as spouses for the sake of parsimony. With their permission, individuals who contacted our research office regarding participation in our study were entered in a draw for $1000. In addition, upon completion of the initial telephone interview, all participants were mailed a small gift, valued at $10.

Study participants were predominantly female (84%) and Caucasian (86%), ranging from 29 to 82 years of age (mean = 59, $SD = 10.9$). 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 one year 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%), a homemaker (7%), or temporarily laid off (1%). The modal family income was between $25 000 and $50 000 (Canadian funds).
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. Of the 160 who agreed to participate in additional eligibility screening, 71 (44%) met the 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 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.

Procedure

Following the screening interview and once eligibility was determined, participants engaged in a structured background telephone interview lasting approximately 30 minutes, followed by brief structured telephone interviews administered twice daily for one week. The daily interview period was limited to one week in order to minimize the burden placed on participants. Daily interviews were scheduled for approximately six and twelve hours after participants woke up in the morning and lasted approximately 10 minutes 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 where they were able to talk privately during each interview. All interviews were conducted by trained female undergraduate and graduate research assistants. Interviewers received intensive
training in the administration of structured research interviews (Singer & Presser, 1989) and were carefully monitored to ensure they responded to participants in a neutral manner. Participants were assigned the same interviewer for both the initial and daily interviews.

Interview sessions were tape recorded with the permission of participants. This allowed for responses to open ended questions to be transcribed, and ensured 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.

**Initial Telephone Interview Measures**

The following variables were assessed during the initial telephone interview.

**Demographics and disease status.** Participants were asked to provide demographic and disease status information. Functional disability was operationalized as difficulties performing eight daily activities (e.g., dressing oneself, getting in and out of bed, walking) on a scale from 1 (without any difficulty) to 4 (unable to do). These items were drawn from a modified version of the Health Assessment Questionnaire (MHAQ; Pincus, Summey, Soraci, Wallston, & Hummon, 1983), which is used frequently in rheumatic disease populations and has demonstrated good reliability and validity in past research (Odegard, Finset, Kvien, Mowinckel, & Uhlis, 2005). Participants reported an average level of functional disability across a range of daily activities of 1.78 (SD = 0.53), ranging from 1.00 to 3.13. 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)].

**Daily Telephone 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, Davis, & Rafaeli, 2003).

**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, Karoly, & Braver, 1986; Wilkie, Lovejoy, Dodd, & Tesler, 1990). The NRS has also demonstrated sensitivity to treatments that are expected to influence pain intensity (Paice & Cohen, 1997).

**Pain catastrophizing.** Whereas Rosenstiel and Keefe (1983) have conceptualized catastrophizing predominantly in terms of feelings of helplessness and being unable to cope effectively with pain, Sullivan and colleagues (2001) have defined catastrophizing as a unitary construct comprised of three strongly related but distinct factors: helplessness (feeling
overwhelmed, negative evaluations of being able to cope effectively with pain), rumination (ruminative thoughts, worry, and an inability to inhibit pain-related thoughts), and magnification (magnification of the unpleasantness of the pain situation and expectancies for negative outcomes). The current study focused on the helplessness dimension of pain catastrophizing. Evidence suggests that the helplessness (versus rumination and magnification) dimension of pain catastrophizing is more strongly related to the pain experience (Sullivan, Lynch, & Clark, 2005) and specifically, the most relevant dimension among those suffering from long-term chronic pain conditions (Sullivan, Sullivan, & Adams, 2002; Vienneau, Clark, Lynch, & Sullivan, 1999).

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 (Rosensteil & Keefe, 1983). Based on past research (Sullivan et al., 1995), the items with the highest item-total correlations were selected for the present scale (e.g., “It was awful and I felt that it overwhelmed me”). The full version of this subscale has previously been demonstrated to have good reliability and validity (e.g., Robinson et al., 1997; Sullivan et al., 1995; 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 alpha for this scale was .82, ranging from .65 to .93 across time points.

**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 (e.g., Northouse & 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 correlation between depression and anxiety subscales (average $r = .69$, ranging from .53 to .89), the two subscales were combined to form a single index of negative affect. Cronbach’s alpha for this index of the negative affect was .89, ranging from .82 to .94 across time points.

**Perceptions of spouse responses.** Perceptions of spouse responses were assessed using a modified version of the received support subscale of the Berlin Social Support Scales (BSSS; Schulz & Schwarzer, 2000). This subscale assesses both positive and negative dimensions of support and has been developed and validated for use with medically ill populations (Luszczynska, Mohamed, & Schwarzer, 2005; Schulz & Schwarzer, 2004). In contrast to measures used to test the operant conditioning model of social support, this taps into general supportive responses from the spouse, and not necessarily those specific to pain and pain-related issues. In previous research using this scale, negative support items have been reverse-scored and combined with positive items to yield an overall summed score for received support (e.g., Luszczynsk et al., 2004), or omitted entirely (e.g., Schulz & Schwarzer, 2004). Based on a substantial body of research suggesting that negative interactions can be as powerful, if not more powerful, predictors of well-being (e.g., Rook, 2001), as well as recommendations from the authors of this scale (R. Schwarzer, personal communication, February 6, 2005), negative items were retained. Participants were asked to indicate the extent to which their spouses responded to them in various positive and negative ways 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.
Thus, information regarding how spouses responded to patients was based on patient perceptions of how spouses responded. For the sake of parsimony, perceptions of positive and negative spouse responses will be referred to as positive and negative spouse responses from this point forward.

The positive spouse response subscale was comprised of nine items and assessed perceptions of emotional (e.g., “Showed me he/she loves and accepts me”), informational (e.g., “Suggested activities that might distract me”), and instrumental (e.g., “Took care of many things for me”) support from the spouse. Only four of the original six emotional support items were used in the current study, in order to help reduce participant burden and obtain a more satisfactory balance between the different dimensions of positive support. Items were selected based on the expected daily occurrence of responses and relevance to the current population. Cronbach’s alpha for the composite positive response subscale was .88, ranging from .83 to .89.

The negative spouse response subscale was comprised of two of the original three negative items on the BSSS, and assessed perceptions of spouse complaints and avoidance. The original item tapping avoidance (“Left me alone”) was reworded (“Avoided me”) so that it more clearly reflected an undesirable response. The item reflecting lack of empathy (“Did not show much empathy towards me”) was omitted from the analyses for two reasons. First, numerous participants reported confusion regarding the double negative (i.e., did not show much empathy – “not at all”). Second, conceptually this item does not clearly fall into an overtly negative or withdrawal response, and the presence/absence of empathy and concern was already tapped into by the positive response subscale. Due to the skewed nature of the two negative support items (e.g., 96% of the scores on the spouse complaint item were either “1” or “0”), each of the negative response items was treated as dichotomous and coded as “1”
(e.g., perception that spouse complained) or "-1" (e.g., perception that spouse did not complain). Given the lack of existing research on the effects of different types of negative responses on well-being, the two items were retained as two distinct items.

**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.

**RESULTS**

**Daily Interview Completion and Descriptive Statistics**

The response rate for the daily interviews was high. Of a possible 966 daily interviews, participants completed 99% of those interviews. Of the 69 participants included in the final sample (i.e., after the two non-compliant participants were dropped), 90% (n = 62) completed all 14 interviews, 9% (n = 6) were missing one interview, and 1% (n = 1) was missing four interviews. The number of missing items on completed interviews was exceptionally low. Complete data was obtained on the single item assessing pain intensity and the three items assessing pain catastrophizing. Two of the 956 completed interviews were missing the satisfaction with spouse responses item, two interviews were missing items from the negative affect scale, and eight interviews had missing items on the spouse response scale. Daily interviews lasted an average of 10 minutes ($SD = 4$) each, ranging from 2 to 30 minutes.

Means and standard deviations were calculated for level one (daily interview) study variables, aggregated across all time points (see 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 $1.27$ ($SD = 0.42$) 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 $3.40$ ($SD = 0.82$). The average morning level of positive spouse responses was $2.27$ ($SD = 0.75$) and evening level was $2.34$ ($SD = 0.74$). Participants reported that their spouses complained about them on $3.7\%$ of the morning time points and $3.2\%$ of the evening time points. Twenty-two percent of participants reported that their spouse complained about them on at least one time point during the study period. Participants reported that their spouses avoided them on $4\%$ of all morning time points and on $5.9\%$ of all evening time points. Twenty-eight percent of participants reported at least one instance in which their spouse avoided them during the study period. The relatively low frequency of negative spouse interactions reported by participants in the current study is consistent with previous findings that negative interpersonal events occur infrequently as compared to positive interpersonal events (Rook, 2001; Rook & Pietromonaco, 1987).

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, $t(474) = 3.48$, $p < .001$ and $t(473) = 3.58$, $p < .001$, respectively. Positive spouse responses were significantly higher in the evening, $t(404) = -3.73$, $p < .001$. No significant differences were found between morning and evening levels of catastrophizing and satisfaction with spouse responses, $t(440) = 1.394$, $p > .10$ and $t(405) = -0.892$, $p > .10$, respectively.
Table 1

Means and standard deviations for daily interview variables (N = 69)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain Intensity (0-10)</td>
<td></td>
</tr>
<tr>
<td>AM Pain</td>
<td>4.05 (2.34)</td>
</tr>
<tr>
<td>PM Pain</td>
<td>3.83 (2.32)</td>
</tr>
<tr>
<td>Negative Affect (1-4)</td>
<td></td>
</tr>
<tr>
<td>AM Negative Affect</td>
<td>1.27 (0.42)</td>
</tr>
<tr>
<td>PM Negative Affect</td>
<td>1.22 (0.39)</td>
</tr>
<tr>
<td>Pain Appraisals (1-4)</td>
<td></td>
</tr>
<tr>
<td>AM Pain Catastrophizing</td>
<td>1.41 (0.60)</td>
</tr>
<tr>
<td>PM Pain Catastrophizing</td>
<td>1.38 (0.60)</td>
</tr>
<tr>
<td>Positive Spouse Responses (1-4)</td>
<td></td>
</tr>
<tr>
<td>AM Positive Spouse Responses</td>
<td>2.27 (0.75)</td>
</tr>
<tr>
<td>PM Positive Spouse Responses</td>
<td>2.34 (0.74)</td>
</tr>
<tr>
<td>Satisfaction with Spouse Responses (1-4)</td>
<td></td>
</tr>
<tr>
<td>AM Satisfaction with Spouse Responses</td>
<td>3.36 (0.87)</td>
</tr>
<tr>
<td>PM Satisfaction with Spouse Responses</td>
<td>3.40 (0.82)</td>
</tr>
</tbody>
</table>

*Values for each study variable were aggregated for each participant, across all time points.*
Bivariate Analyses

Within-time point correlations were calculated among aggregated evening daily interview variables (see Table 2). Lagged correlations among aggregated morning and evening variables were also assessed (see Table 3). Although correlations were calculated based on all time points for each of the 69 participants, significance tests were based on a more conservative degrees of freedom (i.e., number of participants minus two). Not surprisingly, pain intensity, negative affect, and pain catastrophizing were all highly positively correlated, both within the same time point, and from morning to evening. Within the evening time points, satisfaction with spouse responses was significantly associated with higher levels of positive spouse responses and lower incidents of spouse complaints and spouse avoidance. Looking from morning to evening, morning reports of spouse complaints and avoidance were significantly related to higher levels of evening negative affect. There was a trend towards higher morning satisfaction with responses being related to lower levels of evening negative affect.
Table 2

Concurrent correlations among evening daily interview variables

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
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</thead>
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<tr>
<td>1. PM Satisfaction with</td>
<td>-</td>
<td></td>
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<td></td>
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<tr>
<td>Spouse Responses</td>
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<td>2. PM Positive Spouse</td>
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<td></td>
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<tr>
<td>Responses</td>
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<td></td>
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<td></td>
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<td>3. PM Spouse Complaints</td>
<td>-.24*</td>
<td>-.17</td>
<td>.28*</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>4. PM Spouse Avoidance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
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<td>5. PM Pain Intensity</td>
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<td>.14</td>
<td>.03</td>
<td>.07</td>
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<td></td>
</tr>
<tr>
<td>6. PM Negative Affect</td>
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<td>-.05</td>
<td>.17</td>
<td>.17</td>
<td>.45***</td>
<td></td>
<td></td>
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<tr>
<td>7. PM Pain Catastrophizing</td>
<td>-.07</td>
<td>.11</td>
<td>.08</td>
<td>.08</td>
<td>.57***</td>
<td>.53***</td>
<td></td>
</tr>
</tbody>
</table>

Note. *p < .05, **p < .01, ***p < .001, when conservatively assuming that the degrees of freedom equals the number of participants minus two.

*Correlations are based upon all time points for each of the 69 participants. The number of available time points used to calculate each correlation coefficient ranged from 416 to 479 due to missing data for some of the daily study variables.
Table 3

Lagged correlations among morning and evening daily interview variables

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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<th>7</th>
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<td>1. AM Pain Intensity</td>
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<td></td>
</tr>
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<td>3. AM Pain</td>
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<td>.51***</td>
<td>-</td>
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<td></td>
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</tr>
<tr>
<td>4. AM Satisfaction with Spouse Responses</td>
<td>-.14</td>
<td>-.20*</td>
<td>-.10</td>
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<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>5. AM Positive Spouse Responses</td>
<td>.20*</td>
<td>.01</td>
<td>.17</td>
<td>.50***</td>
<td>-</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>6. AM Spouse Complaints</td>
<td>.04</td>
<td>.21</td>
<td>.09</td>
<td>-.21*</td>
<td>-.10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. AM Spouse Avoidance</td>
<td>.13</td>
<td>.26*</td>
<td>.07</td>
<td>-.30*</td>
<td>-.19</td>
<td>.28*</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. PM Pain Intensity</td>
<td>.82***</td>
<td>.42***</td>
<td>.53***</td>
<td>-.18</td>
<td>.17</td>
<td>.12</td>
<td>.12</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. PM Negative Affect</td>
<td>.35**</td>
<td>.68***</td>
<td>.40***</td>
<td>-.22*</td>
<td>.001</td>
<td>.25*</td>
<td>.24*</td>
<td>.45***</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>10. PM Pain Catastrophizing</td>
<td>.44***</td>
<td>.41***</td>
<td>.70***</td>
<td>-.10</td>
<td>.12</td>
<td>.10</td>
<td>.09</td>
<td>.57***</td>
<td>.53***</td>
<td>-</td>
</tr>
</tbody>
</table>

Note. *p < .10, *p < .05, **p < .01, ***p < .001, when conservatively assuming that the degrees of freedom equals the number of participants minus two.

a Correlations are based upon all time points for each of the 69 participants. The number of available time points used to calculate each correlation coefficient ranged from 397 to 487 due to missing data for some of the daily study variables.
Multi-level Regression Analyses

The present study conducted multi-level regression analyses using hierarchical linear modeling (HLM) software (v6.0; Raudenbush, Bryk, Cheong, & Congdon, 2004). This approach offers numerous benefits, including its ability to successfully deal with missing data, as well as to take into account the dependence present 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 during the initial interview, that have a common value within a person (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). Each Level 1 predictor variable was centred 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-centred 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 & Bryk, 2002).

Step one: The null model. The first stage of conducting a multi-level analysis in
HLM involves running a null model (a model with no covariates) for each dependent variable (Nezlek, 2001). This allows one to determine the proportion of between- and within-subject variability present in that variable. Given that evening pain intensity, negative affect, and pain catastrophizing each served as dependent measures, a separate null model was run for each of these variables (see Appendix). The null model for evening pain intensity indicated that significant between-person variability existed among intercepts ($\beta_0$'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 in the current study also demonstrated significant between-person variability. The proportion of within-person variance for evening negative affect was 40%, and for evening pain catastrophizing was 50%.

**Step two: Modeling Level 2 control variables.** The next step was to model the independent effects of demographic and medical status variables on the intercept of the outcome variable. For example:

Level 1: \[ Y_{ij}(PM \text{ Pain Intensity}) = b_{0j} + r_{ij} \]

Level 2: \[ b_{0j} = \gamma_{00} + \gamma_{11}(\text{Gender}) + \gamma_{12}(\text{Years Since Diagnosis}) + \gamma_{13}(\text{Fatigue}) + \gamma_{14}(\text{Functional Disability}) + \mu_{0j} \]

At Level 1, evening pain intensity on any given day [$Y_{ij}(PM \text{ Pain Intensity})$] is a function of one’s average evening pain across all days ($b_{0j}$) and that day’s deviation from the average ($r_{ij}$). At Level 2, the Level 1 intercept ($b_{0i}$) for any person (i) is a function of the average intercept (mean pain) across persons ($\gamma_{00}$), gender, years since diagnosis, fatigue, functional disability, their respective regression coefficients ($\gamma_{11}, \gamma_{12}, \gamma_{13}, \gamma_{14}$) and a random component ($\mu_i$). 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 research demonstrating greater rates of pain catastrophizing among women (e.g., Jensen, Nygren, Gamberale, Goldie, & Westerholm, 1994; Keefe et al., 2000), males reported greater levels of pain catastrophizing in the current sample. No Level 2 variables were found to be related to evening negative affect. Consistent with recommended multilevel model specification, the insignificant effects were dropped and significant variables were retained as control variables in subsequent analyses predicting evening study outcomes (Kreft & De Leeuw, 1998; Snijders & Bosker, 1999).

**Step three: Level 1 modeling.** In the next step, Level 1 predictors were added to the models. Prior to testing lagged models of each evening study outcome, the concurrent relations among evening variables (i.e., within-time point associations) were examined. Each of these concurrent models controlled for morning levels of the outcome study variable of interest. Once concurrent relations among study variables were established, morning predictor variables were specified to predict evening outcome variables, in order to help tease apart issues of causality. The first concurrent and lagged models that were tested are described in greater detail below.

**Research Question 1. Does social support have direct effects on concurrent and lagged levels of pain intensity and negative affect?**

**Direct effects of social support on pain intensity.** First, a concurrent model was specified predicting evening pain intensity that included evening levels of satisfaction with spouse responses, evening positive spouse responses, evening spouse complaints, and evening spouse avoidance, controlling for morning pain intensity. Based on the results of the analyses discussed above, fatigue and functional disability were added as controls at Level 2.
The final model can be expressed as:

Level 1: \[ Y_{ij}(PM \text{ Pain Intensity}) = b_{0j} + b_{1j}(AM \text{ Pain Intensity}) + b_{2j}(PM \text{ Satisfaction with Spouse Responses}) + b_{3j}(PM \text{ Positive Spouse Responses}) + b_{4j}(PM \text{ Spouse Complaints}) + b_{5j}(PM \text{ Spouse Avoidance}) + r_{ij} \]

Level 2: \[ b_{ij} = \gamma_{10} + \gamma_{11}(\text{Fatigue}) + \gamma_{12}(\text{Functional Disability}) + u_{ij} \]

\[ b_{1j} = \gamma_{20} \]
\[ b_{2j} = \gamma_{30} \]
\[ b_{3j} = \gamma_{40} \]
\[ b_{4j} = \gamma_{50} \]

Results indicated that increases in evening satisfaction with spouse responses were associated with decreases in evening pain intensity, \( b = -0.34, t(430) = -2.63, p < .01 \), while increases in evening positive spouse responses were associated with increases in evening pain intensity, \( b = 0.36, t(430) = 2.11, p < .05 \) (see Table 4). Of note, evening positive spouse responses were a significant predictor of evening pain only when participant ratings of satisfaction with those responses were included in the model.\(^{13}\) Evening spouse complaints and spouse avoidance were not significantly related to evening pain intensity, \( b = 0.10, t(430) = 0.88, p > .10 \) and \( b = 0.16, t(430) = 1.21, p > .10 \), respectively.\(^{14}\)
Table 4

Multi-level regression analyses: Concurrent relations of evening social support variables to evening pain intensity, controlling for morning pain intensity

<table>
<thead>
<tr>
<th>Effect</th>
<th>PM Pain Intensity</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Effect</td>
<td>b</td>
<td>SE</td>
</tr>
<tr>
<td>Fatigue</td>
<td>.30*</td>
<td>.12</td>
</tr>
<tr>
<td>Functional Disability</td>
<td>1.37*</td>
<td>.50</td>
</tr>
<tr>
<td>AM Pain Intensity</td>
<td>.45***</td>
<td>.05</td>
</tr>
<tr>
<td>PM Satisfaction with Spouse Responses</td>
<td>-.34**</td>
<td>.13</td>
</tr>
<tr>
<td>PM Positive Spouse Responses</td>
<td>.36*</td>
<td>.17</td>
</tr>
<tr>
<td>PM Spouse Complaints</td>
<td>.10</td>
<td>.12</td>
</tr>
<tr>
<td>PM Spouse Avoidance</td>
<td>.16</td>
<td>.14</td>
</tr>
</tbody>
</table>

*p < .05.  **p < .01.  ***p < .001.
Next, a lagged model was specified predicting evening pain intensity that included morning satisfaction with spouse responses, morning positive spouse responses, morning spouse complaints, and morning spouse avoidance, controlling for morning pain intensity (to capture residualized change in pain from morning to evening; see Table 5). Again, fatigue and functional disability were added as controls at Level 2. The final model for this analysis can be expressed as:

**Level 1:**
\[ Y_{ij} = b_{0j} + b_{1j} Y_{AM} + b_{2j} X_{AM} + b_{3j} X_{AM} + b_{4j} X_{AM} + b_{5j} X_{AM} + r_{ij} \]

**Level 2:**
\[ b_{0j} = \gamma_{00} + \gamma_{11} Y_{Fatigue} + \gamma_{12} Y_{Disability} + u_{0j} \]
\[ b_{1j} = \gamma_{10} \]
\[ b_{2j} = \gamma_{20} \]
\[ b_{3j} = \gamma_{30} \]
\[ b_{4j} = \gamma_{40} \]
\[ b_{5j} = \gamma_{50} \]

Findings from the lagged model revealed that increases in morning satisfaction with spouse responses were associated with decreases in evening pain intensity, \( b = -0.22, t(415) = -1.99, p < .05 \). Meanwhile, spouse complaints in the morning were associated with increases in pain intensity over the course of the day, \( b = 0.31, t(415) = 2.30, p < .05 \). Morning spouse avoidance, as well as morning positive spouse responses, were not significantly related to evening pain intensity, \( b = -0.13, t(415) = -0.63, p > .10 \), and \( b = 0.10, t(415) = 0.79, p > .10 \), respectively.
Table 5

Multi-level regression analyses: Lagged relations of morning social support variables to evening pain intensity, controlling for morning pain intensity

<table>
<thead>
<tr>
<th>Effect</th>
<th>PM Pain Intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$b$</td>
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<tr>
<td>Fatigue</td>
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</tr>
<tr>
<td>Functional Disability</td>
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</tr>
<tr>
<td>AM Pain Intensity</td>
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<tr>
<td>AM Positive Spouse Responses</td>
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<td>AM Spouse Complaints</td>
<td>.31*</td>
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<tr>
<td>AM Spouse Avoidance</td>
<td>-.13</td>
</tr>
</tbody>
</table>

*p < .05. **p < .01. ***p < .001.
Direct effects of social support on negative affect. A concurrent model was specified predicting evening negative affect that included evening levels of satisfaction with spouse responses, evening positive spouse responses, evening spouse complaints, and evening spouse avoidance, controlling for morning negative affect. Findings suggested that evening satisfaction with spouse responses was associated with lower evening negative affect, $b = -0.06, t(431) = -2.30, p < .05$, but that evening positive responses were not significantly related to this outcome, $b = 0.02, t(431) = 0.46, p > .10$ (see Table 6). In terms of negative spouse responses, evening spouse complaints were associated with higher evening negative affect, $b = 0.12, t(431) = 2.94, p < .01$. However, evening spouse avoidance were not significantly related to evening negative affect, $b = 0.01, t(431) = 0.28, p > .10$. 
Table 6
Multi-level regression analyses: Concurrent relations of evening social support variables to evening negative affect, controlling for morning negative affect

<table>
<thead>
<tr>
<th>Effect</th>
<th>PM Negative Affect</th>
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<tbody>
<tr>
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<td>PM Satisfaction with Spouse Responses</td>
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<td>0.02</td>
</tr>
<tr>
<td>PM Spouse Complaints</td>
<td>0.12**</td>
</tr>
<tr>
<td>PM Spouse Avoidance</td>
<td>0.01</td>
</tr>
</tbody>
</table>

* *p < .05. **p < .01.

The lagged model of evening negative affect included the same variables as the lagged model of pain intensity, only controlling for morning negative affect (see Table 7). According to this model, increases in morning satisfaction with spouse responses were associated with decreases in evening negative affect, $b = -0.05, t(416) = -2.18, p < .05$, while increases in morning positive spouse responses were associated with increases in evening negative affect, $b = 0.07, t(416) = 2.86, p < .01$. Neither spouse complaints nor spouse avoidance was related to changes in negative affect over the course of the day, $b = 0.08, t(416) = 1.61, p > .10$, and $b = 0.01, t(416) = 0.27, p > .10$, respectively.
Table 7

Multi-level regression analyses: Lagged relations of morning social support variables to evening negative affect, controlling for morning negative affect

<table>
<thead>
<tr>
<th>Effect</th>
<th>PM Negative Affect</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM Negative Affect</td>
<td>.20**</td>
</tr>
<tr>
<td>AM Satisfaction with Spouse Responses</td>
<td>-.05*</td>
</tr>
<tr>
<td>AM Positive Spouse Responses</td>
<td>.07**</td>
</tr>
<tr>
<td>AM Spouse Complaints</td>
<td>.08</td>
</tr>
<tr>
<td>AM Spouse Avoidance</td>
<td>.01</td>
</tr>
</tbody>
</table>

*p < .05. **p < .01.

Research Question 2. Does social support have direct effects on concurrent and lagged levels of pain catastrophizing?

The concurrent relations among evening social support and evening pain catastrophizing were examined in a model that included evening levels of satisfaction with spouse responses, evening positive spouse responses, evening spouse complaints, and evening spouse avoidance, controlling for morning pain catastrophizing. Findings indicated that increases in evening satisfaction with spouse responses were associated with decreases in evening pain catastrophizing, $b = -0.09, t(399) = -2.12, p < .05$ and reports of spouse complaints were associated with increases in evening pain catastrophizing, $b = 0.09, t(399) =$
2.83, \( p < .01 \) (see Table 8). Evening ratings of positive responses from the spouse and evening avoidance from the spouse were not significantly related to evening pain catastrophizing, \( b = 0.04, t(399) = 0.92, p > .10 \) and \( b = 0.02, t(399) = 0.38, p > .10 \), respectively. However, when evening pain intensity and negative affect were entered in the model, evening spouse complaints and satisfaction with spouse responses were no longer significant predictors of evening pain catastrophizing \( (p > .10) \).

Table 8

Multi-level regression analyses: Concurrent relations of evening social support variables to evening pain catastrophizing, controlling for morning pain catastrophizing

<table>
<thead>
<tr>
<th>Effect</th>
<th>PM Pain Catastrophizing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( b )</td>
</tr>
<tr>
<td>Gender</td>
<td>-.19*</td>
</tr>
<tr>
<td>Fatigue</td>
<td>.08**</td>
</tr>
<tr>
<td>AM Pain Catastrophizing</td>
<td>.39***</td>
</tr>
<tr>
<td>PM Satisfaction with Spouse Responses</td>
<td>-.09*</td>
</tr>
<tr>
<td>PM Positive Spouse Responses</td>
<td>.04</td>
</tr>
<tr>
<td>PM Spouse Complaints</td>
<td>.09**</td>
</tr>
<tr>
<td>PM Spouse Avoidance</td>
<td>.02</td>
</tr>
</tbody>
</table>

\( *p < .05. **p < .01. ***p < .001. \)
Next, a lagged model predicting evening pain catastrophizing was specified. No morning social support variables emerged as significant predictors of changes in pain catastrophizing over the course of the day (all $p > .10$; see Table 9).

Table 9

Multi-level regression analyses: Lagged relations of morning social support variables to evening pain catastrophizing, controlling for morning pain catastrophizing

<table>
<thead>
<tr>
<th>Effect</th>
<th>$b$</th>
<th>$SE$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>-.18**</td>
<td>.08</td>
</tr>
<tr>
<td>Fatigue</td>
<td>.09**</td>
<td>.02</td>
</tr>
<tr>
<td>AM Pain Catastrophizing</td>
<td>.42***</td>
<td>.09</td>
</tr>
<tr>
<td>AM Satisfaction with Spouse Responses</td>
<td>-.01</td>
<td>.04</td>
</tr>
<tr>
<td>AM Positive Spouse Responses</td>
<td>-.01</td>
<td>.04</td>
</tr>
<tr>
<td>AM Spouse Complaints</td>
<td>.07</td>
<td>.05</td>
</tr>
<tr>
<td>AM Spouse Avoidance</td>
<td>-.01</td>
<td>.12</td>
</tr>
</tbody>
</table>

**$p < .01$. ***$p < .001$.
Research Question 3. Does pain catastrophizing have direct effects on concurrent and lagged levels of pain intensity and negative affect (3.1)? Does social support buffer the effects of pain catastrophizing on pain intensity and negative affect (3.2)?

Direct effects of catastrophizing on pain intensity. First, a concurrent model was specified predicting evening pain intensity that included evening catastrophizing, controlling for morning pain intensity. In order to test the unique effects of catastrophizing on pain intensity, above and beyond the effects of negative affect, this model also controlled for concurrent levels of negative affect (Sullivan et al., 2001). As expected, increases in evening catastrophizing were related to increases in concurrent evening pain intensity, $b = 0.85$, $t(439) = 6.95$, $p < .001$ (see Table 10). There was a trend towards increases in evening negative affect predicting increases in evening pain intensity, $b = 0.41$, $t(439) = 1.75$, $p < .09$. 
Table 10
Multi-level regression analyses: Concurrent relations of evening catastrophizing to evening pain intensity, controlling for morning pain intensity and negative affect

<table>
<thead>
<tr>
<th>Effect</th>
<th>PM Pain Intensity</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>b</td>
<td>SE</td>
<td></td>
</tr>
<tr>
<td>Fatigue</td>
<td>.24*</td>
<td>.18</td>
<td></td>
</tr>
<tr>
<td>Functional Disability</td>
<td>1.26</td>
<td>.47</td>
<td></td>
</tr>
<tr>
<td>AM Pain Intensity</td>
<td>.38***</td>
<td>.05</td>
<td></td>
</tr>
<tr>
<td>PM Negative Affect</td>
<td>.41</td>
<td>.24</td>
<td></td>
</tr>
<tr>
<td>PM Pain Catastrophizing</td>
<td>.85***</td>
<td>.12</td>
<td></td>
</tr>
</tbody>
</table>

*p < .09.  \(^{1}p < .06.  \(*p < .01.  \(**p < .001.\)
Next, a lagged model was specified to include morning pain catastrophizing, controlling for morning pain intensity and negative affect. This model indicated that increases in morning pain catastrophizing were associated with increases in evening pain intensity, $b = 0.21, t(444) = 2.01, p < .05$ (see Table 11). Morning negative affect was not significantly related to evening pain intensity, $b = 0.12, t(444) = .43, p > .10$.

Table 11
Multi-level regression analyses: Lagged relations of evening catastrophizing to evening pain intensity, controlling for morning pain intensity and negative affect

<table>
<thead>
<tr>
<th></th>
<th>PM Pain Intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Effect</strong></td>
<td><strong>b</strong></td>
</tr>
<tr>
<td>Fatigue</td>
<td>.27*</td>
</tr>
<tr>
<td>Functional Disability</td>
<td>1.37*</td>
</tr>
<tr>
<td>AM Pain Intensity</td>
<td>.45***</td>
</tr>
<tr>
<td>AM Negative Affect</td>
<td>.12</td>
</tr>
<tr>
<td>AM Pain Catastrophizing</td>
<td>.21*</td>
</tr>
</tbody>
</table>

*p < .05.  ***p < .001.
Direct effects of pain catastrophizing on negative affect. The concurrent model predicting evening negative affect included evening pain catastrophizing and controlled for morning levels of negative affect. In order to test the unique effects of pain catastrophizing on negative affect, above and beyond the effects of pain intensity, concurrent levels of pain intensity were also included in the model. Increases in evening pain catastrophizing were significantly related to increases evening negative affect, $b = 0.22$, $t(441) = 5.21$, $p < .001$ (see Table 12). However, evening pain intensity was not a significant predictor of evening negative affect, $b = 0.02$, $t(441) = 1.42$, $p > .10$.

Table 12
Multi-level regression analyses: Concurrent relations of evening catastrophizing to evening negative affect, controlling for morning negative affect

<table>
<thead>
<tr>
<th>Effect</th>
<th>$b$</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM Negative Affect</td>
<td>.16**</td>
<td>.05</td>
</tr>
<tr>
<td>PM Pain Intensity</td>
<td>.02</td>
<td>.01</td>
</tr>
<tr>
<td>PM Pain Catastrophizing</td>
<td>.22***</td>
<td>.04</td>
</tr>
</tbody>
</table>

**$p < .01$. ***$p < .001$.**
A lagged model was specified to include morning pain catastrophizing, controlling for morning negative affect and morning pain intensity. Increases in morning catastrophizing were associated with increases in negative affect over the course of the day, $b = 0.07$, $t(445) = 2.72, p < .01$ (see Table 13). Similar to the concurrent model, morning pain was not significantly related to changes in negative affect over the course of the day, $b = 0.01$, $t(445) = 0.49, p > .10$.

Table 13

Multi-level regression analyses: Lagged relations of morning catastrophizing to evening negative affect, controlling for morning negative affect

<table>
<thead>
<tr>
<th>Effect</th>
<th>PM Negative Affect</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$b$</td>
</tr>
<tr>
<td>AM Negative Affect</td>
<td>.16*</td>
</tr>
<tr>
<td>AM Pain Intensity</td>
<td>.01</td>
</tr>
<tr>
<td>AM Pain Catastrophizing</td>
<td>.07**</td>
</tr>
</tbody>
</table>

Note. *$p < .05$. **$p < .01$. 55
Summary models predicting pain and negative affect. Before moving on to examine the moderating effects of social support on pain catastrophizing, summary models were specified that tested the independent concurrent and lagged effects of all significant predictor variables on evening pain and negative affect. Once evening satisfaction with spouse responses, positive spouse responses, negative affect, and catastrophizing were included in the same model to predict evening pain intensity, satisfaction with spouse responses and catastrophizing remained significant predictors. The relationship between positive spouse responses and greater pain dropped to a trend ($p < .08$) and negative affect was no longer a significant predictor of evening pain intensity (see Table 14).
Table 14

Multi-level regression analyses: Summary model of concurrent predictors of evening pain intensity, controlling for morning pain intensity

<table>
<thead>
<tr>
<th>Effect</th>
<th>PM Pain Intensity</th>
<th>b</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatigue</td>
<td></td>
<td>.24*</td>
<td>.12</td>
</tr>
<tr>
<td>Functional Disability</td>
<td></td>
<td>1.19*</td>
<td>.51</td>
</tr>
<tr>
<td>AM Pain Intensity</td>
<td></td>
<td>.34***</td>
<td>.05</td>
</tr>
<tr>
<td>PM Pain Catastrophizing</td>
<td></td>
<td>.92***</td>
<td>.14</td>
</tr>
<tr>
<td>PM Negative Affect</td>
<td></td>
<td>.22</td>
<td>.22</td>
</tr>
<tr>
<td>PM Satisfaction with Spouse Responses</td>
<td></td>
<td>-.27**</td>
<td>.10</td>
</tr>
<tr>
<td>PM Positive Spouse Responses</td>
<td></td>
<td>.30$^y$</td>
<td>.17</td>
</tr>
</tbody>
</table>

$^y p < .08. ^* p < .05. ^{**} p < .01. ^{***} p < .001.$
Once morning satisfaction with spouse responses, spouse complaints, and pain catastrophizing were added together in the same model predicting evening pain intensity, morning catastrophizing and spouse complaints remained significant predictors of increases in evening pain intensity. Morning satisfaction with spouse responses was associated with decreases in evening pain intensity, but only as a trend ($p < .09$; see Table 15).

Table 15

Multi-level regression analyses: Summary model of lagged predictors of evening pain intensity, controlling for morning pain intensity

<table>
<thead>
<tr>
<th>Effect</th>
<th>PM Pain Intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$b$</td>
</tr>
<tr>
<td>Fatigue</td>
<td>.32*</td>
</tr>
<tr>
<td>Functional Disability</td>
<td>1.23*</td>
</tr>
<tr>
<td>AM Pain Intensity</td>
<td>.45***</td>
</tr>
<tr>
<td>AM Pain Catastrophizing</td>
<td>.22*</td>
</tr>
<tr>
<td>AM Satisfaction with Spouse Responses</td>
<td>-.20*</td>
</tr>
<tr>
<td>AM Spouse Complaints</td>
<td>.27*</td>
</tr>
</tbody>
</table>

*p < .09. *p < .05. ***p < .001.
With regards to concurrent predictors of evening negative affect, evening spouse complaints and catastrophizing remained significant predictors, and there was a trend for an association between increases in evening satisfaction with spouse responses and decreases in evening negative affect \((p < .08; \text{see Table 16})\).

Table 16

Multi-level regression analyses: Summary model of concurrent predictors of evening negative affect, controlling for morning negative affect

<table>
<thead>
<tr>
<th>Effect</th>
<th>PM Negative Affect</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM Negative Affect</td>
<td>.18** .05</td>
</tr>
<tr>
<td>PM Pain Catastrophizing</td>
<td>.23*** .04</td>
</tr>
<tr>
<td>PM Satisfaction with Spouse Responses</td>
<td>.03† .02</td>
</tr>
<tr>
<td>PM Spouse Complaints</td>
<td>.09* .04</td>
</tr>
</tbody>
</table>

†\(p < .08\). *\(p < .05\). **\(p < .01\). ***\(p < .001\).
When morning satisfaction with spouse responses, perceptions positive spouse responses, and pain catastrophizing were entered together in the same model predicting evening negative affect, all variables remained significant predictors of changes in negative affect (see Table 17).

Table 17

Multi-level regression analyses: Summary model of lagged predictors of evening negative affect, controlling for morning negative affect

<table>
<thead>
<tr>
<th>Effect</th>
<th>PM Negative Affect</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM Negative Affect</td>
<td>.19*</td>
</tr>
<tr>
<td>AM Catastrophizing</td>
<td>.06*</td>
</tr>
<tr>
<td>AM Satisfaction with Spouse Responses</td>
<td>-.05*</td>
</tr>
<tr>
<td>AM Positive Spouse Responses</td>
<td>.05*</td>
</tr>
</tbody>
</table>

*p < .05.
Moderating effects of social support on pain catastrophizing. Next, a series of lagged models were specified to investigate whether the detrimental effects of morning pain catastrophizing on (1) evening pain severity and (2) evening negative affect were attenuated at higher levels of morning social support. In order to help tease apart the causal ordering of variables, all models predicted evening outcome, controlling for morning outcome. Interaction terms were computed using the cross-product of (centred) predictors (i.e., morning satisfaction with responses X morning catastrophizing, morning positive spouse responses X morning catastrophizing; Aiken & West, 1991). Due to power constraints and concerns regarding multicollinearity, the moderating effects of satisfaction with spouse responses and positive spouse responses were tested in separate models. Given that morning satisfaction with spouse responses and spouse complaints were found to be predictors of evening pain in previous analyses, these variables were included in both of the lagged models predicting pain intensity. Findings indicated that satisfaction with spouse responses and positive responses from the spouse did not buffer the effects of morning catastrophizing on evening pain intensity, $b = -0.05$, $t(393) = -0.43$, $p > .10$ (see Table 18; Model 1) and $b = -0.11$, $t(392) = -0.88$, $p > .10$, respectively (see Table 18; Model 2). Although statistical interactions between spouse criticism/avoidance and pain catastrophizing were also of interest, low endorsement of spouse criticism and avoidance items did not permit their examination within an interaction term. For instance, comparing the effects of high or low catastrophizing on pain intensity in the presence or absence of spouse avoidance would have resulted in a greatly imbalanced $n$ for the groups and parameter estimates would be based on a very small proportion of the current sample.
Table 18

Multi-level regression analyses: Lagged relations of morning social support and its interaction with morning pain catastrophizing predicting evening pain intensity, controlling for morning pain intensity

<table>
<thead>
<tr>
<th></th>
<th>PM Pain Intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model 1</td>
</tr>
<tr>
<td><strong>Effect</strong></td>
<td><strong>b</strong></td>
</tr>
<tr>
<td>Fatigue</td>
<td>.32*</td>
</tr>
<tr>
<td>Functional Disability</td>
<td>1.23*</td>
</tr>
<tr>
<td>AM Pain Intensity</td>
<td>.45***</td>
</tr>
<tr>
<td>AM Pain Catastrophizing</td>
<td>.38</td>
</tr>
<tr>
<td>AM Satisfaction with Spouse Responses</td>
<td>- .13</td>
</tr>
<tr>
<td>AM Positive Spouse Responses</td>
<td>-</td>
</tr>
<tr>
<td>AM Spouse Complaints</td>
<td>.27*</td>
</tr>
<tr>
<td>AM Pain Catastrophizing X AM Satisfaction</td>
<td>-.05</td>
</tr>
<tr>
<td>AM Pain Catastrophizing X AM Positive Responses</td>
<td>-</td>
</tr>
</tbody>
</table>

*Note. With respect to AM Positive Spouse Responses, dashed line indicates variable was dropped based on prior analyses demonstrating a non-significant relationship.*

*p < .05. **p < .01. ***p < .001.
Both lagged models predicting evening negative affect included morning satisfaction with responses and positive spouse responses, given their lagged associations with evening negative affect found in previous analyses. Findings from these models showed that morning satisfaction with spouse responses interacted with morning catastrophizing to predict evening negative affect, \( b = -0.09, t(394) = -2.00, p = .05 \) (see Table 19; Model 1). As shown in Figure 2, morning catastrophizing was associated with increases in evening negative affect at lower levels of satisfaction with spouse responses (i.e., one standard deviation below the mean), \( b = 0.21, t(394) = 3.52, p < .01 \). However, when participants reported higher levels of satisfaction with spouse responses, morning catastrophizing was not significantly related to evening negative affect, \( b = 0.03, t(394) = 0.59, p > .10 \). Positive responses from the spouse did not buffer the effects of morning catastrophizing on evening negative affect, \( b = -0.02, t(392) = -0.56, p > .10 \) (see Table 19; Model 2).
Table 19

Multi-level regression analyses: Relations of morning social support and its interaction with morning pain catastrophizing to evening negative affect, controlling for morning negative affect

<table>
<thead>
<tr>
<th>Effect</th>
<th>PM Negative Affect</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model 1</td>
<td>Model 2</td>
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</tr>
<tr>
<td></td>
<td>b</td>
<td>SE</td>
<td>b</td>
</tr>
<tr>
<td>AM Negative Affect</td>
<td>.18*</td>
<td>.07</td>
<td>.19*</td>
</tr>
<tr>
<td>AM Pain Catastrophizing</td>
<td>.35*</td>
<td>.15</td>
<td>.11</td>
</tr>
<tr>
<td>AM Satisfaction with Spouse Responses</td>
<td>.07</td>
<td>.05</td>
<td>-.05*</td>
</tr>
<tr>
<td>AM Positive Spouse Responses</td>
<td>.06¹</td>
<td>.03</td>
<td>.08¹</td>
</tr>
<tr>
<td>AM Pain Catastrophizing X AM Satisfaction</td>
<td>-.09w</td>
<td>.04</td>
<td>-</td>
</tr>
<tr>
<td>AM Pain Catastrophizing X AM Positive Responses</td>
<td>-</td>
<td>-</td>
<td>-.02</td>
</tr>
</tbody>
</table>

¹p < .05. ²p = .05. *p < .05. **p < .01. ***p < .001.
Figure 2. Evening negative affect as a function of morning catastrophizing and morning satisfaction with responses.
Research Question 4. Do pain intensity and negative affect have direct effects on concurrent and lagged levels of pain catastrophizing (4.1)? Does social support moderate the effects of negative affect and pain intensity on pain catastrophizing (4.2)?

Direct effects of pain and negative affect on catastrophizing. First, the direct effects of pain and negative affect on concurrent and lagged levels of pain catastrophizing were examined. After controlling for morning pain catastrophizing, increases in evening pain intensity and negative affect were found to be associated with increases in evening pain catastrophizing, $b = 0.10$, $t(435) = 6.05$, $p < .001$ and $b = 0.45$, $t(435) = 4.26$, $p < .001$, respectively (see Table 20).
Table 20

Multi-level regression analyses: Concurrent relations of evening pain intensity and negative affect to evening pain catastrophizing, controlling for morning pain catastrophizing

<table>
<thead>
<tr>
<th>Effect</th>
<th>PM Pain Catastrophizing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>b</strong></td>
</tr>
<tr>
<td>Gender</td>
<td>-.19*</td>
</tr>
<tr>
<td>Fatigue</td>
<td>.08**</td>
</tr>
<tr>
<td>AM Pain Catastrophizing</td>
<td>.30***</td>
</tr>
<tr>
<td>PM Negative Affect</td>
<td>.45***</td>
</tr>
<tr>
<td>PM Pain intensity</td>
<td>.10***</td>
</tr>
</tbody>
</table>

*p < .05. **p < .01. ***p < .001.
The lagged model suggested that increases in morning pain intensity were associated with increases in evening pain catastrophizing, $b = 0.04$, $t(435) = 2.95$, $p < .01$, but that the effect of morning negative affect on evening pain catastrophizing was non-significant, $b = -0.10$, $t(435) = -1.11$, $p > .10$ (see Table 21).

Table 21
Multi-level regression analyses: Lagged relations of morning pain intensity and negative affect to evening pain catastrophizing, controlling for morning pain catastrophizing

<table>
<thead>
<tr>
<th>Effect</th>
<th>$b$</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>-.19*</td>
<td>.08</td>
</tr>
<tr>
<td>Fatigue</td>
<td>.08**</td>
<td>.02</td>
</tr>
<tr>
<td>AM Pain Catastrophizing</td>
<td>.39***</td>
<td>.08</td>
</tr>
<tr>
<td>AM Negative Affect</td>
<td>-.10</td>
<td>.09</td>
</tr>
<tr>
<td>AM Pain Intensity</td>
<td>.04**</td>
<td>.01</td>
</tr>
</tbody>
</table>

*p < .05. **p < .01. ***p < .001.
Moderating effects of social support on pain and negative affect. A series of lagged models examined whether morning social support attenuated the relationship between (1) morning pain intensity and evening catastrophizing, and (2) morning negative affect and evening catastrophizing. Interaction terms were computed using the cross-product of (centred) predictors (Aiken & West, 1991). The first two models included morning (satisfaction with spouse responses or positive spouse responses), morning pain intensity, and the interaction between morning (satisfaction with spouse responses or positive spouse responses) and morning pain intensity, controlling for morning catastrophizing (see Table 22). The second two models included morning (satisfaction with spouse responses or positive spouse responses), morning pain intensity, morning negative affect, and the interaction between morning (satisfaction with spouse responses or positive spouse responses) and morning negative affect, controlling for morning catastrophizing (see Table 23). Morning satisfaction with spouse responses interacted with both morning pain (trend) and morning negative affect to predict evening catastrophizing, $b = -0.03, t(385) = -1.75, p < .09$ (see Table 22; Model 1), and $b = -0.23, t(384) = -3.37, p < 0.01$ (see Table 23, Model 1). As shown in Figure 3, the relationship between morning pain intensity and increases in evening catastrophizing was attenuated at higher (i.e., one standard deviation above the mean) versus lower (i.e., one standard deviation below the mean) levels of morning satisfaction with spouse responses, $b = 0.04, t(385) = 3.00, p < .01$ vs. $b = 0.10, t(385) = 3.69, p < .001$. The interaction between satisfaction with spouse responses and negative affect is depicted in Figure 4. At higher levels of morning satisfaction with spouse responses, morning negative affect was not predictive of increases in evening catastrophizing in the evening, $b = -0.10, t(384) = -1.08, p > .10$. However, at lower levels of satisfaction with spouse responses,
negative affect in the morning was associated with significant increases in pain catastrophizing over the course of the day, $b = 0.29$, $t(384) = 2.79$, $p < .01$. Positive spouse responses did not moderate the relationship between morning pain intensity or negative affect and evening catastrophizing, $b = -0.02$, $t(383) = -1.39$, $p > .10$ and $b = -0.16$, $t(382) = -1.50$, $p > .10$, respectively.
Table 22

Multi-level regression analyses: Relations of morning social support and its interaction with morning pain severity predicting evening pain catastrophizing, controlling for morning pain catastrophizing

<table>
<thead>
<tr>
<th>Effect</th>
<th>PM Pain Catastrophizing</th>
<th>Model 1</th>
<th>Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>b</td>
<td>SE</td>
</tr>
<tr>
<td>Gender</td>
<td>-0.18*</td>
<td>0.08</td>
<td>-0.18*</td>
</tr>
<tr>
<td>Fatigue</td>
<td>0.09**</td>
<td>0.02</td>
<td>0.09**</td>
</tr>
<tr>
<td>AM Pain Catastrophizing</td>
<td>0.39***</td>
<td>0.09</td>
<td>0.38***</td>
</tr>
<tr>
<td>AM Pain Intensity</td>
<td>0.13*</td>
<td>0.06</td>
<td>0.09*</td>
</tr>
<tr>
<td>AM Satisfaction with Spouse Responses</td>
<td>0.10</td>
<td>0.07</td>
<td>-</td>
</tr>
<tr>
<td>AM Positive Spouse Responses</td>
<td>-</td>
<td>-</td>
<td>0.07</td>
</tr>
<tr>
<td>AM Pain X AM Satisfaction</td>
<td>-0.03z</td>
<td>0.02</td>
<td>-</td>
</tr>
<tr>
<td>AM Pain X AM Positive Responses</td>
<td>-</td>
<td>-</td>
<td>-0.02</td>
</tr>
</tbody>
</table>

Note. With respect to AM Satisfaction with Spouse Responses and AM Positive Spouse Responses, dashed line indicates variable was dropped based on prior analyses demonstrating a non-significant relationship.

* p < .05. ** p < .01. *** p < .001.
Figure 3. Evening pain catastrophizing as a function of morning pain intensity and morning satisfaction with spouse responses.
Table 23
Multi-level regression analyses: Lagged relations of morning social support and its interaction with morning negative affect predicting evening pain catastrophizing, controlling for morning pain catastrophizing

<table>
<thead>
<tr>
<th>Effect</th>
<th>PM Pain Catastrophizing</th>
<th>Model 1</th>
<th>Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>b</td>
<td>SE</td>
</tr>
<tr>
<td>Gender</td>
<td>-.18* (.08)</td>
<td>-.18*</td>
<td>.08</td>
</tr>
<tr>
<td>Fatigue</td>
<td>.09** (.02)</td>
<td>.09**</td>
<td>.02</td>
</tr>
<tr>
<td>AM Pain Catastrophizing</td>
<td>.37*** (.09)</td>
<td>.38***</td>
<td>.09</td>
</tr>
<tr>
<td>AM Negative Affect</td>
<td>.72** (.25)</td>
<td>.39</td>
<td>.28</td>
</tr>
<tr>
<td>AM Pain Intensity</td>
<td>.04* (.02)</td>
<td>.05**</td>
<td>.02</td>
</tr>
<tr>
<td>AM Satisfaction with Spouse Responses</td>
<td>.30** (.09)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>AM Positive Spouse Responses</td>
<td>-</td>
<td>.21</td>
<td>.14</td>
</tr>
<tr>
<td>AM Negative Affect X AM Satisfaction</td>
<td>-.23** (.07)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>AM Negative Affect X AM Positive Responses</td>
<td>-</td>
<td>-.16</td>
<td>.11</td>
</tr>
</tbody>
</table>

Note. With respect to AM Satisfaction with Spouse Responses and AM Positive Spouse Responses, dashed line indicates variable was dropped based on prior analyses demonstrating a non-significant relationship.

*p < .05. **p < .01. ***p < .001.
Figure 4. Even evening pain catastrophizing as a function of morning negative affect and morning satisfaction with spouse responses.
Summary of Findings

Overall, findings suggest an important role of perceptions of spouse support in the day-to-day adjustment to RA. Findings supported both main effect and buffering effect models of social support. Increases in satisfaction with spouse responses were related to decreases in pain intensity and negative affect, both concurrently and over the course of the day. However, the significant associations between satisfaction with spouse responses and concurrent negative affect and lagged pain intensity became trends (i.e., not statistically significant) once pain catastrophizing was entered into the model. In terms of positive spouse responses, increases in positive responses were related to increases in concurrent, but not lagged, levels of pain intensity. This association was a trend once pain catastrophizing was entered in the model. Although positive spouse responses were not related to concurrent levels of negative affect, increases in morning positive spouse responses were related to increases in negative affect over the course of the day. With regards to negative spouse responses, spouse complaints were related to concurrent increases in negative affect, and increases in pain severity over the course of the day. In contrast, spouse avoidance was not significantly related to any of the study outcomes.

None of the social support variables had direct effects on concurrent or lagged levels of pain catastrophizing. Although spouse complaints were related to higher concurrent catastrophizing and satisfaction with spouse responses was related to lower concurrent catastrophizing, these associations were non-significant after controlling for the effects of pain and negative affect on catastrophizing. However, once concurrent levels of pain and negative affect were taken into account, an influence of satisfaction with spouse responses on catastrophizing emerged. That is, the association between morning pain intensity and
increases in evening catastrophizing was attenuated at higher levels of morning satisfaction with spouse responses. The association between morning negative affect and increases in evening catastrophizing became non-significant when patients reported higher morning satisfaction with spouse responses. Positive spouse responses did not moderate the relationship between morning pain and negative affect and increases in evening pain catastrophizing.

Increases in pain catastrophizing were related to concurrent and lagged increases in pain intensity and negative affect in the current study. However, higher levels of satisfaction with spouse responses were found to buffer the detrimental effects of morning pain catastrophizing on evening negative affect. No significant buffering effects were found for positive spouse responses.

DISCUSSION

The primary goal of the current study was to examine the mechanisms through which a supportive social environment may disrupt the vicious cycle of pain, negative affect, and pain catastrophizing among individuals with rheumatoid arthritis. This study offers several methodological advantages over previous research examining the social context of the chronic pain experience. For example, this is the first study to examine both social support and pain catastrophizing in the context of a daily process design, and therefore offers unique insights into how supportive processes unfold over the course of the day. By considering positive and negative responses from the spouse, as well as levels of satisfaction with these responses, the current study was also able to obtain a more comprehensive understanding of how the marital relationship can help or hinder adjustment to chronic pain.

In order for social support research to be clinically relevant, it is essential to clarify
which aspects of social relationships are most strongly related to well-being, as well as identify the mechanisms through which support influences outcomes. Findings from the current study suggest that daily satisfaction with spouse responses is a key dimension of supportive processes among individuals with RA. While perceptions of positive and negative spouse responses also influenced well-being, these findings were less consistent across outcomes. Study findings suggest that, in addition to influencing daily fluctuations in pain intensity and negative affect, satisfaction with spouse responses may also reduce exaggerated negative responses to RA pain and protect against the detrimental effects of these responses. Although not a primary focus of the study, findings also helped to increase understanding of pain catastrophizing as a dynamic, fluctuating process.

**Satisfaction with Spouse Responses**

Findings suggest that changes in day-to-day satisfaction with the spouse can influence well-being through several distinct, but related pathways. First, satisfaction with spouse responses was found to protect individuals from the detrimental effects of pain catastrophizing on negative affect. In the current study, greater pain catastrophizing in the morning was found to be associated with subsequent increases in both negative affect and pain intensity over the course of the day, even after controlling for morning levels of negative affect and pain. This is consistent with a growing number of longitudinal and prospective studies indicating that high levels of catastrophizing can lead to poorer adjustment to chronic pain over time (Granot & Ferber, 2005; Grant et al., 2002; Keefe et al., 2004; Pavlin et al., 2005; for an exception see Hanley et al., 2004). On mornings when participants reported lower satisfaction with their spouses, the effects of pain catastrophizing on negative affect persisted throughout the day. However, when participant reported greater satisfaction with
their spouses, catastrophizing had no significant lasting effects on negative affect.

These results are consistent with past research suggesting that the perceived response of others can attenuate the detrimental effects of maladaptive coping (Marin et al., in press). For example, in a daily diary study of husbands and wives living in stepfamilies, Puterman and colleagues (2007) found that the association between rumination and negative affect was weaker among those who reported greater perceived support from family and friends. Thus, 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 (e.g., Marin et al., in press; Puterman et al., 2007), only one study could be identified that has examined protective effects on pain outcomes per se (Holtzman et al., 2004), and this study found evidence for a buffering effect of support on the relationship between distancing and increased pain severity. Contrary to study hypotheses, increases in pain catastrophizing in the morning was related to increases in evening pain intensity, regardless of the degree to which individuals were satisfied with spouse responses. One possible explanation for this finding is that pain 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. Within the framework of Melzack’s neuromatrix theory of pain (1990, 1993), catastrophizing may increase sensory flow of pain signals, leading to the sensitization of central neural mechanisms. Over time, this may lead to a self-perpetuating cycle of pain catastrophizing and heightened nociceptive processing that is under less psychological control.
Despite a failure to buffer the detrimental effects of catastrophizing on later levels of pain, greater satisfaction with spouse responses was related to decreases in concurrent levels of pain intensity. Such increases in support were also slightly, but not significantly, associated with decreases in pain over the course of the day. The lagged effect of support on pain, although a trend, suggests that this association cannot solely be explained by the fact that increases in pain lead individuals to evaluate others as less supportive. It is also important to note that the effects of support on pain could not be accounted for by changes in negative affect. These findings are consistent with past research demonstrating that individuals who are more satisfied with their support networks are more likely to experience lower levels of pain intensity (Evers, et al., 2003; Savelkoul et al., 2000). Current biopsychosocial models of pain include a cognitive-evaluative dimension of pain and are therefore consistent with the idea that feeling well-supported would lead individuals to judge their pain as less severe (Keefe et al., 2004; Melzack, 2005).

Only two other studies could be identified that have examined the relationship between social support and pain outcomes using a daily process methodology and both used aggregated measures of social support across all sources (Feldman et al., 1999; Holtzman et al., 2004). Among a sample of individuals suffering from reflex sympathetic dystrophy syndrome, Feldman and colleagues (1999) found that when participants reported more perceived helpful responses from their social network, they reported significantly lower pain the following day. However, in a study of individuals with RA, Holtzman and colleagues (2004) failed to find a significant relationship between satisfaction with the response of others and changes in pain intensity. One possible reason for mixed findings among daily diary
studies could be due to the fact that perceptions of support were aggregated across all network members. The significant effects of satisfaction with spouse support across a range of outcomes in the current study suggests the utility of independently examining the effects of support from different sources, and that aggregate measures may have diluted the effects of spouse support in previous research (Felton & Berry, 1992).

Given the powerful effects of pain catastrophizing on adjustment to chronic pain (Sullivan et al., 2001), the present study focused on how support may influence this way of responding to pain on a day-to-day basis. Consistent with study hypotheses, increases in satisfaction with spouse responses in the face of pain and negative affect were found to reduce the likelihood of catastrophizing. More specifically, the relationship between morning pain intensity and evening pain catastrophizing was attenuated when participants reported higher satisfaction with spouse responses. When participants reported lower levels of satisfaction with support, negative affect was significantly related to subsequent increases in catastrophizing over the day. However, on days when participants reported higher levels of satisfaction, the relationship between morning negative affect and evening catastrophizing was non-significant. These findings are consistent with past research demonstrating that a supportive social 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 & 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 support may have reduced the “need” or motivation for individuals to catastrophize as a means of garnering attention and support.

Negative Spouse Responses
In addition to examining the effects of satisfaction with spouse responses on well-being, the current study also examined the impact of specific negative responses from the spouse. The extent to which negative responses influenced day-to-day well-being depended on a number of factors, including the nature of the response (i.e., complaints vs. avoidance), the outcome variable of interest, and whether the association was concurrent or lagged.

**Spouse complaints.** When individuals reported feeling that their spouses had complained about them, they tended to report higher levels of negative affect, even after controlling for prior levels of negative affect and concurrent levels of pain. This finding is consistent with study hypotheses and a wealth of cross-sectional research demonstrating an association between negative social interactions and greater psychological distress (Cano, 2004; Kerns et al., 1990; Papas et al., 2001; Revenson et al., 1991; Romano et al., 1997; Schwartz et al., 1996; Sherman, 2003; Turk et al., 1992). However, given that the effect of spouse complaints on negative affect did not persist across the day, the temporal ordering of these variables remains unclear. For example, it may be that those experiencing greater negative affect were more likely to interpret spouse responses as being critical or rejecting (Marcus & Askari, 1999), particularly if those responses were ambiguous in nature (Lawson, MacLeod, & Hammond, 2002). Alternatively, negative affect may have elicited negative responses from close others (Coyne et al., 1987; Dew & Bromet, 1991).

A failure to find lasting effects of spouse complaints on negative affect is consistent with findings from a recent daily process study of husbands and wives living in stepfamilies, in which daily perceptions of spouse criticism and disappointment in the spouse were related to same day, but not next day negative affect (DeLongis et al., 2004). Transient effects of negative social interactions on negative affect may be explained by Taylor’s (1991).
mobilization-minimization hypothesis. According to Taylor, negative events evoke immediate and unpleasant affective states, and these undesirable states motivate individuals to engage in various cognitive and/or behavioural strategies to minimize the consequences of negative events. Thus, in the context of the current study, a lack of lagged effects of spouse complaints may reflect participants' successful attempts at repairing the negative impact of complaints on negative affect. Nonetheless, this hypothesis remains speculative given that the current study did not specifically assess how participants coped with negative spouse interactions, and one would have expected significant variability in the success of participants' efforts to cope with interpersonal stress.

Consistent with previous research that has found a positive correlation between marital conflict and greater pain (e.g., Flor et al., 1987; Grant et al., 2002; Zautra et al., 1998), complaints from the spouse were associated with significant increases in pain intensity over the course of the day, even after controlling for prior levels of pain and negative affect. A detrimental impact of spouse complaints on pain intensity could be explained by the fact that, in the context of interpersonal conflict, individuals tend to engage in maladaptive coping strategies (e.g., Manne & Zautra, 1989). Indeed, preliminary analyses in the current study found an association between spouse complaints and higher concurrent levels of pain catastrophizing. However, this relationship was non-significant after controlling for negative affect. Lagged relations between spouse complaints and catastrophizing were also non-significant. A failure to find a significant relationship between spouse conflict and catastrophizing is consistent with Cano's (2004) cross-sectional analysis of married individuals with chronic pain. However, others have found a significant, positive association between punishing spouse responses and pain catastrophizing (Boothby et al., 2004; Keefe et
al., 2004). Contradictory findings may reflect methodological and statistical differences between our study and others. For example, previous studies have relied on cross-sectional designs, which have been known to yield significant relations among variables even when no single individual actually demonstrates this relationship (Epstein, 1983). Furthermore, past studies failed to control for negative affect and therefore significant relationships may reflect shared variance between negative affect and perceptions of spouse complaints.

Although an association between complaints and increased pain could not be accounted for by increased use of pain catastrophizing in the current study, an association between complaints and increased pain may be explained by other maladaptive ways of dealing with pain not assessed here. For example, in a previous daily diary study of individuals with RA, disappointment in support was related to greater use of problem solving (e.g., increased my efforts to make things work), a strategy that was related to increases in daily pain (Holtzman et al., 2004; Newth & DeLongis, 2004). Therefore, it is possible that complaints from the spouse triggered participants to “go it alone” in their efforts to cope with their pain, causing them to overexert themselves and experience increases in pain over the course of the day.

Spouse complaints may also have lead to increases in pain intensity via physiological mechanisms. RA is an inflammatory autoimmune disease, which is thought to involve a dysregulation in several stress-related physiological systems that are known impact immune and inflammatory systems, including the hypothalamic pituitary-adrenal axis and sympathetic-adrenal-medullary system (Huyser & Parker, 1998). This has lead to an increasing number of investigations into whether increased stress may actually exacerbate RA disease activity. Among the few studies that have examined the relationship between daily
stress and physiological outcomes among RA sufferers, the evidence has been mixed. Some have found an association between daily stressors and immune functioning (e.g., Thomason, Brantley, Jones, Dyer, & Morris, 1992; Zautra, Burleson, Matt, Roth, & Burrows, 1994, Zautra et al., 1998). For example, in a study of women diagnosed with RA, higher levels of interpersonal conflict were significantly correlated with increases in immune-stimulating hormones (Zautra et al., 1994). However, others have failed to find significant effects (e.g., Dekkers et al., 2001; Leymarie et al., 1997). What is more, the psychological and biological mechanisms that mediate the relationship between stressful events and immune functioning still remain unclear (Segerstrom & Miller, 2004). Finally, a link between spouse complaints and pain ratings is consistent with a recent fMRI study that suggests a common underlying neuroanatomical basis for social and physical pain (Eisenberger, Lieberman, & Williams, 2003; Eisenberger & Lieberman, 2004). In this study, Eisenberger and colleagues (2003) found that self-reported distress following laboratory-induced social rejection was correlated with increased activity in the dorsal subdivision of the anterior cingulate cortex, a region of the brain previously implicated in the affectively distressing dimension of the pain experience (Leiberman et al., 2004; Rainville et al., 1997).

**Spouse avoidance.** Contrary to study hypotheses, participants’ perceptions that their spouses had avoided them were unrelated to concurrent and lagged levels of pain intensity, negative affect, and catastrophizing. A failure to find significant effects was somewhat surprising, particularly in the context of the broader social support literature, which tends to find detrimental effects of negative social interactions on well-being (Rook et al., 1984). However, unlike the current study, the majority of past research has conceptualized negative support as a unidimensional construct and used global measures of negative support that
aggregate across different types of negative interactions. In an effort to disaggregate the construct of negative support, Manne and colleagues have examined the independent effects of both critical and avoidant responses among chronically ill populations (Manne et al., 1997). For example, among individuals with cancer, Manne (1999) has examined the impact of unsupportive spouse responses on cognitive processing among cancer patients. Results from this study indicated that spouse criticism moderated the association between intrusive thoughts and distress, but that spouse avoidance was a weaker, and only marginally significant, moderator of intrusive thoughts. In a study of mothers of children undergoing hemopoietic stem cell transplantation, spouse criticism, but not spouse avoidance, was associated with increases in depressive symptoms over a six month period (Manne et al., 2003). In fact, spouse avoidance was related to decreases in anxiety over time. Keefe and colleagues (2003) also found differential effects of unsupportive responses such that caregiver reports of more frequent critical, but not avoidant, responses towards the patient were related to greater pain catastrophizing among patients. Similarly, in an observational study of newlyweds, Kiecolt-Glaser and colleagues (1993) found that hostile, but not avoidant or withdrawal, spouse behaviours during a 30 minute discussion of marital issues were significantly related to immune and blood pressure changes. Taken together, these findings offer preliminary evidence that critical responses may be a driving factor behind the association between negative support and well-being found in past research.

In order to help understand why complaints may have a more potent impact on well-being than do avoidant behaviours, it is useful to consider that spouses tend to make attributions of their partners’ negative behavior (e.g., whether they were acting with negative intent) and these attributions go on to influence their reactions to this negative behaviour.
Some negative behaviours may be more open to interpretation than others (Manne et al., 1997). For example, avoidant or withdrawal behaviours are typically more subtle and ambiguous than hostile or critical behaviours, which tend to be more overtly negative. Therefore, in the context of the present study, when participants reported that their spouses’ avoided them, they may have been less likely to perceive this behaviour as having malicious intent and more likely to ascribe this behavior to some temporary characteristic of their spouse, such as being tired or busy. On the other hand, when participants reported that their spouses complained about them, these perceptions may have been more likely to be associated with feelings of rejection and an ascription of negative intent, which would have been more likely to lead to greater distress.

An alternative explanation for a failure to find significant effects of avoidant responses in the current study may have been the relatively low frequency with which these were reported. However, reports of spouse complaints were similarly rare in the present study, and were still potent predictors of well-being. It is also possible that avoidant behaviour in the context of a marital relationship does have detrimental effects, but that these effects were not apparent in the time lags assessed here. For example, Preece and DeLongis (2005) found that withdrawal in social relationships was associated with short-term reductions in family tension and negative affect, but over the course of two-years, the effects were negative.

**Positive Spouse Responses**

Contrary to expectations, higher levels of perceived positive responses were not associated with improved day-to-day functioning among participants in the current study. Furthermore, increases in positive spouse responses in the morning were related to increases in negative affect over the course of the day, and there was a trend towards an association
between positive spouse responses and concurrent increases in pain intensity. When detrimental effects of receiving support have been found in past research, researchers have raised alternative explanations for these findings, including the possibility that individuals who are in more distress are more likely to seek and receive support (i.e., reverse causation) and that the positive association between support and distress may be due to some underlying third variable, such as pain or disability (Seidman et al., 2006). In the current study, the association between positive spouse responses and increases in negative affect was a lagged relationship and remained significant even after controlling for prior levels of pain and negative affect. Therefore, this association was unlikely to be a result of reverse causation or the confounding effects of greater pain or negative affect. However, it is possible that this association may be due to some other underlying variable not assessed here. On the other hand, the association between positive spouse responses and increases in pain was a concurrent relationship, controlling for negative affect and prior levels of pain. Therefore, although the presence of third variable confounds was reduced, the possibility that increases in pain lead to increases in received support (and not vice versa) remains a viable alternative.

The use of within-person analyses in the current study also ensured that the association between higher levels of positive responses and worse outcomes could not be attributed to underlying individual difference variables, such as neuroticism or need for support.

That the unexpected association between positive spouse responses and worse outcomes emerged only after controlling for satisfaction with spouse responses might be explained in several ways. First, the high correlation between satisfaction with spouse responses and positive responses may have caused problems with multicollinearity. However, collinearity tolerance statistics suggested that such problems were not likely, and
person-centring all independent variables served to reduce the correlation between these two variables (Kreft & deLeeuw, 1998; Morrow-Howell, 1994). Second, it remains unclear whether the variance in positive spouse responses is conceptually meaningful after controlling for satisfaction with these responses. Finally, the relationship between increases in positive spouse responses and increases in negative affect over the course of the day can be interpreted in the context of Bolger and colleagues’ (2000) work on “invisible support.” These researchers found that perceptions of receiving support from a romantic partner were related to increases in next day depressed mood, controlling for previous day’s depressed mood. However, partner reports of providing support were related to decreases in next day depressed mood among recipients. These findings led Bolger and his colleagues to speculate that support from close others is only detrimental to well-being when it is coded as support by the recipient. Extending this hypothesis to the current study, it is possible that the detrimental effects of positive responses were due to participants feeling they had received more help than usual, and the feelings of burden and lack of self-esteem that may have accompanied those perceptions (Fischer, Nadler, & Whitcher-Alagna, 1982).

While there is evidence to support this “threat to self-esteem” hypothesis (Deelstra et al., 2003), the extent to which individuals benefit or suffer from receiving support likely depends on a myriad of factors, including the perceived equity of supportive exchanges (Walster, Berscheid, & Walster, 1973; Ybema, Kuijer, Buunk, de Jong, & Sanderman, 2001), the quality of the marital relationship (Turk et al., 1992), and the extent to which support matches the specific needs of the recipient (Cutrona, 1990). Research is also beginning to show that the benefits of giving support may actually exceed the benefits of receiving it (Brown, Nesse, Vinokur, & Smith, 2003), and that the relative benefits of giving versus
receiving may vary by gender (Vaananen, Buunk, Kivimaki, Pentti, & Vahtera, 2005). A significant lagged relationship between positive spouse responses and negative affect, but not pain intensity, in the current study suggests that the benefits and costs of receiving support may also vary depending on the outcome in question.

The extent to which supportive responses are associated with well-being may also depend on the extent to which these responses are successful in encouraging adaptive and discouraging maladaptive ways of coping with stress (DeLongis & Holtzman, 2005; Thoits, 1986). Contrary to expectations, higher levels of positive spouse responses were unrelated to concurrent and lagged levels of pain catastrophizing. Based on the stress buffering model of social support (Cohen & Wills, 1985), positive responses from the spouse had been expected to be most effective at higher levels of distress. However, positive spouse responses were unrelated to pain catastrophizing, regardless of concurrent levels of pain and negative affect. Similarly, in the context of feeling helpless and unable to cope with pain, positive responses from the spouse were unrelated to better outcomes. These findings are at odds with previous research suggesting that supportive responses can reduce maladaptive coping and its harmful effects (Marin et al., in press). However, as mentioned above, the effectiveness of received support likely depends on a variety of factors above and beyond the frequency and amount of support received. A failure to find a beneficial effect of positive spouse responses on pain catastrophizing must also be interpreted in the context of a large body of literature demonstrating a powerful and robust effect of pain catastrophizing on well-being (Sullivan et al., 2001). Catastrophizing is characterized by an exaggerated negative response to pain, and by nature is associated with higher levels of pain and distress. As such, close others may have a difficult time offering helpful responses when patients are dealing with pain in this manner.
particularly if it occurs on a regular basis. According to Thoits (1986), ineffective coping responses are often indicative of ineffective supportive responses, and vice versa. Therefore, it is possible that the measure of positive spouse responses used here did not capture those responses that would be most helpful in reducing pain catastrophizing. A lack of relationship between supportive responses and catastrophizing may also reflect the fact that it may be easier for loved ones to effectively reinforce and encourage adaptive coping than it is to inhibit or derail maladaptive patient coping.

Overall, the majority of analyses examining the impact of positive spouse responses on well-being yielded null results. As mentioned above, the positive spouse response scale may not have tapped into relevant supportive gestures. However, this scale did tap into emotional, informational, and instrumental support, all of which have been previously identified as key dimensions of positive social support. It is also unlikely that null effects were due to aggregating across different types of supportive responses, given that supplementary HLM analyses revealed that disaggregating this scale into separate dimensions of positive support would have yielded near identical results to those presented here.

**Pain Catastrophizing**

Although the main focus of the current study was on mechanisms of social support, several findings related specifically to pain catastrophizing warrant attention. Consistent with previous daily diary research (Grant et al., 2002; Keefe et al., 2004) the present study found evidence for within-person fluctuations in pain catastrophizing and that greater catastrophizing can lead to worsening levels of pain and negative affect over the course of the day. Furthermore, significant effects of catastrophizing on outcomes could not be accounted for by shared variance with pain and negative affect. Despite a wealth of research suggesting
that pain and negative affect are inextricably linked, findings from the current study suggest that the association between pain and negative affect may be partly explained by the underlying ways in which individuals interpret and respond to their pain. For example, when pain catastrophizing was controlled for in the model predicting concurrent negative affect, pain intensity was not significantly associated with negative affect. Although a formal test of mediation was not conducted, this pattern is consistent with previous studies suggesting that catastrophizing may help account for an association between depression and pain intensity (Lackner, Quigley, & Blanchard, 2004).

The majority of research on pain catastrophizing has focused on its negative consequences for well-being, with few investigations of factors that might account for within- and between-person differences in catastrophizing. Not surprisingly, results suggested that increases in pain intensity were related to increases in pain catastrophizing, both concurrently and over the course of the day. This is consistent with past cross-sectional research demonstrating that when individuals report higher levels of pain, they are more likely to catastrophize (e.g., Sullivan et al., 2005). These results also replicate a previous daily diary study of individuals suffering from osteoarthritis, where increases in pain catastrophizing followed increases in pain intensity (Keefe et al., 2004). Interestingly, negative affect had significant concurrent associations with pain catastrophizing, but did not lead to increases in catastrophizing over the course of the day.

In addition to results demonstrating the influence of pain intensity on daily fluctuations in catastrophizing, evidence was also found for between-person factors that appear to be related to higher levels of catastrophizing. Fatigue is a commonly reported symptom of RA (Hewlett et al., 2005), and has consistently been linked to lower quality of
life among RA sufferers (Suurmeijer et al., 2001). Findings from the current study suggest that those who experience higher levels of fatigue are also more likely to respond to pain in a catastrophic manner. However, only general levels of fatigue at the beginning of the study period were assessed. Future studies are warranted that examine the temporal ordering of these variables, and the extent to which catastrophizing may account for the relationship between fatigue and poor adjustment to RA. Interestingly, males in this study reported greater catastrophizing than did females. This finding is at odds with many cross-sectional survey studies (Jensen et al., 1994; Keefe et al., 2000; Sullivan et al., 1995) and studies employing laboratory-induced pain tasks (Edwards, Haythornthwaite, Sullivan, & Fillingim, 2004; Jackson, Izzi, Chen, Ebnet, & Eglinis, 2005; Sullivan, Tripp, & Santor, 2000; Thorn et al., 2004) suggesting women are more likely to catastrophize in response to pain. However, not all previous cross-sectional studies have found a gender difference (e.g., Edwards, Augustson, & Fillingim, 2000; Unruh, Ritchie, & Merskey, 1999), and the majority of past research on catastrophizing has not tested for gender effects. Two previous daily studies investigated gender differences in daily levels of catastrophizing, and both failed to find significant effects (Keefe et al., 2004; Turner et al., 2004). Although preliminary analyses by Keefe and colleagues (2004) revealed that non-white males reported greater pain catastrophizing, the sample was small (n = 4), and these participants were dropped from subsequent analyses. The small number of males in the current sample (n = 11) also suggests that gender differences should be interpreted with caution.

The use of a daily process design appears to be an ideal method of studying pain catastrophizing in that it allows for real-time assessment of study variables in an ecologically valid setting, while also enabling researchers to control for underlying third variables through
the use of within-person analyses. Although lab-induced pain and pain catastrophizing can also help reduce retrospective recall bias, it is unclear how applicable these results are to populations where pain reflects an underlying disease process.

**Telephone Diary Methodology**

Daily process studies represent an ecologically valid means of obtaining closer to real-time assessments of social support and related processes over time. A small but growing number of studies have used this approach to investigate factors that influence day-to-day adjustment to chronic pain (e.g., Grant et al., 2002; Keefe et al., 2004). However, the majority of these studies have used paper or electronic diaries and no previous studies could be identified that have used telephone interviews to collect daily diary data among chronic pain populations. The interview compliance rate in the current study was as high or higher than previous electronic and paper diary studies (Feldman et al., 1999; Mohr et al., 2003; Turner et al., 2004). However, it is important to note that two participants were dropped prior to study analyses due to a compliance rate of less than 60%. All participants who agreed to take part in the daily diary protocol completed this portion of the study (i.e., no dropouts). This likely reflects strong rapport built through regular telephone contact with study participants. The number of missing items within completed study interviews was also extremely low. This is consistent with previous studies that have found fewer missing items in telephone versus paper diaries (Hoppe et al., 2000; Morrison, Leigh, & Gillmore, 1999). Having an interviewer administer each individual question to participants likely helped to reduce the number of skipped items, as well as the number of items that were illegible or uncodable (e.g., due to participants circling more than one response).

The relative costs and benefits of using paper versus electronic diaries has received a
great deal of attention in the recent literature, and clearly researchers must consider a number of competing factors when deciding the method by which daily diary data is collected (Tennen et al., 2006). Findings from the current study suggest that, although telephone diaries can be somewhat time and labor intensive for the research, they represent a viable alternative to electronic and paper diaries, particularly when the cost of electronic diaries are prohibitive. However, further research is greatly needed regarding factors that influence participation in telephone diary studies, and daily process designs in general. The extent to which reactivity differs across these different methods of data collection is also unknown and requires empirical investigation.

Clinical Implications

Results from the current study highlight the potential utility of involving close others in formal and informal treatment attempts to increase adjustment to chronic pain. Cognitive behaviour therapy (CBT) for pain management has been shown to improve outcomes in individuals with a variety of chronic pain conditions (Astin, Beckner, Soeken, Hochberg, & Berman, 2002; Chen, Cole, & Kato, 2004; Eccleston, Morley, Williams, Yorke, & Mastroyanannopoulou, 2002; Morley, Eccleston, & Williams, 1999; Turner, Mancl, & Aron, 2006). However, results from these studies suggest that not all individuals benefit from treatment, and among those who benefit, not all appear to maintain treatment gains over time. Emerging research suggests that involving the spouse in CBT for pain management may help enhance treatment gains (Keefe, Caldwell, & Baucom, 1996; Keefe et al., 2004; Saarijarvi, Alanen, Rytkoski, & Hyyppa, 1992). These interventions tend to be behavioural in nature, focusing on communication and problem solving skills, mutual goal setting, and coping skills rehearsal (e.g., Keefe et al., 2004). However, the effects of these interventions have been
modest, suggesting the need for further refinement of couples approaches.

Based on the current study, clinical interventions that enhance satisfaction with spouse responses are expected to be particularly valuable among individuals with chronic pain. While there is some evidence that pain interventions that involve the spouse can increase marital satisfaction (Keefe et al., 1999), not all studies have found significant improvements in marital satisfaction (Keefe et al., 2004; Saarijarvi et al., 1992). The extent to which these interventions are successful in improving satisfaction with spouse responses is also unknown. Cano and Leonard (2006) have recently suggested the use of integrative behavioural couples therapy (ICBT; Jacobson & Christensen, 1996) as an alternative to current behavioural approaches for individuals with chronic pain who are maritally distressed. An integral part of ICBT is increasing emotional acceptance and empathy among couples. Rather than focusing on changing specific spouse behaviours, the goal of emotional acceptance is to increase couples' tolerance and acceptance of one another's behaviour. Although ICBT has not been formally tested among individuals with chronic pain, this approach holds promise as a way of increasing satisfaction with spouse responses.

Findings from the present study also suggest that, rather than trying to increase positive social exchanges, interventions may be better served by focusing on reducing negative social exchanges. Targeting overt negative exchanges, such as complaining, may be especially useful. Given that higher levels perceived positive responses were related to increases in negative affect in the current study, it may also be beneficial to help spouses provide support in a way that patients do not necessarily feel that they are receiving more support than they normally do. Finally, the current study highlights the importance of a supportive social environment in reducing pain catastrophizing and its harmful effects.
However, research is needed to help determine how spouses can respond to patients in a manner that is empathetic and encouraging of adaptive coping, without reinforcing exaggerated negative displays of pain and distress (Sullivan et al., 2001).

**Study Limitations**

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 findings from the current study are generalizable to other chronic pain populations, as well as predominantly male samples, remains to be seen. That the majority of participants were Caucasian, middle-class and had at least a high school education may also limit the generalizability of study findings. Another limitation of the current study is a reliance on self-report data. However, by asking participants to report on experiences and events that had occurred during the past several hours, the author was able to reduce the retrospective bias that often plagues self-report data (Gorin & Stone, 2001). Possible concerns regarding response biases in the data were also addressed by focusing on within-person fluctuations in study variables over time, whereby each participant served as their own control. However, due to the self-report nature of our data, it remains unclear how well participants’ perceptions of the nature and frequency of spouse responses would have mapped onto either spouse ratings of how they responded, or ratings of an outside observer. However, previous research suggests that individuals’ perceptions of the support they receive from others are actually more predictive of well-being than are others’ reports of what they provided (e.g., Manne, Ostroff, Winkel, Grana, & Fox, 2005). One notable exception comes from a daily diary study of couples by Bolger and
colleagues (2000), who found that emotional support had a beneficial effect on recipient well-being, only when it was not coded as support by the recipient. Other variables assessed in the current study, such as satisfaction with spouse support, reflect internal cognitive processes that would not have been suitably assessed by reports of close others or observational reports.

Despite the advantages of using a daily diary methodology, several potential limitations of this approach warrant attention (Bolger, et al., 2003; DeLongis, Hemphill, & Lehman, 1992). In order to minimize participant burden, it was necessary to use brief versions of existing measures, and reduce the number of constructs assessed in the daily interview (Bolger et al., 2003). For example, although pain has been conceptualized as a multidimensional construct, only one dimension (pain intensity) was assessed here. Pain intensity was ideally suited for assessment in a daily diary format, given that it is relatively quick and easy for adults to identify and gauge, and tends to fluctuate within individuals with RA over time (Jensen & Karoly, 2001; Holtzman et al., 2004). However, this limited assessment precluded an investigation of the relationship between psychosocial variables and other aspects of the pain experience, such as sensory (e.g., aching, sharp) and affective (e.g., tiring, cruel) qualities of pain (Melzack, 2005). Some concern has been raised regarding the possibility of reactivity in the context of daily process designs. However, across a variety of chronic pain populations, research suggests that intensive daily monitoring does not significantly alter the experiences or behaviours under examination (e.g., Aaron, Turner, Mancl, Brister, & Sawchuk, 2005; Cruise, Broderick, Porter, Kaell, & Stone, 1996; Peters et al., 2000). For example, among individuals with temporomandibular disorder, Aaron and colleagues (2005) failed to find a significant change in pain and pain-related variables (e.g., mood, perceived control, functional limitations) over the course of a 14-day study period.
Unfortunately, no studies could be identified that have specifically examined reactivity of social support processes in daily diary research. Finally, a daily process design represented an ecologically valid means of examining the temporal ordering of study variables over time. However, without an experimental study design, the extent to which social support actually causes improvements or declines in well-being remains unclear.

**Summary and Future Directions**

Findings from the current study demonstrate an important role of day-to-day supportive processes among individuals with chronic pain. Satisfaction with spouse responses emerged as a particularly important aspect of the support process and raises the obvious question – what determines satisfaction with spouse responses? Prior research by Lakey and Cassady (1990) has suggested that perceived satisfaction with support may function in part as a stable personality trait, demonstrating high correlations with cognitive variables such as self-esteem and dysfunctional attitudes, and low correlations with actual supportive behaviours. However, the current study demonstrated that when satisfaction with support is assessed repeatedly over a relatively brief period of time, ratings of satisfaction fluctuate within individuals, and these fluctuations have important implications for well-being. Although positive spouse responses were correlated with higher levels of satisfaction with support in the current study, they could not account for the beneficial effects of satisfaction with responses. Clearly, satisfaction with spouse support is more than a reflection of how much support was received. More recent conceptualizations of satisfaction with social support depict this construct as a complex combination of state and trait-like influences (Lakey & Scoboria, 2005). Future research is needed to increase understanding of factors that contribute to within-person fluctuations in satisfaction with support, including daily physical
symptoms (e.g., pain, fatigue), positive and negative affect, and attributions of supportive gestures. Previous cross-sectional work has emphasized the role of relationship satisfaction (Kaul & Lakey, 2003) and recipient and provider personality in predicting ratings of perceived support (Beach, Fincham, Katz, & Bradbury, 1996; Lakey et al., 2002). Further research regarding these and other recipient and provider characteristics (e.g., physical and mental health, attachment style), and relationship characteristics (e.g., history of past supportive and unsupportive responses) is also warranted. Daily diary designs, which allow for the simultaneous examination of within- and between-person factors, would be particularly well-suited to address these questions.

The majority of past research on the social context of catastrophizing has focused on ways in which spouse responses to pain behaviours may reinforce catastrophizing, with mixed results (Boothby et al., 2004; Keefe et al., 2004). However, in order to gain a more comprehensive understanding of how the social environment may reinforce and reduce catastrophizing, findings from the current study suggest the need for future studies to assess specific spouse responses to pain and distress, as well as patients’ satisfaction with these responses. As mentioned earlier, further research is needed to determine how spouses can respond to patients in a way that can reduce pain catastrophizing and its effects. Recent studies have found acceptance of pain (i.e., engagement in daily activities despite acknowledged pain, and a willingness to have pain present without attempting to avoid or reduce the pain) to be associated with improved functioning (McCracken, 1998; McCracken & Eccleston, 2005; McCracken, Vowles, & Eccleston, 2005). Within a dyadic context, these findings suggest that spouses may also play a role in patient acceptance of pain (McCracken, 2005).
The current findings add to a growing literature suggesting the importance of disaggregating the negative dimension of social support, and the unique predictive value of complaints and criticism from close others. In order to advance our knowledge in this area, further empirical investigation into the underlying taxonomy of the negative dimensions of support is needed, along with the development of measures reflecting these dimensions. It is also unclear whether different types of complaints and/or criticism are more predictive of outcomes than others. For example, complaints about how one is handling one’s illness may have different effects than complaints about personal qualities. The current study focused on how individuals coped with daily pain, but it would also be interesting to investigate how individuals coped specifically with perceptions of negative spouse behaviour.

On average, the present sample was characterized by infrequent reports of negative social exchanges and low levels of negative affect. In order to better understand the causes and consequences of negative interactions, it is recommended that future studies specifically target distressed and maritally distressed individuals. The likelihood of capturing more negative interpersonal events would also be increased by extending the length of the study period beyond the seven-day period that was used here.

The current study offers unique insights into social support processes as they unfold over the course of a day. However, the effects of support on outcomes within a day may be much different than the effects of these processes on more long-term outcomes (DeLongis & Holtzman, 2005; Rook, 2001). For example, although spouse avoidance did not predict within-day study outcomes, evidence suggests that a repeated, ongoing pattern of avoidance and withdrawal within the context of close relationships can eventually take its toll on both psychological well-being and relationship satisfaction (Preece & DeLongis, 2005). In the
same vein, satisfaction with spouse responses emerged as a coping resource in the current study by reducing levels of catastrophizing and its effects on negative affect. However, the extent to which spouses can protect against the long-term consequences of pain catastrophizing, or conversely, whether a repeated pattern of patient catastrophizing may actual erode supportive relationships, and interfere with both patient and spouse well-being remains unclear (Cano, 2004). These questions can be best answered using longitudinal studies that follow couples over the course of months and years.

The current study focused on the effects of social support on negative affect, pain, and catastrophizing. However, future research is needed to investigate how daily social support processes interrelate with other relevant outcomes, such as positive affect and other disease-related outcomes. For example, there is some evidence for domain-specific effects of social relationships on well-being, such that negative aspects of social relationships are more strongly associated with negative affect, whereas positive aspects (e.g., satisfaction with support, received support) relate more to positive affect (Finch, 1998; Lakey, Tardiff, & Drew, 1994). Further, although pain is often cited as the most problematic symptom of RA, patients also report significant difficulty with unpredictable and fluctuating levels of fatigue and ability to complete activities of daily living (Rupp et al., 2004; Suurmeijer et al., 2001). Thus, investigations into the extent to which support may influence daily fluctuations in these outcomes would be particularly valuable (Riemsma et al., 1998).

Similar to most previous research on the social context of chronic pain, the current study examined social support processes entirely from the perspective of the patient. However, in order to advance knowledge in this area, a more dyadic approach that includes an assessment of both patient and spouse perspectives, and how these perspectives interact to
predict well-being is warranted. This will allow researchers to answer unique and important questions that involve the concordance or discordance between patient and spouse reports, as well as the relative costs and benefits of giving versus receiving social support on well-being. Given that marital satisfaction has been shown to impact appraisals of social support in past research, attention to how relationship quality influences day-to-day supportive processes is also needed in future research (DeLongis et al., 2004; Turk et al., 1992).

Consistent with a higher prevalence of RA among women (Anderson et al., 1985), the current study examined social support processes in a predominantly female sample. Unfortunately, this precluded an in-depth analysis of gender differences in supportive processes. In a recent review of marriage and health, Kiecolt-Glaser and Newton (2001) reported that accumulating research suggests women show greater physiological responses to marital conflict and that these physiological changes tend to last longer among women than men. In the context of the current study, it remains unclear whether spouse complaints were associated with well-being because complaints are harmful to patients suffering from chronic pain, or whether complaints are important for women, or both. One way in which researchers may be able to disentangle gender effects from patient-caregiver effects in future research is to study populations in which the prevalence of disease is more equal across gender (Revenson, Abraido-Lanza, & Majerovitz, 2005).

In conclusion, the current study highlights the significant role of close relationships in promoting well-being among individuals living with rheumatoid arthritis. The main goal of this study was to examine the mechanisms through which spouse support influences well-being on a day-to-day basis, and findings suggest that pain catastrophizing may be an important link in this process. Unfortunately, the social context of pain catastrophizing has
received little attention in past research. Findings from this study suggest the need for continued research in this area, including an examination of how providers can best respond to exaggerated displays of pain and distress, and how to maintain relationships in the context of this maladaptive way of responding to pain. More broadly, this study demonstrates the utility of integrating social support and coping perspectives to obtain a more comprehensive understanding of patient adjustment to chronic pain (DeLongis & Holtzman, 2005; Schreurs & de Ridder, 1997).

In order for the social support literature to remain clinically relevant, further research on the psychological and biological pathways through which support influences well-being is essential. However, the current findings suggest that much greater attention needs to be given to understanding the determinants of perceptions of social support (Dunkel-Schetter & Skokan, 1990). In the current study, the extent to which participants were satisfied with daily spouse responses had important implications for well-being. However, the extent to which these ratings were based on internal psychological processes, external characteristics of the support environment, or an interaction between the two, remains unclear. Clearly, models of social support must take into account both intra- and interpersonal factors that influence the degree to which individuals feel supported in their day-to-day lives. Observational methods, as well as methods that take into account the perspective of both members of a couple will be valuable tools in helping to tease apart these issues in future research.
FOOTNOTES

1 A version of this dissertation has been accepted for publication in *Pain.*

2 Despite intensive recruitment efforts, daily diary data was obtained for only 30 spouses of the 69 married patients in the current study. Given the lack of power to conduct analyses of interest using the spouse data, only the patient daily diary data are included in the present analyses.

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

4 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, Bradley, Young, McDaniel, & Wise, 1985).

5 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).

6 Three items from the rumination subscale of the PCS were also included in the daily
diary protocol, and were selected based on those with the highest item-total correlation found in past research (Sullivan et al., 1995). In contrast to previous studies showing an association between pain rumination and pain-related outcomes (Sullivan et al., 1998), rumination was not significantly related to changes in pain or negative affect over the course of the day within the current study (i.e., $p > .10$ for all tests). Analyses also failed to demonstrate concurrent or lagged associations between any of the social support variables and pain rumination (i.e., $p > .10$ for all tests). This is inconsistent with past research showing that social support may help reduce rumination among individuals dealing with chronic stress (Nolen-Hoeksema, Parker, & Larson, 1994). Based on recommendations to drop non-significant effects from multi-level models (Kreft & De Leeuw, 1998; Snijders & Bosker, 1999), pain rumination was dropped from all analyses. This did not affect the pattern of results presented here. Findings highlight the importance of investigating the presence of differential outcomes and determinants of the different dimensions of pain catastrophizing.

Nonetheless, previous analyses conducted on a subset of this data suggest that patient reports of spouse responses are not purely based on internal psychological processes and are related to spouse reports in meaningful ways. For example, among the 30 patients and spouses who both completed the daily diary protocol, spouse reports of providing higher levels of positive responses to the patient were significantly related to patient reports of receiving higher levels of positive responses (DeLongis, Holtzman, Puterman, & Pomaki, 2005).

Although there is some evidence to suggest that different types of supportive responses may have different relations to study outcomes (Doeglas et al., 1994), an aggregate measure of positive spouse responses was used for several reasons. Preliminary analyses
revealed moderate to high intercorrelations among positive response subscales (r's ranging from .47 to .70). Exploratory HLM analyses also demonstrated that the three individual subscales (emotional, informational, instrumental) showed a virtually identical pattern of associations with study outcomes as the aggregate measure, and therefore did not add to our understanding of the association between positive spouse responses and well-being. Thus, in the interest of parsimony and issues of statistical power, it was deemed most appropriate to use a single positive spouse response scale.

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.

Based on recommendations by Biesanz (J. Biesanz, personal communication, February 6, 2007), a parallel set of multi-level analyses was also conducted using uncentred data. These analyses revealed virtually the same pattern of results as are presented here.

Preliminary analyses controlled for day of week and weekday/weekend effects on fluctuations in evening pain intensity, negative affect, and pain catastrophizing. The day of week contrasts used Sunday as the reference group. No evidence for these effects was found for evening negative affect or pain catastrophizing (i.e., p > .10 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 < .05) and higher levels of evening pain on Tuesdays (p < .08). However, once other study variables were entered into the model, these effects became non-significant (p > .10). Therefore,
weekday/weekend and weekday variables were dropped from all analyses presented here.

12 Given the high correlation between satisfaction with spouse responses and positive spouse responses, tests for multicollinearity were conducted using standard linear regression analysis. All variance inflation factors were less than 1.6, suggesting that multicollinearity was not a likely problem (Morrow-Howell, 1994).

13 This pattern of results suggests the presence of a cooperative suppressor effect (Paulhus, Robins, Trzesniewski, & Tracy, 2004). That is, at the bivariate level, satisfaction with spouse responses and positive spouse responses were significantly positively correlated. However, when these two predictors were entered together in the multi-level regression analysis, the beta coefficients of the predictors increased and had opposite signs. Supplementary analyses revealed that the beta coefficient for satisfaction with spouse responses increased from $b = -0.24, p < .05$ (when the model did not include positive spouse responses) to $b = -0.34, p < .01$ (when the model did include positive spouse responses) and the coefficient for positive spouse responses increased from $b = 0.19, p > .10$ (when the model did not include satisfaction with spouse responses) to $b = 0.36, p < .05$. Significance tests for suppressor effects are similar to those used for mediation (Paulhus et al., 2004). However, despite well-established statistical techniques for testing single-level mediational models such as the Sobel test (Sobel, 1982), to this author’s knowledge, methods have not yet been published for analysis of lower-level mediation (i.e., both predictors at Level 1) in random-intercept multi-level models. Therefore, no formal significance test was conducted here.

14 Although evening spouse complaints were associated with increases in evening pain severity ($p < .05$), this effect was non-significant when satisfaction with spouse responses was included in the model.
Again, these results are suggestive of a cooperative suppressor effect.

Supplementary analyses revealed that the beta coefficient for satisfaction with spouse responses increased from $b = -0.03, p > .10$ to $b = -0.05, p < .05$ and the coefficient for positive spouse responses increased from $b = 0.04, p > .05$ to $b = 0.07, p < .05$. 
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The following is an example of a null model using evening pain intensity:

Level 1: \[ Y_{ij}(\text{PM Pain Intensity}) = b_{0j} + r_{ij} \]

Level 2: \[ b_{0j} = \gamma_{00} + u_{0j} \]

The above model specifies evening pain intensity \((Y_{ij})\) at time point \(i\) for individual \(j\) as a function of \(b_{0j}\) and \(r_{ij}\). \(b_{0j}\) is composed of the grand sample mean of evening pain intensity across all participants and all evening time points \((\gamma_{00})\), plus the between-person residual parameter \((u_{0j}); \text{i.e., the difference between the grand sample mean and an individual’s own mean across all evening time points}\). Meanwhile, \(r_{ij}\) represents the within-person residual parameter \((i.e., the difference between an individual’s own mean across all time points and their level of pain intensity on that particular evening)\). Results of this model allow one to estimate the amount of between- and within-person variance being accounted for by subsequent models.
APPENDIX B

UBC Research Ethics Board Certificates of Approval