LIVING WITH SPINAL CORD INJURY: EXAMINING THE ROLE OF DAILY MOOD REGULATION, SOCIAL SUPPORT, AND CATASTROPHIZING IN PAIN

by

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ABSTRACT

Spinal cord injury (SCI) and the subsequent events resulting from such a life-altering event can present a host of impairments, stressors and challenges in many aspects of one’s life. Of the stressors and medical complications found in SCI, pain has been reported to be the most frequent and disabling condition that affects activities of daily living and social life for those living with SCI. Using an intensive longitudinal design, the current line of research examined the ways in which mood regulation, social support, and catastrophizing affect the experience of pain in a sample of 87 individuals with SCI. Following an initial interview, participants completed brief telephone interviews twice daily across five days. Hypotheses were tested using multilevel modeling, with daily measures nested within individuals. Study 1 examined the ways in which mood regulation impacted pain intensity both within and across days. Regulation of positive mood was found to prospectively predict decreases in pain intensity. In addition, an examination of gender differences revealed that some mood regulation processes significantly predicted changes in pain for women but not for men. Study 2 examined the moderating role of social support in the relationship between catastrophizing and pain. Perceptions of global support availability were found to buffer the deleterious effects of catastrophizing on pain. Specifically, catastrophizing was not significantly associated with subsequent changes in pain intensity for individuals perceiving high levels of support availability. For those with average or low levels of perceived support, catastrophizing prospectively predicted increases in pain. In addition, perceptions of critical responses from the support provider were also found to moderate the association between catastrophizing and pain. When perceptions of criticism were high, catastrophizing was found to prospectively predict increases in pain. In contrast, when perceptions of criticism
were at average or below-average levels, catastrophizing was not significantly associated with pain. Taken together, findings from these studies may aid in designing effective interventions for managing pain in individuals with SCI, by tailoring programs to individual needs based on their particular strengths in mood regulation and including close others in determining the most appropriate ways in which to provide support.
PREFACE

Together with my advisor, Dr. Anita DeLongis, I was responsible for the identification, formulation, and design of the project titled, *Examining Day-to-Day Stress and Coping Among Individuals with Spinal Cord Injury: Effects on Mood, Functional Ability and Health Status*. In addition, I was responsible for data collection, data management, and participant troubleshooting (with support from Dr. DeLongis and the assistance of undergraduate students). Formulation of all research questions and analyses of data reported herein were performed by me, with guidance from Dr. DeLongis.

I am the primary contributor and author of the work presented in this dissertation. The results reported in Chapter 2 are in preparation to be submitted for publication: Lam, M., & DeLongis, A. (in prep). *Mood regulation and the experience of pain in individuals living with spinal cord injury*. The results reported in Chapter 3 are in preparation to be submitted for publication: Lam, M., & DeLongis, A. (in prep). *The Social Context of Catastrophizing in the Experience of Pain in Individuals Living with Spinal Cord Injury*. All results were derived from the same aforementioned research project, for which I was responsible for data collection, data management, and data analysis. My co-author, Dr. DeLongis, assisted with data analysis and interpretation, and manuscript revisions. All research contained herein was approved by the UBC Behavioural Research Ethics Board (Project Title: “Examining Day-to-Day Stress and Coping Among Individuals With Spinal Cord Injury: Effects on Mood, Functional Ability and Health Status,” certificate numbers B04-0721 and H04-80721-003).
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To my dad:

After the millions of pages you’ve read, I’ve got a few more here, waiting for you.
CHAPTER 1: GENERAL INTRODUCTION

In Canada there are over 86,000 people living with SCI with an estimated 4,300 new cases of SCI annually (Noonan et al., 2012). Similar figures are reflected in the United States (U.S.), where there are approximately 273,000 people living with SCI¹ and an incidence of approximately 12,000 new cases per year (“Facts and Figures at a Glance | National Spinal Cord Statistical Center,” n.d.). The most common cause of traumatic SCI (T-SCI) is motor vehicle collisions, which in some countries account for up to 50 per cent of traumatic SCIs (Ackery, Tator, & Krassioukov, 2004). Falls, work related accidents, violence (predominantly stabs and gunshot wounds), sports and aquatic/diving injuries, self-inflicted injuries and suicide attempts comprise other major causes of traumatic SCIs (Ackery et al., 2004). Although estimates vary largely, nontraumatic SCI (NT-SCI) can account for up to 65 per cent of all SCIs. Common causes of NT-SCI include cancer, intervertebral disc disease, infection, vertebral injury and spinal cord vascular disease (McDonald & Sadowsky, 2002; van den Berg, Castellote, de Pedro-  

¹ The prevalence and incidence rates reported for the United States (U.S.) include only traumatic cases of SCI. There are currently no published reports of the prevalence or incidence rates of nontraumatic SCI in the U.S., and with the exception of a handful of studies in Australia and Canada (Noonan et al., 2012), little is known about the epidemiology of nontraumatic SCI. Estimation of the prevalence and incidence of nontraumatic SCI is challenging as there has been an absence of federal and state registries in the U.S. (McDonald & Sadowsky, 2002). In addition, as a result of the heterogeneous causes of nontraumatic SCIs, there is a lack of consensus on its definition and what diagnoses should be included (DeVivo, 2012; McDonald & Sadowsky, 2002). Despite these hurdles, conservative estimates suggest that prevalence of SCI would quadruple if nontraumatic cases were included (McDonald & Sadowsky, 2002). The current research on SCI include both traumatic and non-traumatic causes however, the majority of studies cited herein refer to traumatic causes of SCI.
Cuesta, & Mahillo-Fernandez, 2010). Unlike NT-SCI, where the ratio between genders is roughly equivalent, males comprise a substantial proportion of the T-SCI population, with some estimates surpassing 80 per cent (Ackery et al., 2004). In terms of age at the time of injury, T-SCI has predominantly affected a younger population with ages ranging from 20 – 40 years old worldwide. Interestingly Ackery and colleagues (2004) note a trend in the past decade towards an older average age at time of T-SCI in developed countries, with some mean ages for example in the mid-fifties.

According to Spinal Cord Injury Canada, it is estimated that SCI cost approximately $3.6 billion per year, of which $1.8 billion being direct health care expenses (“SCI Facts | Spinal Cord Injury Canada,” n.d.). Similarly, in the U.S., the annual spending on the treatment of T-SCI has been estimated to be $US 9.7 billion (Berkowitz, 1998). T-SCI has been found to be the second most expensive condition to treat in the U.S., ranking third among conditions necessitating the most lengthy stay in hospitals (Winslow, Bode, Felton, Chen, & Meyer, 2002). Over a lifetime, the costs per T-SCI patient have often been estimated to range from 2.1 million dollars to 5.4 million dollars (US dollars) (Cao, Chen, & DeVivo, 2011)

Among those living with SCI, there is a large degree of variability in paralysis and functional impairment, determined primarily by the level of injury (Maynard et al., 1997; McDonald & Sadowsky, 2002). Level of injury refers to the lowest point on the spinal cord where motor and/or sensory function is either decreased or absent injury (Maynard et al., 1997). In general, SCIs that are higher result in greater loss of movement and/or feeling. Tetraplegia (also referred to as quadriplegia) is an injury of the cervical spinal cord (levels C1-C8) which refers to weakness or paralysis in both the arms and legs. All parts of the body below the neck may be impacted, often resulting in dependencies on a respirator or other mechanical devices to
manage impaired involuntary functions such as breathing, and body temperature maintenance (Palmer, Kriegsman, Palmer, McDonald, & Sadowsky, 2008). Injuries to the thoracic (levels T1 – T12) and lumbar (levels L1 – L5) portions of the spinal cord result in paraplegia, which means weakness or paralysis of the legs. Although weakness in the torso may be an issue, functioning of the hands are not commonly affected in paraplegics. Sexual dysfunction, loss of bladder and bowel control and loss of sensation are common to tetraplegia, paraplegia as well as sacral injuries (levels S1 – S4) SCIs which are relatively rare (Palmer et al., 2008).

Although the level of injury reveals the location of the damage to the spinal cord, the type of injury details the amount of damage to the width of the spinal cord. Thus, in conjunction with the level of injury, SCIs are additionally categorized as either complete or incomplete (Palmer et al., 2008). A complete injury suggests damage to the spinal cord such that no sensory and motor function exists below the level of injury. With partial or incomplete injuries some motor and/or sensory function remains intact below the level of injury (Palmer et al., 2008). Incomplete injuries yield a variety of manifestations such that some individuals may have motor function but no sensations below the level of injury or vice versa, while others may have both movement and feeling, but on the right or left side only (Palmer et al., 2008).

1.1 Challenges and stressors in SCI

Although SCI itself demands substantial medical resources, people living with SCI quite often seek medical attention for a host of secondary conditions arising from SCI. Long term respiratory complications are a leading cause of morbidity and mortality in SCI, with pneumonia being the principal cause of death in chronic SCI (Devivo, Black, & Stover, 1993). Higher levels
of injury progressively impact lung volumes and the function of muscles responsible for respiration, leading to decreased inspiratory and maximal expiratory pressures (Roth et al., 1997). Bladder and bowel function constitutes another major secondary complication in SCI, with a substantial proportion of SCI patients dealing with such issues. At one year post-injury, only 34% and 41% of tetraplegics and paraplegics respectively could satisfactorily void their bladders without the aid of extrinsic bladder pressure or catheters (McKinley, Jackson, Cardenas, & DeVivo, 1999). At 20 years after injury these proportions declined to 22% for tetraplegics and 32.8% for paraplegics. As such, genitourinary complications are one of the most common reasons for rehospitalisation in SCI with issues including urinary tract infections, calculi in the kidneys, bladder, or ureter (i.e. kidney stones), and renal failure, (McKinley et al., 1999). Loss of motor function, which leads to reduced physical function and a sedentary lifestyle, has been found to contribute to a myriad of health problems in SCI. For example, as a result of extended periods seated in wheelchairs, pressure ulcers, lesions caused by unrelieved pressure on soft tissue covering bony areas such as the hips, are the most common secondary condition in SCI (McKinley et al., 1999). A recent review found that compared to ambulatory subjects, almost all risk factors for cardiovascular disease were more prevalent in subjects with SCI (Myers, Lee, & Kiratli, 2007). The authors note that physical inactivity of those living with SCI may contribute to high total cholesterol, blood pressure abnormalities, deep vein thrombosis, heart rhythm disturbances, and increased prevalence of obesity, insulin resistance, metabolic syndrome, and diabetes. Not surprisingly, cardiovascular mortality rates and mortality at younger ages were higher among those living with SCI than compared to able-bodied subjects (Myers et al., 2007). Other important secondary conditions include musculoskeletal issues such as loss of bone mineral density, fractures, and overuse injuries (Chiodo et al., 2007). For example, findings
from a study of men with SCI found that 61% met the World Health Organization criteria for osteoporosis while fractures had occurred after SCI in 34% (Lazo et al., 2001).

Activities of daily living that are taken for granted in a healthy population can often become extremely stressful and challenging following SCI. For example, up to 60% of respondents report impairments affecting self-care activities such as dressing, washing, toileting, and caring for body parts, while 30% identify difficulties with eating and drinking (Bloemen-Vrencken, Post, Hendriks, De Reus, & De Witte, 2005; Kirchberger et al., 2010). Not surprisingly, mobility is another significant issue for many people with SCI. A high proportion of those with SCI (68% - 96%) report impairment in changing and maintaining body position, transferring oneself, lifting and carrying objects, moving around, using transportation, and driving (Kirchberger et al., 2010). In terms of health issues, bladder (e.g. incontinence and urinary tract infections) and bowel regulation (e.g. incontinence, diarrhoea, constipation) are the two most commonly cited health concerns with up to 90% and 85% respectively of respondents reporting impairment in function (Bloemen-Vrencken et al., 2005; Kirchberger et al., 2010). Given the loss of function and sensation below the level of injury, another health concern for those with SCI is sexual functioning. Many men face significant changes in orgasm, arousal, erectile function and fertility. Although a large proportion of men remain concerned with the sexual satisfaction of both their partner’s and their own sexual satisfaction post-injury (Burns, Mahalik, Hough, & Greenwell, 2008), many are dissatisfied with their sex lives, experience a strong sense of sexual inadequacy, and have little sexual desire (Phelps, Albo, Dunn, & Joseph, 2001).

In addition to the stressors associated with activities of daily living, people with SCI face financial stressors that surpass the normal costs of living. For example, research estimates the
average initial hospital expenditures including acute care, rehabilitation and any rehospitalisation immediately following SCI to be $435,312 (2009 US dollars) (DeVivo, Chen, Mennemeyer, & Deutsch, 2011). Following recovery and rehabilitation, expenses in the first year post-injury averaged $65,246, which included an average of approximately $7,000 for home modifications to improve accessibility. After the first two years following SCI, annual costs for hospital expenses, other medical expenses, supplies and equipment were estimated to be $29,201 per year. Finally, expenses for personal assistance (i.e., nurse and homecare) cost an average of $45,837 per year. Actual costs of SCI varied greatly, depending primarily on the level of injury, with greater disability resulting in higher costs (DeVivo et al., 2011). Depending on the severity of the injury and the age at which the SCI occurred direct lifetime costs have been estimated to be between 2.1 million to $5.4 million dollars (Cao et al., 2011). Unfortunately for many with SCI, the financial strain due to such costs is further compounded by lowered rates of employment post injury. While up to 85% of individuals who sustain SCI are either pursuing an education or employed at the time of injury, only 13% to 67% report returning to work or school post injury (Lidal, Huynh, & Biering-Sorensen, 2007; Yasuda, Wehman, Target, Cifu, & West, 2002). Even if employment is secured, sustaining employment may be an issue as well as even fewer proportions of people with SCI report being currently employed (Conroy & McKenna, 1999). Furthermore, research comparing income before and after injury found that post injury, 47% of those surveyed to have no income (unemployed), 22% had less income, 13% had an equivalent income, and only 17% had higher incomes than pre-injury (Ramakrishnan, Loh, & Omar, 2011). Of those employed post-injury, fewer held managerial or professional positions in comparison to a substantial proportion finding work in clerical and data entry fields(Conroy & McKenna, 1999).
1.2 Pain

Of the stressors and medical complication found in SCI, pain has been reported to be the most frequent and disabling condition that affects activities of daily living (e.g. mobility, housework, sleep, self-care, and recreational activities) and social life for those living with SCI (Bloemen-Vrencken et al., 2005; Jensen, Hoffman, & Cardenas, 2005). In a recent study examining perceived causes of changes in function and quality of life, pain and loss of strength were identified with greater frequency than secondary health complications, emotional (e.g. stress, anxiety, depression) and social factors (e.g. finances, employment, family and relationship issues (Price, Kendall, Amsters, & Pershouse, 2004). Even when measurable change in function and quality of life had not occurred, individuals with SCI most frequently endorsed pain as a perceived threat to future changes function and quality of life. Indeed chronic pain presents a serious complication for many individuals, as it has been estimated to affect up to 96% of those with SCI, with 18-63% reporting severe, disabling pain (Dijkers, Bryce, & Zanca, 2009; Ravenscroft, Ahmed, & Burnside, 2000; Rintala, Loubser, Castro, Hart, & Fuhrer, 1998; Siddall, McClelland, Rutkowski, & Cousins, 2003; Turner, Cardenas, Warms, & McClellan, 2001). In contrast to paralysis and functional impairment, pain intensity has not been found to differ significantly by the level or completeness of injury (Dijkers M, Bryce T, & Zanca J, 2009). In fact, across varying levels of impairment, pain has been shown to be quite widespread with individuals reporting an average of 3.4 different pain locations both above and below the level of injury (Widerström-Noga, Felipe-Cuervo, & Yezierski, 2001). In addition, severity of chronic pain in persons with SCI has been shown to be substantially higher than that found in normative samples (Jensen et al., 2005).
For individuals with SCI, the pain experience can vary in a multitude of ways including location, severity, type and duration. Pain in those with SCI has been categorized into four broad categories which include: visceral, musculoskeletal, above-level neuropathic, and below-level neuropathic (Siddall, Taylor, & Cousins, 1997). Approximately 42% of those living with SCI report having musculoskeletal pain, which can result from the SCI itself, an injury following SCI, overuse or strain of the muscles, arthritic changes, or wear and tear of the joints, often from manual wheelchair use (Chiodo et al., 2007). Musculoskeletal pain is often described as dull, aching, and exacerbated by movement or exercise (Siddall et al., 2003). Neuropathic pain is another common form of chronic pain in SCI, with up to 36% and 24% of respondents reporting neuropathic pain at and below the level of injury respectively (Chiodo et al., 2007). Caused by abnormal signals from the nerves that were damaged by the SCI, neuropathic pain includes transitional zone pain, radicular pain, and central pain, dysesthetic pain, or diffuse pain, and manifests as sharp, burning, shooting, electric, or stabbing pain (Siddall et al., 1997). Visceral pain is less common in SCI and is associated with spontaneous, poorly localized, dull or cramping pain in the abdominal region. Given such variability in pain location, severity, type and duration, accurate identification of a specific cause or stimulus is often difficult, making it challenging to successfully treat (Siddall, Taylor, McClelland, Rutkowski, & Cousins, 1999).

Although initially viewed as a biophysical problem requiring medical or surgical solutions chronic pain has been increasingly conceptualized within contemporary biopsychosocial models that are now widely accepted in the general field of chronic pain research (Hadjistavropoulos et al., 2011; Perry, Nicholas, & Middleton, 2010). In fact, recent studies have shown the historical use of pharmacological treatments such as opioids to be ineffective suggesting that in conjunction with medication, holistic treatments including stress reduction, relaxation, and
exercise to be more efficacious (Chiodo et al., 2007). Given the challenges and stressors individuals with SCI face, the goal of the current body of research is to better understand the ways in which mood regulation, pain catastrophizing and the social environment impact the pain experience as it unfolds over time. As indicated below, these are factors that have been identified as important factors in the experience of pain in the larger literature on pain.

1.3 Emotion regulation

As defined by the International Association for the Study of Pain, “[pain is] an unpleasant sensory and emotional experience [emphasis added] associated with actual or potential tissue damage, or described in terms of such damage” (Merskey & Bogduk, 1994, p. 209) Indeed, a vast amount of research has provided evidence for the direct and interactive roles of sensory information and affective state (Gatchel, Peng, Peters, Fuchs, & Turk, 2007; Robinson & Riley, 1999). Emotional distress has been demonstrated to result from persistent pain, to precipitate pain symptoms, to moderate pain severity, and to perpetuate the experience of pain (Gatchel et al., 2007). For example, a wealth of research has demonstrated the ability of current mood to modulate reports of pain and tolerance to it. Negative emotions have been found to influence both pain and daily activities in a sample of children with sickle cell disease (Gil et al., 2003). Reciprocal associations between emotion and pain have also been demonstrated, such that affective responses to prior pain predict future levels of pain (Boersma & Linton, 2006). Levels of depression have also been consistently associated with chronic pain (Dima, Gillanders, & Power, 2013; Gatchel, 2004). For example, past episodes of depression have been found to predict future pain (Fifield, Tennen, Reisine, & McQuillan, 1998) as well as exacerbate the relationship between stress and pain (Zautra et al., 2007).
Given the relationship between emotions and pain, the ability to regulate one’s emotions may be important to the pain experience of individuals with SCI given the number of stressors they may encounter on a daily basis. Emotion regulation\(^2\) examines the ways in which individuals control which emotions they have, when they have them, and how such emotions are experienced and expressed (Gross, 1998). Gross’ process model of emotion regulation (1998) defined five sets of emotion regulatory processes: situation selection, situation modification, attentional deployment, cognitive change and response modulation (see Webb, Miles & Sheeran, 2012, for a review of the efficacy of specific strategies for regulation of emotions). Situation selection refers to approaching or avoiding specific places, people, or situations to regulate emotions. Situational modification entails altering a potentially emotion-eliciting situation in such a way as to prevent the generation of emotion. Situational selection or modification may represent pre-emptive ways in which to regulate emotions before they occur. In the context of pain, experimental studies have demonstrated that mood induction can predict subsequent changes in the pain experience. For instance, decreases in pain intensity have been found following positive mood induction by exposure to pleasant pictures (de Wied & Verbaten, 2001; Meagher, Arnau, & Rhudy, 2001), reading pleasant statements (Zelman, Howland, Nichols, & Cleeland, 1991), exposure to humorous audio recordings (Cogan, Cogan, Waltz, & McCue, 2012).

\(^2\) In his recent review on emotion regulation, (Koole, 2009) notes that although it is possible to distinguish semantically between emotion regulation, mood regulation, affect regulation, and coping with stress, the overlap between these constructs is considerable. Furthermore, he suggests that the borders between these constructs are not distinct and that regulation of emotions, moods, affect, and stress are fundamentally about changing basic states of feeling good and bad. Although the terms “emotion regulation” and “mood regulation” are found herein, they are considered to represent a common underlying construct, as evidenced by Koole’s support for a broader conception of emotion regulation.
1987), pleasant music (Good, 1996), and humorous film (Weisenberg, Raz, & Hener, 1998). These findings provide support for lowering pain intensity through emotion regulation via the selection of such pleasurable situations.

Attentional deployment refers to strategies such as rumination, concentration and distraction in which attention is directed either away or towards the emotion-eliciting situation or the emotions themselves. A recent meta-analysis suggests that of these strategies, distraction may be the most effective in regulating negative emotions, especially compared to the effects of concentration (Webb, Miles & Sheeran, 2012). Research examining attentional deployment in the context of pain has found reductions in pain intensity when attention has been diverted. For instance, distraction has been found to diminish reports of pain in laboratory settings (Campbell et al., 2010; Dahlquist et al., 2009) and during medical procedures (DeMore & Cohen, 2005; Simmons, Chabal, Griffith, Rausch, & Steele, 2003), however findings are equivocal in the context of chronic pain (Affleck et al., 1999; Newth & Delongis, 2004; Watkins, Shifren, Park, & Morrell, 1999) and may be influenced by individual differences (Hadjistavropoulos, Hadjistavropoulos, & Quine, 2000). In contrast to distraction, rumination refers to the tendency to perseverate on stressors, negative mood, and other self-related negative thoughts (Nolen-Hoeksema, 2004; Spasojević, Alloy, Abramson, Maccoun, & Robinson, 2003; Trapnell & Campbell, 1999). This inability to disengage from such negative thoughts has consistently demonstrated to predispose individuals to distress, depression (Davis, Lehman, Wortman, Silver, & Thompson, 1995; Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008; Puterman, DeLongis, & Pomaki, 2010; Robinson & Alloy, 2003) and to exacerbate pain and disability (Sullivan, Stanish, Waite, Sullivan, & Tripp, 1998).
Cognitive change refers to the modification of the evaluation of the emotion-eliciting events and includes such approaches as cognitive reframing, denial, reappraisal and downward social comparison. Cognitive reframing and reappraisal have been identified as common coping strategies and have been included in measures which have been used to assess the ways in which individuals respond to chronic pain (Folkman & Lazarus, 1980; Rosenstiel & Keefe, 1983; Smith, Wallston, Dwyer, & Dowdy, 1997). Finally response modulation refers to the direct influence of behavioural (e.g. via suppression of emotional expression), experiential or physiological responding (e.g. via drugs, exercise or biofeedback).

Although many emotion regulation strategies have demonstrated an association with decreased pain intensity in both experimental and nonexperimental studies, only a few studies have examined whether actual measured changes in emotion significantly impact the experience of pain beyond the confines of the laboratory setting. A handful of recent studies have utilized intensive longitudinal designs and multilevel modeling analyses to examine the relationship between emotion regulation (partially defined as measured changes in mood over time) and pain. In a variety of populations, regulation of both positive and negative emotions has been found to predict decreases in pain both across and within days (Connelly et al., 2007; Connelly et al., 2012; Paquet, Kergoat, & Dube, 2005). In a sample of individuals living with rheumatoid arthritis, (Connelly et al., 2007) found that maintaining favorable affective states or recovering from less than desirable affective states led to decreases in pain the following day. Similar effects have also been reported to occur within a day. For instance, Paquet et al. (2005) assessed hospitalized elderly patients within days across several weeks and found decreases in pain intensity were predicted by the overall number of regulated emotions as well as the regulation of anxiety. In a sample of children with juvenile idiopathic arthritis, Connelly et al. (2012) found
similar within day effects whereby upregulation of positive emotions following a period of low positive emotions and attenuation of high negative emotions predicted reductions in subsequent pain intensity. Although this formulation of emotion regulation has only recently been examined, taken together these findings suggest that emotion regulation may indeed play an important role in the experience of pain.

1.4 Pain catastrophizing

In contrast to emotion regulation, which can be viewed as an adaptive way of managing pain, catastrophizing is a maladaptive response to pain which has been identified as amongst the most important psychological factors in chronic pain (Keefe, Rumble, Scipio, Giordano, & Perri, 2004; Smeets, Vlaeyen, Kester, & Knoettnerus, 2006; Sullivan et al., 2001). Described as the tendency to exaggerate or magnify the seriousness or threat value of pain sensations, catastrophizing has been associated with reports of feeling worried, fearful and being unable to divert attention away from pain (Sullivan et al., 2001). Increasingly, research is clear in indicating that when individuals in chronic pain respond to their pain and its consequences in such an exaggerated negative manner, they tend to experience a host of negative outcomes, such as increased pain intensity (Edwards et al., 2010; Grant, Long, & Willms, 2002; Severeijns, Vlaeyen, van den Hout, & Weber, 2001; Tan, Jensen, Robinson-Whelen, Thomby, & Monga, 2001), greater psychological distress (Edwards et al., 2010; Severeijns et al., 2001), and functional disability (Severeijns et al., 2001; Sullivan et al., 1998). Indeed the relationship between pain and catastrophizing has been documented in a wide range of patient groups including rheumatoid arthritis (Holtzman & DeLongis, 2007; Sturgeon & Zautra, 2013), low back pain (Flor, Behle, & Birbaumer, 1993), surgery (Jacobsen & Butler, 1996), and mixed chronic pain (Sullivan & Deon, 1990). In samples of individuals with SCI, cross sectional
studies have found catastrophizing to be related to pain intensity, pain interference with activities of daily living, psychological distress, and pain related disability. (Giardino, Jensen, Turner, Ehde, & Cardenas, 2003; Turner, Jensen, Warms, & Cardenas, 2002; Wollaars, Post, van Asbeck, & Brand, 2007). Catastrophizing has also been found to mediate the relationship between pain intensity, psychological distress and functional disability (Ullrich, Jensen, Loeser, & Cardenas, 2007). The only longitudinal study examining pain and catastrophizing in SCI found baseline catastrophizing to predict greater pain interference and poorer psychological functioning after six months (Hanley, Raichle, Jensen, & Cardenas, 2008). Recent longitudinal and prospective studies of catastrophizing in individuals with acute pain (Edwards, Fillingim, Maixner, Sigurdsson, & Haythornthwaite, 2004; Granot & Ferber, 2005; Papaioannou et al., 2009) and chronic pain conditions (Covic, Adamson, Spencer, & Howe, 2003; Haythornthwaite, Clark, Pappagallo, & Raja, 2003) have found catastrophizing to be an important factor in predicting deleterious pain outcomes. For example, in a sample of individuals receiving lumbar fusion surgery, catastrophizing measured preoperatively predicted postoperative pain (Papaioannou et al., 2009). Finally, research utilizing daily process designs, which allow for a more fine grained examination of pain and catastrophizing as they unfold across time, have also found catastrophizing to predict changes in pain both within and across days (Holtzman & DeLongis, 2007; Keefe et al., 2004; Sturgeon & Zautra, 2013). In a sample of individuals with chronic pain, increases in catastrophizing in the morning, controlling for morning pain and negative mood, were related to increased evening pain intensity and negative mood (Grant et al., 2002). From cross-sectional studies to intensive longitudinal designs, research on catastrophizing and pain has advanced dramatically over the past 20 years. Accordingly, much recent research seeks to gain a more detailed understanding of this complex relationship by
examining moderating and mediating pathways through which catastrophizing affects the pain experience (Buenaver, Edwards, & Haythornthwaite, 2007; Cano, 2004; Cano, Leong, Heller, & Lutz, 2009; Sturgeon & Zautra, 2013).

One pathway through which catastrophizing may exacerbate pain and disability is through its effects on the social environment. Research suggests that pain not only functions as a sign of threat to the sufferer, but also engages people in the social environment (Craig, 2004; Hadjistavropoulos & Craig, 2002). The Communications Model of Pain (Craig, 2009; Hadjistavropoulos & Craig, 2002; Hadjistavropoulos & Craig, 2004; Hadjistavropoulos et al., 2011) provides a biopsychosocial conceptualization of pain, in which it serves as a means of communication to alert others to possible threat and to elicit empathy and care provision. In addition, the Communications Model of Pain considers the influence of the social environment in the experience of pain, by devoting attention to others’ perceptions of and responses to pain behaviours (Hadjistavropoulos et al., 2011). In line with this, The Communal Coping Model of catastrophizing and pain suggests that pain catastrophizing may not be just a maladaptive coping response contributing to increased pain, but may serve a communicative function to solicit desirable and/or reinforcing responses such as support or sympathy from close others (Sullivan et al., 2001; Sullivan, Tripp, & Santor, 2000; Thorn, Ward, Sullivan, & Boothby, 2003). Indeed, catastrophizing has been positively associated with a host of interpersonal responses including perceived solicitous responses (Cano, 2004; Giardino et al., 2003), perceived instrumental support (Keefe et al., 2003), perceived punishing responses (Buenaver et al., 2007), and perceived critical responses to pain (Boothby, Thorn, Overduin, & Ward, 2004). Such perceptions of solicitous, critical and punishing responses from support providers have been positively related to both pain intensity and depressive symptoms and provide evidence that the
social environment may be one pathway through which catastrophizing exacerbates pain outcomes (Sullivan et al., 2001).

1.5 Social support

Social support is defined as an exchange of resources between individuals intended to enhance the well-being of the recipient (Shumaker & Brownell, 1984). It conveys the information of being loved, cared for, esteemed, valued and bestows a sense of belonging (Cobb, 1976). An overwhelming amount of research has found reliable and strong associations between social support and better health outcomes (Berkman, Glass, Brissette, & Seeman, 2000; Uchino, 2004, 2006). For individuals with SCI, social support represents a key resource in meeting the challenges presented by functional limitations, secondary medical complications, financial stressors and pain. Social support has been examined as a significant factor in both health status and adjustment among individuals with SCI and generally mirrors findings of the broader literature on social support (Muller, Peter, Cieza, & Geyh, 2012). Studies of individuals with SCI have found social support to be associated with decreased risk of mortality (Krause & Carter, 2009) and morbidity, with a lower frequency of secondary medical conditions (Anson, Stanwyck, & Krause, 1993; Rintala, Young, Hart, Clearman, & Fuhrer, 1992; Saladin & Krause, 2009; Suzuki, Krahn, McCarthy, & Adams, 2007), health (McColl PhD, Arnold, Charlifue, & Gerhart, 2001) and disability problems (McColl et al., 2001). Global perceptions of well-being have also been positively associated with social support, with reports of increased quality of life, subjective well-being and satisfaction with life (Coyle, Shank, Kinney, & Hutchins, 1993; Hampton, 2004; McColl et al., 2001; McColl & Rosenthal, 1994; Post, Ros, & Schrijvers, 1999; Rintala et al., 1992; Rintala, Robinson-Whelen, & Matamoros, 2005; Sherman, DeVinney, &
Sperling, 2004). Moreover, research has demonstrated the beneficial influence of social support on mental health outcomes as evidenced by lower levels of depression (Beedie & Kennedy, 2002; Elliott et al., 1991; Elliott, Herrick, Witty, Godshall, & Spruell, 1992; Herrick, Elliott, & Crow, 1994; Kishi, Robinson, & Forrester, 1994; Hughes, Swedlund, Petersen, & Nosek, 2001; Stroud, Turner, Jensen, & Cardenas, 2006), anxiety (Kennedy & Rogers, 2000; Pollard & Kennedy, 2007; Rintala et al., 2005) and suicidal ideation (Beedie & Kennedy, 2002; Kishi, Robinson, & Kosier, 2001). With respect to pain, social support has been found to be associated with lower intensity in a handful of cross-sectional studies (Widerstrom-Noga, Cruz-Almeida, Felix, & Adcock, 2009). For example, individuals perceiving greater support from close others and their community reported less pain below the level of injury, compared to those perceiving less support (Anson et al., 1993). Another cross-sectional study found higher levels of perceived support to be associated with lower levels of pain catastrophizing but not pain intensity (Raichle, Hanley, Jensen, & Cardenas, 2007). The only longitudinal study examining the effects of social support on pain outcomes in those with SCI found lower baseline perceptions of support to be associated with more consistent pain assessed across a ten year period (Rintala, Hart, & Priebe, 2004).

Despite the well-documented benefits of social support, research has also demonstrated a number of ways in which the social environment can negatively impact adjustment for individuals with chronic illnesses or disability. Punishing or negative response from support providers, in the form of criticism, avoidant behaviour, irritation or frustration towards the patient or expressions of anger have been shown to have deleterious effects on well-being. In fact, research suggests that negative aspects of social relationships may be stronger predictors of health outcomes than are positive aspects (Helgeson, 1993; Jones, Rollman, White, Hill, &
In a variety of chronic pain populations, negative responses from the support provider have been reliably related with increased psychological distress and depression (Boothby et al., 2004; Cano, 2004; Helgeson, 1993; Manne & Zautra, 1989; Sherman, 2003). Negative behaviors from close others have also been associated with increased pain behavior (Romano, Jensen, Turner, Good, & Hops, 2000) and pain intensity (Flor, Kerns, & Turk, 1987; Giardino et al., 2003; Romano et al., 2000). Similar findings have been reported in studies examining patient-partner interactions in individuals with SCI. Patient reports of negative responses from close others have been associated with increased pain perception and severity (Conant, 1998; Summers, Rapoff, Varghese, Porter, & Palmer, 1991), pain related activity interference (Stroud et al., 2006), and depressive symptom severity (Boekamp, Overholser, & Schubert, 1996; Stroud et al., 2006).

The aforementioned findings on the beneficial and detrimental effects of support provider responses have been primarily addressed by cross-sectional methods that preclude the examination of support provision as it unfolds from moment to moment within a day. Studies employing a daily process design to test the effect of day-to-day supportive exchanges have found a beneficial role of support on physical functioning in chronically ill populations. For example, in a sample of older adults with vision loss, perception of received emotional support was associated with lower functional disability (Reinhardt, Boerner, & Horowitz, 2006). In another study of persons with rheumatoid arthritis, satisfaction with received support was found to attenuate the relationship between catastrophizing and pain as well as the association between catastrophizing and negative affect (Holtzman & DeLongis, 2007). Research utilizing such
methods have also demonstrated the deleterious effects of negative responses from close others (DeLongis, Capreol, Holtzman, O’Brien, & Campbell, 2004; Stader & Hokanson, 1998). For example dissatisfaction with support in the morning was found to indirectly affect pain intensity in the evening by encouraging the use of maladaptive coping strategies (Holtzman, Newth, & Delongis, 2004). Although a growing number of studies have employed daily process designs, such methods have yet to be utilized in examining the role that social support plays in the day-to-day lives of those with SCI and how changes in support across time are associated with the experience of pain.

1.6 Intensive longitudinal designs

Research on the psychosocial predictors of pain in SCI and in chronic pain populations more broadly have relied heavily on cross-sectional designs. For example, research addressing the effects of catastrophizing on pain has often asked participants to recall average levels of pain over a specific period of time and to report their general tendencies to catastrophize in response to such episodes. Findings from correlational studies must be interpreted with caution for a number of reasons. For instance, participant attempts to recall prior levels of pain intensity were found to be inaccurate, having given more weight to the most intense levels or most recent levels in their estimation of average pain (Stone, Broderick, Kaell, DelesPaul, & Porter, 2000). In addition, cross-sectional designs preclude the understanding of the temporal ordering of variables, thus preventing any causal inferences to be drawn from the data.

Intensive longitudinal designs allow for the examination of behaviours, thoughts, physiology and feelings as they occur in their natural contexts. Importantly, these designs can describe the unfolding of a temporal process, thus ruling out some possible causal pathways
Compared to traditional longitudinal designs which often assess participants a few times over long periods, intensive designs permit researchers to capture repeated measures of participant responses over shorter periods of time that reflect the underlying theory of change for a particular process (Bolger & Laurenceau, 2013). These designs, which include diary studies, are appropriate for examining a host of methodological issues including, time-lagged effects, intraindividual change, interpersonal differences in change, aggregated effects, and dyadic interdependence (Bolger, Davis, & Rafaeli, 2003). A growing number of studies have utilized daily process methodologies to examine the contributions of catastrophizing (Grant et al., 2002; Holtzman & DeLongis, 2007; Keefe et al., 2004; Sturgeon & Zautra, 2013) social support and emotion regulation (Connelly et al., 2007; Connelly et al., 2012; Paquet et al., 2005) in predicting adjustment in populations of chronic illness and disability.

Research utilizing daily process designs are increasingly relying on handheld electronic devices (e.g. smartphones, tablets) to collect data on the experiences of participants as they occur within a day. Compared to traditional pencil and paper diaries, the use of such technology can reduce the amount of manual data entry and provide an accurate record of the time after each completed assessment (Tennen, Affleck, Coyne, Larsen, & DeLongis, 2006). Given the possible functional limitations of some participants, the current study employed live telephone interviews to capture participant responses, as electronic devices may have been difficult to operate. This approach provides the opportunity to ask more detailed, open ended questions and can strengthen participant engagement and motivation, despite being more time and labor intensive than electronic alternatives (Hoppe et al., 2000).

Multilevel modeling (also known as hierarchical linear modeling) has emerged as the most appropriate method of data analysis for handling the repeated-measures data obtained in
daily process studies (Bolger & Laurenceau, 2013). Such modeling techniques provide an ideal framework to examine both between person differences and the within-person changes that occur over time. As pain, catastrophizing, emotion regulation, and interpersonal interactions are all dynamic processes which fluctuate within the course of a day, the current research utilized a daily process methodology and employed multilevel modeling to examine the relationships amongst these variables as they unfold over time.

1.7 Overview of the dissertation

The broad goal of the following studies was to examine the role of psychological and social factors (including emotion regulation, pain catastrophizing and social support) in the experience of pain in a sample of individuals with SCI. As research has demonstrated important differences between women and men in a number of these variables, the following set of studies also examined whether the hypothesized relationships were moderated by gender. This research seeks to gain a better understanding of these relationships, in order to extend the current research in SCI and inform possible intervention strategies for managing pain in this population. This body of research arises from a larger project entitled, *Examining day-to-day stress and coping among individuals with spinal cord injury: Effects on mood, functional ability, and health status.* Findings from the following set of studies are the first to be prepared for publication and are based on data collected from the same sample of individuals living with SCI.

Study 1 (Chapter 2) examines the prospective relationship between mood regulation and pain intensity. An empirically derived definition of mood regulation was employed to assess whether the ability (or inability) to maintain or recover desirable affective states prospectively predicted changes in pain intensity. Study 2 (Chapter 3) investigates the role of the social environment in the relationship between catastrophizing and pain. Specifically, the moderating
effects of perceptions of support and criticism from the support provider were examined in the prospective prediction of pain intensity from catastrophizing. The concluding chapter of the dissertation (Chapter 4) summarizes and integrates these findings and presents implications for the findings, limitations of the research, and recommendations for future research.
CHAPTER 2: MOOD REGULATION AND THE EXPERIENCE OF PAIN IN INDIVIDUALS WITH SPINAL CORD INJURY

For many individuals living with spinal cord injury (SCI), pain appears to be the most frequent and disabling condition affecting activities of daily living and social life (Bloemen-Vrencken et al., 2005). The pain experience can vary in a multitude of ways including location, severity, type and duration, making it difficult for proper assessment and successful treatment. The historical use of pharmacological treatments alone have been found to be largely ineffective suggesting that in conjunction with medication, alternative treatments such as stress reduction can be more efficacious (Chiodo et al., 2007). One possible process through which pain reduction interventions may be targeted is emotion regulation. Recent research has shown emotion regulation to play an important role in the experience of pain. Both experimental work (Masedo & Rosa Esteve, 2007; Quartana, Bounds, Yoon, Goodin, & Burns, 2010) and field studies (Connelly et al., 2007; Connelly et al., 2012; Paquet et al, 2005) have provided evidence that managing the experience and expression of emotions can influence the pain experience. A handful of recent studies have utilized intensive longitudinal designs and multilevel modeling analyses to examine the relationship between mood regulation and pain.

3 This chapter has been adapted from a version being prepared for submission: Lam, M., & DeLongis, A. (in prep). Mood regulation and the experience of pain in individuals with spinal cord injury. It has been modified to fit the format of this thesis.
In a variety of populations, regulation of both positive and negative emotions has been found to predict decreases in pain both across and within days (Connelly et al., 2007; Connelly et al., 2012; Paquet et al., 2005). In a sample of individuals living with rheumatoid arthritis, Connelly et al. (2007) found that maintaining favorable affective states or recovering from less than desirable affective states led to decreases in pain the following day. Similar effects have been reported to occur within a day (Connelly et al., 2012; Paquet et al., 2005). For example, Paquet et al. (2005) assessed hospitalized elderly patients within days across several weeks and found decreases in pain intensity were predicted by the overall number of regulated emotions as well as the regulation of anxiety.

**Gender Differences**

Research on emotion, emotion regulation and pain has found that such processes differ in important ways for men and women. Compared to men, who are viewed as tending to suppress or avoid the expression and experience of emotions, women are widely viewed as having greater tendencies to experience, express and dwell on their emotions (Barrett & Bliss-Moreau, 2009; Brody, 1993; Fischer & Manstead, 2000; Nolen-Hoeksema, 2012). Gender differences in emotion regulation have also been documented (Tamres, Janicki, & Helgeson, 2002). For example, women have been found to utilize a more diverse set emotion regulation strategies, report regulating their emotions more frequently (Nolen-Hoeksema & Aldao, 2011) and are more often successful at regulating their emotions than men (Paquet et al., 2005).

The investigation of sex and gender differences in the experience of pain has also garnered considerable attention over the past 20 years. In epidemiological and clinical studies women have been found to be at increased risk for many chronic pain conditions and also report higher acute pain following medical procedures (Fillingim, King, Ribeiro-Dasilva, Rahim-
Williams, & Riley, 2009). In studies of experimentally induced pain, women have been found to
display greater sensitivity (i.e., lower pain tolerance and pain threshold) across multiple pain
modalities compared to men (Fillingim et al., 2009; Fillingim & Maixner, 1995; Riley,

At present, studies on mood regulation and pain hint at the importance of future
interventions aimed at improving mood regulation with the ultimate goal of decreasing pain.
However, it remains unclear for whom such efforts would be best targeted. Given the
aforementioned differences between women and men, gender may be one plausible moderator of
the relationship between mood regulation and pain. The purpose of the present study is to
replicate previous findings in which mood regulation prospectively predicts decreases in pain,
both within and across days, and more importantly, to examine whether such effects differ
between women and men. Mood regulation has been operationalized as either maintenance or
recovery of desirable affective states (Paquet et al., 2005). Desirable affective states refer to
instances in which positive mood is higher than the individual’s average or negative mood is
lower than usual levels. Conversely, undesirable affective states refer to instances in which
either positive mood is lower than average or negative mood is higher than average. Thus,
maintenance of a desirable affective state refers to positive mood remaining above average or
negative mood remaining below average across two assessments. Recovery of a desirable
affective state refers to positive mood rising from below average levels to an individual’s
average or beyond, or negative mood decreasing from higher than average levels to average
levels or below. The following was hypothesized: a) maintaining positive or negative mood at
desirable levels would predict decreases in subsequent pain intensity, b) recovery of positive or
negative mood from undesirable levels would result in lower subsequent pain intensity c) when
either positive or negative mood is in a desirable state but cannot be maintained increases in pain intensity are expected and d) the inability to recover from less than desirable positive or negative affective states predict increases in pain intensity. Given the gender differences in the experience of both pain and emotion, it was further hypothesized that: e) mood regulation (i.e. maintenance or recovery of desirable affective states e) would result in greater decreases in pain for women than men, and f) the inability to maintain desirable affective states or recover from undesirable affective states would predict greater increases in pain intensity for women compared to men.

2.1 Methods

Recruitment was completed in conjunction with the British Columbia Paraplegics Association (BCPA). In accordance with confidentiality agreements with their patients, researchers were not granted access to patient names and addresses for recruitment purposes. An employee of the BCPA was remunerated for mailing and tracking prepared recruitment letters, and provided details on the number of letters mailed. The letter invited interested persons to phone the research center at which time the project manager provided a basic overview of the study, determined eligibility, and if appropriate, scheduled a convenient time for an in-person interview.

Eligibility criteria required participants to have a SCI, be 18 years of age, and have a working knowledge of both written and spoken English. Immediately following their SCI, patients typically undergo treatment and intensive rehabilitation to maximize the chances of recovery. As such, patients within the first year following their injuries are often inundated with requests to participate in research focused on the effective means of treatment and rehabilitation. To prevent patients from becoming overwhelmed and overburdened by research and given the
important differences between early post-acute and long-term adjustment to SCI (Kirchberger et al., 2010) only those patients who were a minimum one year post-injury were sent recruitment letters. As an expression of gratitude for their participation, all participants received $15 for each completed phase of the study, for a maximum of $45.

*Phase 1.* A trained interviewer met with the participant at either their residence or in the lab. After consent was obtained, the initial interview was conducted to assess a host of variables including, (1) basic demographics, including age, gender, ethnicity, socioeconomic status and marital status (2) details of the SCI, including the cause, date of injury, level of injury, whether the SCI was complete or incomplete, and current functioning of upper and lower body, and use of arms and legs and (3) any medications participants were taking. This initial interview took approximately 45 minutes to finish. Upon completion of the initial questionnaire, the interviewer distributed materials necessary for phases two and three.

*Phase 2.* In the second phase, participants were given the choice of completing a questionnaire booklet on their own, with the assistance of their caregiver or other support person if needed, or with a member of our research team – either over the telephone or in-person. The questionnaire required approximately 45 minutes and involved the assessment of key individual difference variables.

*Phase 3:* The final phase followed participants over a five day span. Each day a trained interviewer contacted participants by telephone approximately six and 12 hours after waking. These brief, twice-daily interviews lasted 10-15 minutes and assessed a number of variables including mood (Derogatis, 1975) and pain. Wherever possible, daily interview questions were derived from established and validated psychometric scales to ensure valid and reliable
measurement of desired constructs. In these situations, a small number of items were chosen from each scale based on those which best represent the target construct (and those aspects which were most relevant to the study). Some items were reworded to reflect their use in a daily diary format (e.g., Affects Balance Scale; Derogatis, 1975).

**Measures**

*Level of injury.* Among those living with SCI, there is a large degree of variability in paralysis and functional impairment, determined primarily by the level of injury (Maynard et al., 1997; McDonald & Sadowsky, 2002). Level of injury refers to the lowest point on the spinal cord where motor and/or sensory function is either decreased or absent (Maynard et al., 1997). In general, SCIs that are higher result in greater loss of movement and/or feeling. Tetraplegia (also referred to as quadriplegia) is an injury of the cervical spinal cord (levels C1-C8) which refers to weakness or paralysis in both the arms and legs. Injuries to the thoracic (levels T1–T12) and lumbar (levels L1–L5) portions of the spinal cord result in paraplegia, which means weakness or paralysis of the legs.

*Type of injury.* Although the level of injury reveals the location of the damage to the spinal cord, the type of injury details the amount of damage to the width of the spinal cord. Thus, in conjunction with the level of injury, SCIs are additionally categorized as either complete or incomplete (Maynard et al., 1997; Palmer et al., 2008). A complete injury suggests damage to the spinal cord such that no sensory and motor function exists below the level of injury. With partial or incomplete injuries some motor and/or sensory function remains intact below the level of injury (Palmer et al., 2008). Incomplete injuries yield a variety of manifestations such that some individuals may have motor function but no sensations below the level of injury or vice
versa, while others may have both movement and feeling, but on the right or left side only (Palmer et al., 2008).

Cause of injury. The causes of SCIs are categorized as either traumatic or non-traumatic. Of the causes of traumatic SCIs motor vehicle collisions are the most common and can account for up to 50 per cent of traumatic SCIs in some countries (Ackery et al., 2004). Falls, work related accidents, violence (predominantly stabs and gunshot wounds), sports and aquatic/diving injuries, self-inflicted injuries and suicide attempts comprise other major causes of traumatic SCIs (Ackery et al., 2004). Although estimates vary largely, non-traumatic SCIs can account for up to 65 per cent of all SCIs. Common causes of non-traumatic SCIs include cancer, intervertebral disc disease, infection, vertebral injury and spinal cord vascular disease (van den Berg et al., 2010). Participants were asked to describe the event leading to their SCI which was then coded as traumatic or non-traumatic (Table 2.1).

Pain intensity. Patients indicated 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 shown good validity in previous research, demonstrating significant associations with other measures of pain intensity (Jensen, Karoly, & Braver, 1986).

Negative mood. Negative mood was assessed using the average of three items (sad, hopeless, worthless) from the Affects Balance Scale (Derogatis, 1975), which has been shown to have good internal consistency in prior research (Northouse & Swain, 1987). Participants were asked to indicate the extent to which each word described how they felt “so far today/since [the participant and interviewer] last spoke” on a 7-point Likert scale (1 ('not at all') to 7 ('very much')). The reliability of within subject change for this abbreviated scale was assessed using the
focal reliability measure (Bolger & Laurenceau, 2013; Cranford et al., 2006), which was found to be acceptable ($R_C = .72$).

**Positive mood.** Positive mood was assessed based on the average of three items (happy, glad, cheerful) from the Affects Balance Scale (Derogatis, 1975). Again, participants were asked to indicate the extent to which each word described how they felt “so far today/since [the participant and interviewer] last spoke” on a 7-point Likert scale (1 (‘not at all’) to 7 (‘very much’)). The reliability of within subject change for this abbreviated measure of positive mood was high ($R_C = .87$).

**Mood regulation**

Consistent with previous research (Carstensen, Pasupathi, Mayr, & Nesselroade, 2000), mood regulation was operationalized as maintaining or recovering desirable affective states. For each participant, average values for negative and positive mood were calculated based on ten assessments of negative and positive mood taken over five days. A desirable affective state was defined as either lower than average negative mood or as higher than average positive mood. An undesirable affective state was observed when negative mood was above an individual’s mean or positive mood was below an individual’s mean. This approach resulted in scores for two basic types of mood regulation: maintenance across two time points of an affective state at a level that is more desirable than one’s average and recovery of an affective state from a less than desirable level to one’s average or beyond (please refer to Table 2.3 and Figure 2.1).

**Negative mood maintenance.** Participants were considered to have maintained low intensity of negative mood across two consecutive time points if their level of negative mood was below their own mean at both previous and current time points (i.e., either the morning and evening of
the same day, or the evening and the following morning). **Positive mood maintenance.** When positive mood remained higher than the individual’s average across two consecutive time points positive mood maintenance was assessed as present. **Negative mood recovery.** Negative mood was considered to be recovered when negative mood was higher than average at one time point, then “recovered” to at or below average by the next time point. **Positive mood recovery.** Similarly, the occurrence of positive mood recovery was considered to have occurred when positive mood was reported below the individual’s average for positive mood, but rose to or beyond their mean by the subsequent measurement point. Dichotomous variables were created for positive and negative mood recovery and maintenance, each taking the value of 1 if regulation had been observed and 0 if absent.

**Mood non-regulation**

A thorough search of the literature revealed no previous studies examining mood regulation as defined here that have explored instances in which individuals were unable to regulate their mood. Following from the operational definitions above, this inability to regulate mood could be described as either non-maintenance or non-recovery. Non-maintenance would indicate instances in which the individual could not maintain a desirable affective state across two consecutive assessments. Non-recovery describes situations in which individuals remain at an undesirable affective state across two assessments, unable to recover at the subsequent time point (please refer to Table 2.3 and Figure 2.1). **Negative mood non-maintenance.** Non-maintenance of negative mood occurred when negative mood rose from a desirable level (i.e. below average) to the individual’s average or beyond at the subsequent assessment. **Positive mood non-maintenance.** When current positive mood was above an individual’s average but dropped to or below their average at the following assessment, non-maintenance was assessed as
having occurred. *Negative mood non-recovery.* Negative mood non-recovery was noted when negative mood remained higher than average across current and subsequent time points. *Positive mood non-recovery.* Similarly, the occurrence of positive mood non-recovery was said to be present when positive mood remained below an individual’s average across two consecutive time points. Again, dichotomous variables were created for positive and negative mood non-recovery and non-maintenance, each taking the value of 1 if non-regulation had been observed and 0 if absent.

Given the manner in which mood regulation and non-regulation variables were defined and coded, a number of intercorrelations were expected and found amongst these variables (see Table 2.4). First, zero values for mood maintenance captured instances in which recovery could have occurred, and vice versa. Similarly, zero values for non-maintenance captured instances in which non-recovery could have occurred, and vice-versa. Indeed, small to moderate correlations between maintenance and recovery (as well as non-maintenance and non-recovery) processes were found (see Results and Table 2.4). For example, positive mood maintenance was found to be significantly and negatively correlated with positive mood recovery.

Second, zero values indicating an absence of non-regulation captured instances in which mood regulation occurred. Similarly, for regulation, zero values included instances in which non-regulation occurred. As described in the results section (also see Table 2.4) significant small to moderate negative correlations were found between related mood regulation and non-regulation processes (i.e. between maintenance and non-maintenance or recovery and non-recovery). For example, maintenance of positive mood was significantly correlated with non-maintenance of positive mood.
Mood regulation variables were also related along affective dimensions such that positive correlations were found between positive and negative mood (non-) regulation processes. For example, positive mood maintenance was significantly correlated with negative mood maintenance. Given these patterns of relationships, two separate sets of models were examined in order to account for the shared variances among predictors. The first set of models examined the impact of mood regulation on pain (i.e., Pain = Positive mood maintenance + positive mood recovery + negative mood maintenance + negative mood recovery) and the effect of non-regulation on pain (i.e. Pain = Positive mood non-maintenance + positive mood non-recovery + negative mood non-maintenance + negative mood non-recovery). This first set of models accounted for intercorrelations that might exist between maintenance and recovery or non-maintenance and non-recovery. The second set of models predicting pain from variables grouped in terms of either maintenance/non-maintenance (e.g. pain = positive mood maintenance + positive mood non-maintenance + negative mood maintenance + negative mood non-maintenance) or recovery/non-recovery (e.g. pain = positive mood recovery + positive mood non-recovery + negative mood recovery + negative mood non-recovery). This second set of models accounted for intercorrelations between regulation and non-regulation for each specific process (e.g. positive mood maintenance and positive mood non-maintenance). In addition, both sets of models accounted for correlations between affective dimensions of regulation and non-regulation processes. For example, whenever a positive mood regulation process was modeled, the negative mood regulation counterpart was also included (i.e., negative mood recovery was always included when positive mood recovery was modelled). For the sake of brevity, only findings from the first set of models are presented and discussed, however both models yielded similar results.
Participants

All 94 interested individuals who contacted our research coordinator met eligibility requirements. Of these, 82 (87.23%) completed all three phases of the study, while nine individuals (9.57%) completed two phases and the remaining three (3.19%) participated only in the initial interview. On average, individuals who did not fully participate in the study did not differ significantly on SCI and demographic variables, when compared to individuals who had completed all three phases of the study.

Eighty seven individuals completed the twice daily interview component of the study, for which the response rate was high. Of the 870 possible time-points, participants in the final sample completed 96.5% of those interviews. Ninety one percent of the 87 participants completed all daily questionnaires twice daily across the five days. Six individuals were excluded from the final analyses as they did not have consecutive reports of affect, making it difficult to determine whether mood regulation had occurred. One additional participant was omitted due missing information for a number of control variables. Excluded individuals did not significantly differ on demographic and study variables compared to those included in the study. The final sample of 80 participants was predominantly male (67.5%), Caucasian (84.8%), and had an average age of 49.20 years (ranging from 18-78). About half of participants (52.50%) were married or living common law, with others single (33.75%), divorced/separated (8.75%) or widowed (2.5%). Approximately one third (35%) of respondents reported being employed, while the remainder were either unemployed (33.30%) or retired or receiving disability benefits (31.70%). Estimates of annual income before taxes averaged $35,392, with a median of $21,600. The level of injury for the majority of respondents was primarily cervical (50.0%) or
thoracic (42.3%) and injury severity was reported to be complete (versus incomplete) by 56% of the sample. A high proportion of respondents (87.34%) reported the cause of their SCI to be traumatic. At the time of interview, participants had been living with SCI for an average of 18.42 years (SD = 13.66), with injuries occurring at an average age of 31.59 years (SD = 15.11) (Table 2.1). Within person averages were calculated for Level 1 (daily interview) study variables and then averaged across the sample (Table 2.2). Participants reported an average level of pain intensity\(^4\) of 3.11 (SD = 2.04). Average scores for positive mood were 4.66 (SD = 1.27) and 1.43 (SD = 0.72) for negative mood.

2.2 Data analysis

Multilevel regression analyses were conducted using hierarchical linear modeling (HLM) software (version 6.0; Raudenbush, Bryk, Cheong, & Congdon, 2004). A multilevel approach using HLM offers several advantages, including its ability to adequately deal with missing data and examine associations between predictors and outcomes while taking into account dependence in the data that arises from the repeated measurement of the same variables for each participant across multiple assessments. Using HLM, within-person variation was modeled at Level 1 and between-person variation was modeled at Level 2, allowing for the simultaneous examination of both 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

\(^4\) During phase one of the study, participants were asked to rate the severity of their pain over the past week. Across the sample, this average (4.92) was similar to retrospective reports of pain intensity found in other SCI samples (Hanley, Raichle, Jensen, & Cardenas, 2008; Jensen, Hoffman, & Cardenas, 2005; Turner, Cardenas, Warm, & McClellan, 2001). Interestingly, the average of within day averages for pain intensity reported here (3.11) was much lower than the average reported during phase one.
specification of between-person variation, the Level 1 regression parameters were used to estimate average parameter estimates across all subjects as well as the amount of variation around this average.

Repeated measures data that were collected twice daily across five days were added at Level 1. Measures that were collected during phases 1 & 2, such as demographic and SCI related variables were added at Level 2. A fully random model was specified for all analyses, whereby the intercepts and slopes of the outcome and predictor variables were allowed to vary freely. In all models continuous level 1 variables were centered around each individual’s mean and continuous level 2 variables were grand mean centered around the sample mean. Such centering allowed for a more meaningful interpretation of coefficients, significantly reduced multicollinearity in the data, and removed the confound of slope and intercept variance (Kreft, de Leeuw, & Aiken, 1995; Kreft, Kreft, & Leeuw, 1998). Binary variables gender, mood regulation (maintenance and recovery of positive and negative mood) and non-regulation (non-recovery and non-maintenance) were left uncentered.

All multilevel models testing the effects of mood regulation or non-regulation on pain initially included the level 1 variable time (time-point) to control for any time related trends in responses. The level 2 variables gender, years since injury, level of injury, completeness of injury, and age were also included in order to control for possible between-person differences in pain. These control variables were dropped from subsequent analyses as tests of their

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5 Estimated annual income was initially included as a level-2 control variable and was found to be a significant predictor of average pain, ($\beta = .01, p < .05$). However, the inclusion of this variable did not affect the significance of the findings, and therefore it was removed from analyses for power considerations.
coefficients were not found to be significant (i.e. $p > .05$). Each of the final models predicting current pain from either mood regulation or non-regulation included controls for previous pain, prior positive and negative mood and use of pain medication (all at level 1). To examine the independent effects of mood regulation (or non-regulation) on current pain, prior reports of pain were included as a covariate to control for the high correlation between successive reports of pain intensity. Given the well-established relationship between mood and pain, prior levels of both positive and negative mood were also included as level 1 controls, in order to assess the impact of mood regulation above and beyond the contributions of mood itself. For example, the level 1 model predicting current pain from positive and negative mood regulation was specified as $\text{Pain}_{ij} = \beta_{0j} + \beta_{1j} (\text{positive mood maintenance})_{ij} + \beta_{2j} (\text{positive mood recovery})_{ij} + \beta_{3j} (\text{negative mood maintenance})_{ij} + \beta_{4j} (\text{negative mood recovery})_{ij} + \beta_{5j} (\text{pain})_{(1-i)j} + \beta_{6j} (\text{positive mood})_{(1-i)j} + \beta_{7j} (\text{negative mood})_{(1-i)j} + \beta_{8j} (\text{use of pain medication}) + r_{ij}$. At level 2, gender and also individual averages for both positive and negative mood were included as controls for between-person differences in pain intensity. For example, $\beta_{00} = \pi_{0j} + \pi_{01} (\text{gender}) + \pi_{02} (\text{average positive mood}) + \pi_{03} (\text{average negative mood}) + r_{ij}$.

2.3 Results

Frequency of mood regulation and non-regulation

For positive and negative mood, Table 2.3 provides the proportion of occurrences for mood regulation and non-regulation, (1) by type (e.g. recovery or non-maintenance of desirable affective levels) and (2) by the overall proportion of regulation and non-regulation. Averaging across positive and negative mood, mood regulation occurred 55.15% of possible episodes, with
maintenance and recovery of desirable states occurring 37.68% and 17.47% respectively. The inability to maintain or recover to desirable mood states occurred 15.08% and 13.33% of episodes respectively, totalling 28.41% of episodes in which non-regulation occurred. To assess the degree to which individuals concurrently maintained or recovered or failed to maintain or recover their mood, phi coefficients were calculated for regulation and non-regulation of both positive and negative mood. Results reported in Table 2.4 indicate significant positive relationships between positive and negative mood with respect to maintenance, recovery, non-maintenance and non-recovery, such that the presence of a specific form of positive mood regulation was related to the presence of the same specific form for negative mood. Given the manner in which mood regulation (and non-regulation) was operationalized into binary variables it was not surprising to find a number of negative associations. First, recovery and maintenance of (and the failure to recover and maintain) desirable mood states was found to be significantly and negatively correlated. In other words maintenance of a desirable mood was associated with the absence of recovery, and vice versa. Second, for both positive and negative mood, a significant inverse relationship was found such that the presence of mood regulation (either maintenance or recovery) was related to the absence of the inability to regulate one’s mood (both non-maintenance and non-recovery).

**Gender Differences**

Each individual’s mean and standard deviation was calculated for the variables of interest across the diary component of the study. From these values mean differences between women and men were examined using independent samples t-tests (α=.05). No significant differences were found between men and women with respects to mean levels of pain intensity, pain medication use, positive or negative mood, and frequency of regulation and non-regulation of
mood. Similarly, no significant gender differences were found in the variability in pain intensity, positive or negative mood. In addition, independent samples t-tests and chi-square tests ($\alpha=.05$) of demographic variables (Table 2.1) did not reveal any significant gender differences, with the exception of estimated pre-tax income. Specifically, men estimated a significantly higher pre-tax income than women, $t(66) = -2.49, p < .05$. Finally, Fisher z-transformations and z-tests were employed to determine whether correlations between mood regulation processes differed between men and women (Table 2.5). No significant differences were found ($\alpha=.05$).

**Mood regulation and subsequent pain**

To examine whether mood regulation prospectively predicted pain, positive mood maintenance and recovery and negative mood maintenance and recovery were simultaneously modelled while controlling for previous levels of pain, prior positive and negative mood, average levels of positive and negative mood, and use of pain medication. Regulation of positive mood but not negative mood was found to prospectively predict changes in pain. Specifically, positive mood recovery was found to predict decreases in subsequent pain ($\beta = -.35, p < .05$) after controlling for previous levels of pain, prior positive and negative mood, average positive and negative mood, and use of pain medication. Here decreases in pain were predicted when positive mood was recovered from a lower than average level to or beyond the individual’s average. The remaining mood regulation processes of positive mood maintenance, negative mood maintenance, and negative mood recovery were not significant predictors of pain (Table 2.6 model 1).

Next, possible between-person (level 2) moderators of the relationship between mood regulation and pain were examined. In separate models, cross-level interactions between gender
and each of the four mood regulation processes were added to the model discussed above. A significant interaction between gender and positive mood maintenance was found ($\beta = .39, p < .05$) suggesting that positive mood maintenance was beneficial for women but not for men with regards to pain (Table 2.6, model 2). A test of simple slopes revealed that positive mood maintenance significantly predicted decreases in subsequent pain ($p < .05$) for women but not for men (see Figure 2.2). Gender was not however found to interact with positive mood recovery, negative mood maintenance or negative mood recovery.

**Mood non-regulation and subsequent pain**

Next, the impact of the inability to effectively regulate mood was examined by prospectively predicting pain from positive and negative mood non-maintenance and non-recovery, controlling for prior pain, prior levels of negative and positive mood, average levels of positive and negative mood, and prior medication use. The non-recovery of positive mood from lower than average levels was found to significantly increase subsequent levels of pain ($\beta = .44, p < .05$). In other words, pain was predicted to increase when positive mood remained below-average across two consecutive measurements. The inability to recover from above-average levels of negative mood or maintain high positive mood or low negative mood did not significantly predict subsequent pain (see Table 2.7, model 1).

Next, possible between-person (level 2) moderators of the relationship between mood non-regulation and pain were probed. In separate models, cross-level interactions between gender and each of the four mood non-regulation processes were added to the model mentioned above. First, gender was found to significantly interact with positive mood non-recovery ($\beta = -.77, p < .01$), but not with negative mood non-recovery or positive and negative mood non-
maintenance (Table 2.7, model 2). The interaction between gender and positive mood non-
recovery suggests that pain is significantly higher for women when positive mood cannot be
recovered from below-average levels to the individual’s average or beyond. For men, the
inability to recover from low levels of positive mood did not predict changes in subsequent pain
(Figure 2.3). Gender was not found to be a significant moderator of the relationship between
pain and the remaining three mood non-regulation processes of positive mood non-maintenance,
negative mood non-maintenance and negative mood non-recovery.

2.4 Discussion

The purpose of the present study was to examine how mood regulation prospectively
impacts the pain experience in a sample of individuals living with SCI. Using multilevel
modeling techniques, support was found for a number of the proposed hypotheses. First,
positive mood recovery was found to predict decreases in subsequent pain intensity. When
individuals were able to raise positive mood from less than desirable levels to or beyond their
average, they experienced significantly lower levels of pain. Conversely, the inability to recover
from lower than average levels of positive mood predicted increases in pain. That is when
positive mood remained below average across two consecutive time-points individuals
experienced significantly higher pain intensity. These findings remained significant even after
controlling for use of pain medication, previous levels of pain intensity, previous positive mood
and previous negative mood. In addition, models controlled for average negative and positive
mood suggesting that these relationships between mood regulation and pain remain, independent
of the effects of average negative and positive mood. Findings from the present study provide
support to current models of pain. For example, Melzack’s (1999) neuromatrix theory of pain
considers emotional processing to be a central component in the experience of pain. Indeed,
mood regulation may serve to reduce the amount of input to the cognitive-evaluative neuromodule of the body-self neuromatrix, thus decreasing output that serves to influence the pattern of pain. In addition, the present finding fit well with similar studies which have also utilized intensive longitudinal designs to examine the role of emotion regulation in the experience of pain (Connelly et al., 2007; Connelly et al., 2012; Paquet et al., 2005).

Given gender differences in the experience of pain and mood regulation, the current study also sought to examine whether the relationship between mood regulation and pain intensity differed for men and women. As hypothesized, gender differences were found such that women’s but not men’s pain experiences were significantly impacted by certain mood regulation processes. Specifically, positive mood maintenance was found to significantly decrease the experience of pain for women, but not for men. When women maintained their positive mood at higher than average levels over two consecutive time points, overall significant decreases in pain intensity were found. Findings also suggest that the inability to recover positive mood tended to result in increased pain intensity for women but not for men. Men’s inability to recover from lower than average levels of positive mood did not predict significant changes in pain intensity. For women however, significant increases in pain intensity were found when positive mood remained below average over two consecutive assessments. These findings support and extend the extant literature in which the choice of mood regulation strategies, the efficacy of such strategies and the variability of the pain experience has been shown to differ between women and men (Keefe et al., 2004; Paquet et al., 2005).

Although the present study found support for the hypotheses that mood regulation would predict reduced pain intensity, this was only supported for the regulation of positive mood. Both maintenance and recovery of negative mood were not found to be significant predictors of
decreases in subsequent pain. Furthermore, the inability to maintain lower than average negative mood or recover from higher than average levels of negative mood were not related to subsequent increases in pain intensity. In contrast to past research that utilized similar daily process methods (Connelly et al., 2007; Connelly et al., 2012; Paquet et al., 2005), regulation of negative mood did not predict changes in the pain experience in this study. One possible explanation for the inconsistency in these findings may be in the choice of adjectives used to operationalize negative mood. In the present study negative mood was assessed using low arousal, negatively valenced terms (e.g., sad, worthless, and helpless). In comparison, previous research (Connelly et al., 2007; Connelly et al., 2012; Paquet et al., 2005) operationally defined negative mood using higher arousal negative affect terms, such as anger and anxiety. Given this, it is unclear whether regulation of specific emotions or broader affective states (e.g., negative mood) is most efficacious in reducing pain. Further determination of which specific emotions to regulate, in order to most effectively decrease pain, would be useful in designing future pain management interventions.

Findings from the current study largely support extant literature while also making a number of important advances. The present study prospectively examined the impact of mood regulation on pain in a sample of individuals with SCI. Living with SCI presents a host of stressors and challenges which can affect emotional states in a variety of ways. Although the relationship between pain and emotion has received much attention in the SCI literature, the ways in which the experience of pain is impacted by the ability (or inability) to manage such emotional ups and downs remained unexplored. The present findings suggest that pain intensity can be reduced as a result of effective mood regulation within and across days. In addition to the benefits of successful mood regulation, the current findings also highlight the deleterious effects
of the inability to recover from undesirable mood states. These data suggest that clinical interventions teaching response focused mood regulation skills may significantly impact each patient’s pain experience by recovering one’s positive and negative mood back to desirable levels following particularly stressful or challenging events. In examining gender differences as a moderator of the relationship between mood regulation and pain, the current findings suggest clinical interventions focused on mood regulation might significantly improve the pain experience of women with SCI, but may not be beneficial for men, or at least men with SCI related pain. Future research will be needed to identify key determinants of men’s pain experiences.

**Future Directions**

A high proportion (85%) of the current sample self-identified as being Caucasian. Cross-cultural research on emotion suggests that individuals from independent versus interdependent cultures experience variation in the types and intensity of emotional experiences (Kitayama, Markus, & Kurokawa, 2000; Mesquita & Karasawa, 2002; Wang, 2004). Given this, future research examining cross-cultural differences is needed.

The daily diary portion of the current study assessed participants twice per day over five days. Employing such a design allowed for the examination of mood regulation variables that described regulation that occurred both within days (e.g. typically between afternoon and evening) as well as across consecutive days (e.g. from one evening to the afternoon of the next day). However, the examination of only within or across day regulation and pain was not feasible as power was significantly decreased by having only four occurrences of mood regulation to model. As such, it is unclear whether the present findings occur only within a day, only across consecutive days or both within and across days.
As those with SCI often face difficulties with activities of daily living, (e.g. mobility, feeding, toileting, washing, and dressing) researchers must carefully consider the balance of increasing participant burden with the methodological benefits of multiple assessments within a day. However, increasing sampling frequency within days (e.g. four or more assessments), would allow future research to examine such relationships in greater detail. For example, concurrent reports of pain and mood used in the present study could be avoided by deriving mood regulation from two consecutive assessments of mood and then predicting pain intensity from the subsequent (i.e., third) time point. A higher frequency of reporting would also permit modeling of more complex relationships, examining possible mediators of the association between mood regulation and pain.

Third, mood regulation and non-regulation were empirically defined as change in mood over time. An important next step would be to examine regulation strategies that may mediate these changes in mood, including social, cognitive and behavioural strategies used by those living with SCI to regulate mood and manage the pain experience. In addition to investigating effective strategies for mood regulation, future research might also investigate possible factors that may mediate the inability to recover from less than desirable levels of positive or negative mood. For example, response styles such as rumination and pain catastrophizing have been shown to perpetuate and even exacerbate negative mood (Holtzman & DeLongis, 2007; Moberly & Watkins, 2008; Mor & Winquist, 2002). Elucidation of such possible pathways in future research could provide the empirical basis to promote novel avenues for clinical intervention to help diminish the pain experience of those living with SCI.

Finally, although the findings from the present study support the extant literature on mood regulation and pain, careful consideration must be taken when assessing gender
differences in a sample of individuals with SCI. In such a sample, gender differences may be confounded with the propensity to take risks, a relationship that may prove difficult to disentangle. Gender differences in a host of risk taking behaviours have been well documented, with findings suggesting that during adolescence and young adulthood, males are much more likely to engage in risky behaviours than females (Byrnes, Miller, & Schafer, 1999; Turner & McClure, 2003). Unlike non-traumatic causes of SCIs (e.g. cancer, birth defects, and complications from drug use) where the ratio between genders is roughly equivalent, males have typically comprised a large proportion of SCIs resulting from traumatic causes (e.g. motor vehicles accidents, falls, and violence) (Ackery et al., 2004). In terms of age at the time of injury, SCI has predominantly affected a younger population with ages ranging from 20 – 40 years old worldwide. As traumatic causes accounted for 87.5% of the SCIs in this sample, it is important to examine the event resulting in the SCI. Of particular importance is the possibility that men may be more likely to be responsible for the cause of their SCI than women due to a greater proclivity towards risky behaviour. To determine whether gender effects could be attributed to alternative explanations in this sample, independent samples t-tests were performed to examine whether men and women differed on a number of SCI related variables. No significant gender differences were found with respect to age at injury, proportion of traumatic versus non-traumatic causes of SCI, injury severity and completeness of SCI (α = .05). Although participants were asked about the incident that resulted in their SCI, assessing risky behaviour and attributions of responsibility or blame for their SCI was difficult to ascertain. The majority of participants provided extremely brief responses such as “fell at work” or “motor vehicle accident” without providing details regarding attributions of responsibility and blame. Research on gender differences in mood regulation and pain in other pain populations (e.g. rheumatoid
arthritis), in which the possible causes of the injury or disease is not confounded with gender, will be important to further examine these issues. Alternatively, subsequent research on gender differences in SCI could focus on samples with non-traumatic SCIs, or follow methodologies which utilize public records to objectively identify individuals who were not responsible for the traumatic events resulting in their SCI (e.g., motor vehicle accidents, see (Lehman, Wortman, & Williams, 1987). Finally, it is worthwhile to note that in many instances, there is far greater variability within the groups of men and women respectively than mean differences between the sexes. Further research utilizing a more fine grained examination of the role of gender may reveal a better understanding of those who might benefit most from interventions targeting emotion regulation strategies.

Despite these limitations, data from the present study provides support for the importance of mood regulation in the pain experience of individuals with SCI, especially for women. Future research could bolster these findings by examining possible strategies that result in effective mood regulation, investigating mediators of the mood regulation and pain relationship and determining whether the present findings replicate in different chronic pain populations and cultural contexts.
## Table 2.1

### Participant Demographics (n=80)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Overall Mean (SD)</th>
<th>Overall %</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>49.20 (13.06)</td>
<td>50.69 (13.14)</td>
<td>46.12 (12.57)</td>
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</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>67.50</td>
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</tr>
<tr>
<td>Females</td>
<td>32.50</td>
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<td></td>
</tr>
<tr>
<td>Education level</td>
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<td></td>
</tr>
<tr>
<td>Some schooling</td>
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<td>33.30</td>
<td>15.40</td>
<td></td>
</tr>
<tr>
<td>High school diploma</td>
<td>35.00</td>
<td>31.50</td>
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</tr>
<tr>
<td>Bachelor’s degree</td>
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<td>14.80</td>
<td>19.20</td>
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</tr>
<tr>
<td>PhD/professional</td>
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<td>3.70</td>
<td>3.80</td>
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</tr>
<tr>
<td>Other</td>
<td>17.50</td>
<td>16.70</td>
<td>19.20</td>
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</tr>
<tr>
<td>Estimated annual income (pre-tax)</td>
<td>$35,392 (50,580)</td>
<td>$42,074* (57,473)</td>
<td>$20,452* (16,921)</td>
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<td>Employment status</td>
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</tr>
<tr>
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</tr>
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<td>Marital status</td>
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<td>Single</td>
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<td>33.30</td>
<td>34.60</td>
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<td>Married/common-law</td>
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<td>53.70</td>
<td>50.00</td>
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<td>Divorced/separated</td>
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<td>Widowed</td>
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<td>Other</td>
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<td>1.90</td>
<td>3.80</td>
<td></td>
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<tr>
<td>Level of injury</td>
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</tr>
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<td>Cervical</td>
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<td>51.90</td>
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<td>Injury severity</td>
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<tr>
<td>Non-traumatic</td>
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<td>11.32</td>
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<tr>
<td>Years since injury</td>
<td>18.42 (13.66)</td>
<td>20.09 (14.44)</td>
<td>14.67 (11.08)</td>
<td></td>
</tr>
<tr>
<td>Age when SCI occurred</td>
<td>31.59 (15.11)</td>
<td>31.57 (15.36)</td>
<td>31.65 (14.89)</td>
<td></td>
</tr>
</tbody>
</table>

*Note.* *p* < .05; **p** < .01; ***p*** < .001
Table 2.2

Descriptive statistics of daily measures, averaged within and across individuals

<table>
<thead>
<tr>
<th>Variable</th>
<th>Overall Mean (SD)</th>
<th>Male Mean (SD)</th>
<th>Female Mean (SD)</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain</td>
<td>3.11 (2.04)</td>
<td>3.18 (1.82)</td>
<td>2.96 (2.46)</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>Positive mood</td>
<td>4.66 (1.27)</td>
<td>4.82 (1.24)</td>
<td>4.35 (1.30)</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Negative mood</td>
<td>1.43 (0.72)</td>
<td>1.39 (0.71)</td>
<td>1.51 (0.73)</td>
<td>1</td>
<td>7</td>
</tr>
</tbody>
</table>
Table 2.3

Definition of mood regulation and frequency of occurrence of each type

<table>
<thead>
<tr>
<th>Emotion intensity</th>
<th>Type of mood regulation</th>
<th>Entire sample</th>
<th>Females</th>
<th>Males</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Frequency of occurrences (%)</td>
<td>Cumulative frequency (%)</td>
<td>Frequency of occurrences (%)</td>
</tr>
<tr>
<td>Positive moods</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High start</td>
<td>High end</td>
<td>Maintenance</td>
<td>31.45</td>
<td>32.47</td>
</tr>
<tr>
<td>Low start</td>
<td>Avg/high end</td>
<td>Recovery</td>
<td>21.45</td>
<td>52.90</td>
</tr>
<tr>
<td>High start</td>
<td>Avg/Low end</td>
<td>Non-Maintenance</td>
<td>19.57</td>
<td>20.78</td>
</tr>
<tr>
<td>Low start</td>
<td>Low end</td>
<td>Non-recovery</td>
<td>19.42</td>
<td>91.89</td>
</tr>
<tr>
<td>Negative moods</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low start</td>
<td>Low end</td>
<td>Maintenance</td>
<td>43.91</td>
<td>50.22</td>
</tr>
<tr>
<td>High start</td>
<td>Avg/Low end</td>
<td>Recovery</td>
<td>13.48</td>
<td>57.39</td>
</tr>
<tr>
<td>Low start</td>
<td>Avg/High end</td>
<td>Non-Maintenance</td>
<td>10.58</td>
<td>10.82</td>
</tr>
<tr>
<td>High start</td>
<td>High end</td>
<td>Non-Recovery</td>
<td>7.25</td>
<td>75.22</td>
</tr>
</tbody>
</table>

Note.

a across 690 possible occasions
b across 231 possible occasions
c across 459 possible occasions
Table 2.4

Phi coefficients between regulation and non-regulation processes of positive and negative mood for entire sample

<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>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. positive mood maintenance</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. positive mood recovery</td>
<td>-.35**</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. negative mood maintenance</td>
<td>.20**</td>
<td>-.03</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. negative mood recovery</td>
<td>-.10**</td>
<td>.19**</td>
<td>-.35**</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. positive mood non-maintenance</td>
<td>-.33**</td>
<td>-.26**</td>
<td>.01</td>
<td>-.08*</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. positive mood non-recovery</td>
<td>-.33**</td>
<td>-.26**</td>
<td>-.12**</td>
<td>.05</td>
<td>-.24**</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. negative mood non-maintenance</td>
<td>-.10**</td>
<td>-.10**</td>
<td>-.30**</td>
<td>-.14**</td>
<td>.19**</td>
<td>.08*</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>8. negative mood non-recovery</td>
<td>-.14**</td>
<td>-.01</td>
<td>-.25**</td>
<td>-.11**</td>
<td>-.08*</td>
<td>.26**</td>
<td>-.10*</td>
<td>-</td>
</tr>
</tbody>
</table>
Table 2.5

Phi coefficients between regulation and non-regulation processes of positive and negative mood for females and males (above and below diagonal respectively)

<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>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. positive mood maintenance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>-.36**</td>
<td>.15**</td>
<td>-.08</td>
<td>-.36**</td>
<td>-.38**</td>
<td>-.15*</td>
<td>-.12</td>
</tr>
<tr>
<td>2. positive mood recovery</td>
<td>-.35**</td>
<td>-</td>
<td>.08</td>
<td>.23**</td>
<td>-.27**</td>
<td>-.28**</td>
<td>-.08</td>
<td>-.05</td>
</tr>
<tr>
<td>3. negative mood maintenance</td>
<td>.22**</td>
<td>-.03</td>
<td>-</td>
<td>-.40**</td>
<td>.02</td>
<td>-.16*</td>
<td>-.35**</td>
<td>-.32**</td>
</tr>
<tr>
<td>4. negative mood recovery</td>
<td>-.11*</td>
<td>.17**</td>
<td>-.33**</td>
<td>-</td>
<td>-.08</td>
<td>-.03</td>
<td>-.14*</td>
<td>-.12</td>
</tr>
<tr>
<td>5. positive mood non-maintenance</td>
<td>-.32**</td>
<td>-.25**</td>
<td>.01</td>
<td>-.08*</td>
<td>-</td>
<td>-.28**</td>
<td>-.20**</td>
<td>-.13</td>
</tr>
<tr>
<td>6. positive mood non-recovery</td>
<td>-.31**</td>
<td>-.24**</td>
<td>-.12*</td>
<td>.10*</td>
<td>-.22**</td>
<td>-</td>
<td>.08</td>
<td>.29**</td>
</tr>
<tr>
<td>7. negative mood non-maintenance</td>
<td>-.08</td>
<td>-.11*</td>
<td>-.28**</td>
<td>-.14*</td>
<td>.18**</td>
<td>.09</td>
<td>-</td>
<td>-.11</td>
</tr>
<tr>
<td>8. negative mood non-recovery</td>
<td>-.15**</td>
<td>-.02</td>
<td>-.22**</td>
<td>-.10*</td>
<td>-.06</td>
<td>.23**</td>
<td>-.09</td>
<td>-</td>
</tr>
</tbody>
</table>
Table 2.6

Multilevel regression analyses: positive and negative mood regulation predicting pain

<table>
<thead>
<tr>
<th>Effect</th>
<th>Current Pain</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Model 1</td>
<td></td>
<td>Model 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>coefficient</td>
<td>SE</td>
<td>coefficient</td>
<td>SE</td>
<td></td>
</tr>
<tr>
<td>Level 2 (controls)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>0.10</td>
<td>0.46</td>
<td>0.00</td>
<td>0.49</td>
<td></td>
</tr>
<tr>
<td>Average positive mood</td>
<td>-0.20</td>
<td>0.19</td>
<td>-0.20</td>
<td>0.19</td>
<td></td>
</tr>
<tr>
<td>Average negative mood</td>
<td>0.79**</td>
<td>0.28</td>
<td>0.80**</td>
<td>0.28</td>
<td></td>
</tr>
<tr>
<td>Level 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Previous pain</td>
<td>0.03</td>
<td>0.05</td>
<td>0.03</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>Use of pain medication</td>
<td>0.66**</td>
<td>0.21</td>
<td>0.66**</td>
<td>0.21</td>
<td></td>
</tr>
<tr>
<td>Previous positive mood</td>
<td>-0.15*</td>
<td>0.07</td>
<td>-0.13</td>
<td>0.07</td>
<td></td>
</tr>
<tr>
<td>Previous negative mood</td>
<td>-0.23*</td>
<td>0.09</td>
<td>-0.21*</td>
<td>0.09</td>
<td></td>
</tr>
<tr>
<td>Negative mood maintenance</td>
<td>-0.25</td>
<td>0.20</td>
<td>-0.24</td>
<td>0.20</td>
<td></td>
</tr>
<tr>
<td>Negative mood recovery</td>
<td>-0.11</td>
<td>0.19</td>
<td>-0.11</td>
<td>0.19</td>
<td></td>
</tr>
<tr>
<td>Positive mood recovery</td>
<td>-0.35*</td>
<td>0.15</td>
<td>-0.34*</td>
<td>0.15</td>
<td></td>
</tr>
<tr>
<td>Positive mood maintenance</td>
<td>-0.24</td>
<td>0.14</td>
<td>-0.50**</td>
<td>0.17</td>
<td></td>
</tr>
<tr>
<td>Positive mood maintenance X Gender</td>
<td>-</td>
<td>-</td>
<td>0.39*</td>
<td>0.19</td>
<td></td>
</tr>
</tbody>
</table>

Note. Controlling for previous pain, previous positive mood, previous negative mood, average positive and average negative mood and use of pain medication.

SE= robust standard errors.
Table 2.7

Multilevel regression analyses: positive and negative mood NON-regulation predicting pain

<table>
<thead>
<tr>
<th>Effect</th>
<th>Current Pain</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Model 1</td>
<td>Model 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 2 (controls)</td>
<td></td>
<td>coefficient</td>
<td>SE</td>
<td>coefficient</td>
<td>SE</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td>0.17</td>
<td>0.47</td>
<td>0.26</td>
<td>0.47</td>
</tr>
<tr>
<td>Average positive mood</td>
<td>-0.16</td>
<td>0.18</td>
<td>-0.17</td>
<td>0.18</td>
<td></td>
</tr>
<tr>
<td>Average negative mood</td>
<td>0.83</td>
<td>0.27</td>
<td>0.83</td>
<td>0.27</td>
<td></td>
</tr>
<tr>
<td>Level 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Previous pain</td>
<td>0.04</td>
<td>0.05</td>
<td>0.04</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>Use of pain medication</td>
<td>0.70**</td>
<td>0.20</td>
<td>0.69**</td>
<td>0.20</td>
<td></td>
</tr>
<tr>
<td>Previous positive mood</td>
<td>-0.06</td>
<td>0.07</td>
<td>-0.04</td>
<td>0.07</td>
<td></td>
</tr>
<tr>
<td>Previous negative mood</td>
<td>-0.15</td>
<td>0.10</td>
<td>-0.14</td>
<td>0.10</td>
<td></td>
</tr>
<tr>
<td>Negative non-mood maintenance</td>
<td>0.30</td>
<td>0.19</td>
<td>0.29</td>
<td>0.19</td>
<td></td>
</tr>
<tr>
<td>Negative mood non-recovery</td>
<td>0.18</td>
<td>0.31</td>
<td>0.16</td>
<td>0.31</td>
<td></td>
</tr>
<tr>
<td>Positive mood non-maintenance</td>
<td>0.14</td>
<td>0.14</td>
<td>0.13</td>
<td>0.14</td>
<td></td>
</tr>
<tr>
<td>Positive mood non-recovery</td>
<td>0.44*</td>
<td>0.17</td>
<td>.93**</td>
<td>0.28</td>
<td></td>
</tr>
<tr>
<td>Positive mood non-recovery X Gender</td>
<td>-</td>
<td>-</td>
<td>-0.77**</td>
<td>0.28</td>
<td></td>
</tr>
</tbody>
</table>

Note. Controlling for previous pain, previous positive mood, previous negative mood, average positive and average negative mood and use of pain medication.
Figure 2.1. Illustrations of mood regulation and non-regulation processes
Figure 2.2. Cross-level interaction between positive mood maintenance and gender predicting current pain, controlling previous pain, previous positive mood, previous negative mood, average positive mood, average negative mood and use of pain medication
Figure 2.3. Cross-level interaction between positive mood non-recovery and gender predicting current pain, controlling previous pain, previous positive mood, previous negative mood, average positive mood, average negative mood and use of pain medication
CHAPTER 3: THE SOCIAL CONTEXT OF CATASTROPHIZING IN THE EXPERIENCE OF PAIN IN INDIVIDUALS LIVING WITH SPINAL CORD INJURY

In Canada there are approximately 86,000 people living with spinal cord injury (SCI) with an estimated 4,300 new cases of SCI annually (Noonan et al., 2012). SCI and the subsequent events resulting from such a life-altering event can present a host of impairments, stressors and challenges that can persist across the lifespan. For many, these stressors and challenges include secondary health conditions, mobility issues, difficulties with activities of daily living, and financial strain resulting from SCI related costs and lowered rates of employment post-injury (Bloemen-Vrencken et al., 2005; Kirchberger et al., 2010). Accordingly, much research in SCI has progressed from the development of “curative” interventions, to a focus on improving the experience of living with SCI.

Of the many challenges for individuals living with SCI, pain has been reported to be the most frequent and disabling condition that affects activities of daily living and social life (Bloemen-Vrencken et al., 2005). Chronic pain has been estimated to affect up to 60-80% of those with SCI, with 30-58% reporting severe, disabling pain (Ravenscroft et al., 2000; Rintala et al., 1998; Siddall et al., 2003). For individuals with SCI, the pain experience can vary in a multitude of ways including location, severity, type and duration, making it difficult for accurate assessment and successful treatment. Two major categories of pain that plague those living with

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6 This chapter has been adapted from a version being prepared for submission: Lam, M., & DeLongis, A. (in prep). The social context of catastrophizing in the experience of pain in individuals living with spinal cord injury. It has been modified to fit the format of this thesis.
SCI are neuropathic and musculoskeletal pain. Approximately 42% of those living with SCI report having musculoskeletal pain, which can result from the SCI itself, an injury following SCI, overuse or strain of the muscles, arthritic changes, or wear and tear of the joints, often from manual wheelchair use (Chiodo et al., 2007). Neuropathic pain is the most common type of chronic pain in SCI, with up to 36% and 24% of respondents reporting neuropathic pain at and below the level of injury respectively (Chiodo et al., 2007). Neuropathic pain includes transitional zone pain, radicular pain, and central pain, dysesthetic pain, or diffuse pain, and is caused by abnormal signals from the nerves that were damaged by the SCI (Siddall et al., 1997). As a result, identification of a specific cause or stimulus of neuropathic pain is often difficult, making it challenging to treat (Siddall et al., 1999).

**Pain catastrophizing.**

Although initially viewed as a biomedical problem requiring medical or surgical solutions (Melzack & Loeser, 1978) chronic pain has been increasingly conceptualized within contemporary biopsychosocial models that are now widely accepted in the general field of chronic pain research (Perry et al., 2010; Siddall & Middleton, 2006). It is clear that psychosocial factors play a significant role in the experience of chronic pain, and catastrophizing has been identified as among the most important of these (Holtzman & DeLongis, 2007; Sullivan et al., 2001). Catastrophizing has been described as the tendency to exaggerate or magnify the seriousness or threat value of pain sensations. Furthermore, catastrophizing has been associated with reports of feeling worried, fearful and being unable to divert attention away from pain (Sullivan et al., 2001). Increasingly, research is clear in indicating that when individuals in chronic pain respond to their pain and its consequences in such an exaggerated negative manner, they tend to experience a host of negative outcomes, such as increased pain intensity (Grant et
al., 2002; Severeijns et al., 2001; Tan et al., 2001), greater psychological distress (Severeijns et al., 2001), and functional disability (Severeijns et al., 2001; Sullivan et al., 1998). Indeed the relationship between pain and catastrophizing has been documented in a wide range of patient groups including rheumatoid arthritis (Holtzman & DeLongis, 2007), low back pain (Flor et al., 1993), surgery (Jacobsen & Butler, 1996), and mixed chronic pain (Sullivan & Deon, 1990). In samples of individuals with SCI, cross sectional studies have found catastrophizing to be related to pain intensity, pain interference with activities of daily living, psychological distress, and pain related disability (Giardino et al., 2003; Turner et al., 2002; Wollaars et al., 2007). Catastrophizing has also been found to mediate the relationship between pain intensity, psychological distress and functional disability (Ullrich et al., 2007). A recent literature search revealed only one longitudinal study examining pain and catastrophizing in SCI and found baseline catastrophizing to predict greater pain interference and poorer psychological functioning after six months (Hanley et al., 2008).

The communal coping model of catastrophizing and pain incorporates an interpersonal context in the experience and management of pain (Sullivan et al., 2001). In traditional perspectives of coping with pain, coping efforts are employed to reduce the physical and emotional discomfort associated with pain. In contrast, the communal coping model suggests that pain catastrophizing may not be just a maladaptive response contributing to increased pain, but may also be a way to elicit support from close others (Sullivan et al., 2001; Thorn et al., 2003).

Research has found reliable associations between social support and better health outcomes (for a review see Berkman et al., 2000; Uchino, 2004, 2006). For those with chronic pain, both cross-sectional and longitudinal research suggest that higher satisfaction with social
support is associated with fewer depressive symptoms (Suurmeijer et al., 2005) and lower pain intensity (Evers, Kraaimaat, Geenen, Jacobs, & Bijlsma, 2003). Indeed, social support has been found to be a significant factor in both health status and adjustment among individuals with SCI. Individuals with SCI who perceived high levels of social support reported levels of well-being only slightly lower than population means of non-disabled individuals of the same age (Schulz & Decker, 1985). In addition, social support in SCI has been associated with greater life satisfaction and quality of life along with lower depression, helplessness, suicidal ideation, morbidity and mortality (Mueller, Peter, Cieza, & Geyh, 2012). Although the benefits of social support have been well documented, the impact of the social environment on catastrophizing in SCI has only recently been considered (e.g., Raichle, Hanley, Jensen, & Cardenas, 2007).

The examination of the social environment in which catastrophizing occurs should not only include the beneficial contributions provided by close others but should also consider the consequences of negative responses from support providers. Research suggests that negative aspects of social relationships may be stronger predictors of health outcomes than are positive aspects (Helgeson, 1993; Schuster et al., 1990; Stroud et al., 2006; Walen & Lachman, 2000). Negative behavior from close others, such as expressions of anger, criticism, and ignoring, have been associated with increased pain behavior (Romano et al., 2000) and poorer psychological adjustment (Helgeson, 1993; Manne & Zautra, 1989). Similar findings have been reported in studies examining patient-partner interactions in individuals with SCI. Patient reports of negative responses from close others have been associated with increased pain perception and severity (Conant, 1998; Summers et al., 1991), pain related activity interference, and depressive symptom severity (Stroud et al., 2006). Interestingly, Cano, Leong, Heller, and Lutz, (2009) suggest that although catastrophizing may also be a way to elicit support from close others, such
indirect support-seeking behaviors may be aversive for support providers who might respond with unsupportive or rejecting behaviors (Cano et al., 2009). Indeed, catastrophizing has been associated with greater perceived solicitousness, punishing and critical responses from the support provider (Buenaver et al., 2007; Cano et al., 2009; Keefe et al., 2003). For example, in a cross-sectional study of individuals with cancers of the gastrointestinal system, catastrophizing was correlated with greater perceived instrumental support from the support provider, but also with greater support provider reported stress, avoidant and critical responses to the patient (Keefe et al., 2003). Although such findings associating 1) catastrophizing with negative responses from the support provider and 2) such negative responses with poor psychological and physical health, the ways in which negative responses from the support provider impact the pain experience in the context of catastrophizing remains relatively unexplored.

Present study

Unfortunately, the majority of research on both SCI and on the social context of catastrophizing has relied heavily on retrospective, cross-sectional designs. Recently, a growing number of prospective studies utilizing intensive longitudinal designs suggest that catastrophizing can lead to poorer physical and psychological outcomes even within the course of a day (Grant et al., 2002; Holtzman & DeLongis, 2007; Keefe et al., 2004). Such studies employing a daily process design permit the examination of day-to-day fluctuations in pain, catastrophizing and support provision. For example, in a sample of persons living with rheumatoid arthritis, increases in catastrophizing was found to prospectively predict increases in pain while satisfaction with received support was found to buffer the relationship between catastrophizing and negative affect (Holtzman & DeLongis, 2007). The present study moves beyond reports of satisfaction with received support by examining perceptions of both positive
and negative support provider responses, in addition to global perceptions of support availability, thus providing a more nuanced portrayal of the role of the perceived social environment in the context of catastrophizing and pain. In addition, the current study is the first to employ an intensive longitudinal design to examine such processes as they unfold over the day for those living with SCI. Twice daily assessments for five days allowed for an investigation of processes closer to their real-time occurrence and clarification of the temporal ordering of variables (Bolger & Laurenceau, 2013). The following was hypothesized: a) increased catastrophizing was expected to prospectively predict higher pain intensity, b) increased levels of support were expected to prospectively predict decreases in pain intensity, c) increases in criticism from the support provider were expected to prospectively predict increases in pain intensity, d) the relationship between catastrophizing and pain was expected to be moderated by support such that only high levels support were expected to serve to buffer against the negative effects of catastrophizing on pain, and e) the relationship between catastrophizing and pain was expected to be moderated by criticism from the support provider such that high but not low levels of negative responses would exacerbate the deleterious effects of catastrophizing on pain. All hypothesized models controlled for previous levels of pain intensity and negative mood in prospectively predicting subsequent pain. In addition, as social support has been found to serve a number of functions (Cohen, Mermelstein, Kamarck, & Hoberman, 1985), global perceptions of tangible, belonging and appraisal support as well as within day perceptions of received support and the satisfaction with it were separately modeled to provide a more detailed examination of the role of support in the pain experience. Hypotheses that predicted beneficial direct or moderating effects of support were expected to be found regardless of the support type modelled.
3.1 Methods

Recruitment was completed in conjunction with the British Columbia Paraplegic Association (BCPA). In accordance with confidentiality agreements with their patients, the research team was not granted access to patient names and addresses for recruitment purposes. An employee of the BCPA was remunerated for mailing and tracking prepared recruitment letters, and provided details on the number of letters mailed. The letter invited interested persons to phone our research center at which time the project manager provided a basic overview of the study, determined eligibility, and if appropriate, scheduled a convenient time for an in-person interview.

Eligibility criteria required participants to have a SCI, be 18 years of age, and have a working knowledge of both written and spoken English. Immediately following their SCI, patients typically undergo treatment and intensive rehabilitation to maximize the chances of recovery. As such, patients within the first year following their injuries are often inundated with requests to participate in research focused on the effective means of treatment and rehabilitation. To prevent patients from becoming overwhelmed and overburdened by research and given the important differences between early post-acute and long-term adjustment to SCI (Kirchberger et al., 2010) only those patients who were a minimum one year post-injury were sent recruitment letters. As an expression of gratitude for their participation, all participants received $15 for each completed phase of the study, for a maximum of $45.

Phase 1. A trained interviewer met with the participant at either their residence or in the lab. After consent was obtained, the initial interview was conducted to assess a host of variables including, (1) basic demographics, including age, gender, ethnicity, socioeconomic status and
marital status (2) details of the SCI, including the cause, date of injury, level of injury, whether the SCI was complete or incomplete, and current functioning of upper and lower body, and use of arms and legs and (3) any medications participants were taking. This initial interview took approximately 45 minutes to finish. Upon completion of the initial questionnaire, the interviewer distributed materials necessary for phases two and three.

**Phase 2.** In the second phase, participants were given the choice of completing a questionnaire booklet on their own, with the assistance of their caregiver or other support person if needed, or with a member of our research team – either over the telephone or in-person. The questionnaire required approximately 45 minutes and involved the assessment of key individual difference variables, such as perceptions of social support availability.

**Phase 3:** The final phase followed participants over a five day span. Each day a trained interviewer contacted participants by telephone approximately six and 12 hours after waking. These brief, twice-daily interviews lasted 10-15 minutes and assessed a number of variables including pain, pain catastrophizing, negative mood and perceptions of received support. Wherever possible, daily interview questions were derived from established and validated psychometric scales to ensure valid and reliable measurement of desired constructs. In these situations, a small number of items were chosen from each scale based on those which best represent the target construct (and those aspects which were most relevant to the study). Some items were reworded to reflect their use in a daily diary format (e.g., Affects Balance Scale, (Derogatis, 1975).
SCI and Questionnaire measures

*Level of injury.* Among those living with SCI, there is a large degree of variability in paralysis and functional impairment, determined primarily by the level of injury (Maynard et al., 1997; McDonald & Sadowsky, 2002). Level of injury refers to the lowest point on the spinal cord where motor and/or sensory function is either decreased or absent (Maynard et al., 1997). In general, SCIs that are higher result in greater loss of movement and/or feeling. Tetraplegia (also referred to as quadriplegia) is an injury of the cervical spinal cord (levels C1-C8) which refers to weakness or paralysis in both the arms and legs. Injuries to the thoracic (levels T1 – T12) and lumbar (levels L1 – L5) portions of the spinal cord result in paraplegia, which means weakness or paralysis of the legs.

*Type of injury.* Although the level of injury reveals the location of the damage to the spinal cord, the type of injury details the amount of damage to the width of the spinal cord. Thus, in conjunction with the level of injury, SCIs are additionally categorized as either complete or incomplete (Palmer et al., 2008). A complete injury suggests damage to the spinal cord such that no sensory and motor function exists below the level of injury. With partial or incomplete injuries some motor and/or sensory function remains intact below the level of injury (Palmer et al., 2008). Incomplete injuries yield a variety of manifestations such that some individuals may have motor function but no sensations below the level of injury or vice versa, while others may have both movement and feeling, but on the right or left side only (Palmer et al., 2008).

*Cause of injury.* The causes of SCIs are categorized as either traumatic or non-traumatic. Of the causes of traumatic SCIs motor vehicle collisions are the most common and are estimated to account for up to 43 per cent of traumatic SCIs in Canada and up to 50 per cent in other
countries (Ackery et al., 2004; Pickett, Campos-Benitez, Keller, & Duggal, 2006; Pickett, Simpson, Walker, & Brison, 2003). Falls, work related accidents, violence (predominantly stabs and gunshot wounds), sports and aquatic/diving injuries, self-inflicted injuries and suicide attempts comprise other major causes of traumatic SCIs (Ackery et al., 2004). Although estimates vary largely, non-traumatic SCIs account for approximately 49 per cent of all SCIs in Canada (Noonan et al., 2012). Common causes of non-traumatic SCIs include cancer, intervertebral disc disease, infection, vertebral injury and spinal cord vascular disease (van den Berg et al., 2010). Participants were asked to describe the event leading to their SCI which was then coded as traumatic or non-traumatic (see Table 3.1)

Perceptions of available social support. Perceptions of the availability of social support from the participant’s social network were measured by three subscales of the Interpersonal Support Evaluation List (ISEL; Cohen et al., 1985). Tangible support refers to an individual’s perception of the availability of instrumental aid. Appraisal support refers to the availability of someone to talk to about one’s problems. Belonging support refers the availability of people with whom one can do things with. Participants were asked to rate the degree to which they felt the statement was true of them by circling on of the following response choices: 1 (‘definitely false’), 2 (‘probably false’), 3 (‘probably true’), and 4 (definitely true’). Each subscale consisted of four statements from which an average value was calculated. Internal consistency for each of tangible support (Chronbach’s α = .70) belonging support (Chronbach’s α = .84) and appraisal support (Chronbach’s α = .76) was found to be acceptable.
Diary measures

Pain intensity. Patients indicated 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 been commonly used in intensive longitudinal designs (Hamilton, Zautra, & Reich, 2005; Holtzman & DeLongis, 2007; Keefe et al., 2004) and has shown good validity in previous research, demonstrating significant associations with other measures of pain intensity (Jensen et al., 1986).

Pain catastrophizing. Pain catastrophizing was assessed within days using three items from the helplessness subscale of the Pain Catastrophizing Scale (PCS; Sullivan, Bishop, & Pivik, 1995), which has previously shown good reliability and validity (Sullivan, Lynch, & Clark, 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 [the participant and interviewer] last spoke” on a 5-point Likert scale ranging from 1 (‘not at all’) to 5 (‘A lot’). Pain catastrophizing was not assessed when participants did not report feeling any pain. The reliability of within subject change was assessed using the focal reliability measure (Bolger & Laurenceau, 2013; Cranford et al., 2006), which was found to be acceptable ($R_C = .65$).

Perceptions of received support. Six items drawn from the Received Support subscale of the Berlin Social Support Scale (BSSS; Schulz & Schwarzer, 2003) were used to assess received support. Participants were asked to reflect on interactions with one nominated support provider “so far today/since [the participant and interviewer] last spoke” and to indicate the extent to
which each statement described that interaction on a 5-point Likert scale ranging from 1 (‘strongly disagree’) to 5 (‘strongly agree’). Received support was calculated by averaging across these six items\(^7\). Of the six items, two single items assessing satisfaction with support, and criticism from the support provider, were also separately examined. The reliability of within subject change for perceptions of received support was found to be acceptable \((R_C = .59)\).

**Negative mood.** Negative mood was assessed using the average of three items (sad, worthless, hopeless) from the Affects Balance Scale (Derogatis, 1975), which has been shown to have good internal consistency in prior research (Northouse & Swain, 1987). Participants were asked to indicate the extent to which each word described how they felt “so far today/since [the participant and interviewer] last spoke” on a 7-point Likert scale (1 (‘not at all’) to 7 (‘very much’)). The reliability of within subject change for negative mood was found to be acceptable \((R_C = .71)\).

**Participants**

All 94 interested individuals who contacted our research coordinator met eligibility requirements. Of these, 82 (87.23%) completed all three phases of the study, while nine individuals (9.57%) completed two phases and the remaining three (3.19%) participated only in the initial interview. On average, individuals who did not fully participate in the study did not

\(^7\) Similar results were obtained analyzing models in which received support was composed of only four support items (i.e. models in which criticism from the support provider and satisfaction with support were excluded).
differ significantly on SCI and demographic variables, when compared to individuals who had completed all three phases of the study.

Eighty seven individuals completed the twice daily interview component of the study, for which the response rate was high. Of the 870 possible time-points, participants in the final sample completed 96.5% of those interviews. Ninety one percent of the 87 participants completed all daily questionnaires twice daily across the five days. Seven individuals were excluded from the final analyses as they did not report having any pain (and therefore no pain catastrophizing) across the five days. An additional four individuals were excluded from analysis as they did not complete consecutive reports of pain and pain catastrophizing, preventing the use of their data in the lagged models presented here. Excluded individuals (both those without reports of pain and those with insufficient data) did not significantly differ on demographic and study variables compared to those included in the study. Table 3.1 provides details of the final sample of 76 participants, which was predominantly male (68.4%), Caucasian (84.3%), and had an average age of 49.29 years (ranging from 21-78). About half of participants (51.40%) were married or living common law, with others single (32.90%), divorced/separated (10.50%) or widowed (2.6%). Approximately one third (35%) of respondents reported being employed, while the remainder were either unemployed (33.30%) or retired or receiving disability benefits (31.70%). Estimates of annual income before taxes averaged $36,581, with a median of $21,800. The level of injury for the majority of respondents was primarily cervical (50.0%) or thoracic (43.20%) and injury severity was reported to be complete (versus incomplete) by 54.9% of the sample. At the time of interview, participants had been living with SCI for an average of 18.30 years (SD = 13.63), with injuries occurring at an average age of 31.81 years (SD = 14.99). A majority of participants completed the take-home questionnaires on
their own (64.5%), while others (25%) required assistance or did not indicate whether they received assistance (10.5%). Not surprisingly, a chi-square test found a significant difference ($p < .05$) such that those completing questionnaires on their own had a lower than expected frequency of high level of injury (i.e., more paraplegia than tetraplegia), while those requiring assistance had a higher frequency of tetraplegia than expected. Independent sample t-tests and additional chi-square tests revealed no significant differences ($\alpha = .05$) on study variables between those who independently completed questionnaires and those who required assistance. Individual means and standard deviations were calculated for Level 1 (daily interview) study variables and then averaged across participants (Table 3.2). Participants reported an average level of pain intensity\(^8\) of 3.38 (SD = 1.87). Perceived availability of support was high with average levels of tangible, appraisal and belonging support reported as 3.17 (SD = 0.69), 3.12 (SD = 0.74) and 2.91 (SD = 0.86) respectively. When participants reported interacting with support providers, received support was found to be relatively high, with an average of 3.99 (SD = 0.44). In addition, perceived criticism from the support provider was reported to be 1.30 (SD = 0.45).

3.2 Data analysis

Multilevel regression analyses were conducted using hierarchical linear modeling (HLM) software (Raudenbush et al., 2004). A multilevel approach using HLM offers several

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\(^8\) During phase one of the study, participants were asked to rate the severity of their pain over the past week. Across the sample, this average (4.54) was similar to retrospective reports of pain intensity found in other SCI samples (Hanley et al., 2008; Jensen et al., 2005; Turner et al., 2001). Interestingly, the average of within day averages for pain intensity reported here (3.11) was much lower than the average reported during phase one.
advantages, including its ability to adequately deal with missing data and examine associations between predictors and outcomes while taking into account dependence in the data that arises from the repeated measurement of the same variables for each participant across multiple assessments. Using HLM, within-person variation was modeled at Level 1 and between-person variation was modeled at Level 2, allowing for the simultaneous examination of both 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 were used to estimate average parameter estimates across all subjects as well as the amount of variation around this average.

Repeated measures data that were collected twice daily across five days were added at Level 1. Measures that were collected during phases 1 & 2, such as demographic, SCI specific variables and more stable perceptions of support were added at Level 2. A fully random model was specified for all analyses, whereby the intercepts and slopes of the outcome and predictor variables were allowed to vary freely. In all models continuous level 1 variables were centered around each individual’s mean and continuous level 2 variables were grand mean centered around the sample mean. Such centering allows for a more meaningful interpretation of coefficients, significantly reduces multicollinearity in the data, and removes the confounding of slope and intercept variance (Kreft et al., 1995, 1998). The binary variable indicating use of pain medication was left uncentered.

All multilevel models testing the effects of pain catastrophizing and social support on pain initially included the level 1 variable time (time-point) to control for any time related trends in responses. The level 2 variables gender, years since injury, level of injury, completeness of injury, and age were also included in order to control for possible between-person differences in
pain. With the exception of gender, these control variables were dropped from subsequent analyses as tests of their coefficients were not found to be significant (i.e. $p > .05$). Controls for previous pain, prior negative mood and use of pain medication (all at level 1) were included in each of the final models predicting current pain from prior pain catastrophizing and either daily reports of support provider responses (e.g. received support or criticism) or more stable perceptions of available support. To examine the independent effects of prior catastrophizing on current pain, prior reports of pain were included as a covariate to control for the high correlation between successive reports of pain intensity. Prior negative mood was also included as a control as research suggests it may play an important role in the relationship between pain and catastrophizing (Holtzman & DeLongis, 2007). For example, the level 1 model predicting current pain from prior catastrophizing and received support was specified as $Pain_{ij} = \beta_{0j} + \beta_{1j}$ (negative mood) $+ \beta_{2j}$ (use of pain medication) $+ \beta_{3j}$ (pain) $+ \beta_{4j}$ (pain catastrophizing) $+ \beta_{5j}$ (received support) $+ r_{ij}$. Given its association with pain (Fifield et al., 1998; Schanberg, Gil, Anthony, Yow, & Rochon, 2005), average negative mood was included as a control at level 2 in order to account for between person differences. For example, $\beta_{00} = \pi_{oj} + \pi_{01}$ (average negative mood) $+ r_{ij}$.

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9 Estimated annual income was initially included as a level-2 control variable and was found to be a significant predictor of average pain, ($\beta = .01, p < .05$). However, the inclusion of this variable did not affect the significance of the findings, and therefore it was removed from analyses for power considerations.
3.3 Results

Frequency of daily measures

Although the final sample of 76 participants completed 97.2% of the possible 760 assessments, many of the daily variables were answered less frequently. Table 3.2 provides the proportion of assessments for which pain, catastrophizing, negative mood and interactions with the support provider (e.g. received support) were reported. Participants reported having no pain for 9.8% of the total assessments, resulting in reports of some amount of pain 89.2% of the time. Catastrophizing about pain was also reported 89.2% of all assessments as catastrophizing was only assessed when participants indicated some level of pain. Assessments of perceived reception of support, satisfaction with support and criticism from the support provider were reported 61.90-63.50% of all possible daily measurements as participants did not interact with their support providers across all possible assessments.

Bivariate correlations

Table 3.3 describes bivariate correlations between primary study variables. Variables assessed within days (e.g. pain) were first averaged for each person, and then averaged across participants. As expected, pain, catastrophizing and negative mood were all positively and moderately correlated. Not surprisingly received support was correlated with criticism from the support provider and satisfaction with support, given these items were included in its formulation. In addition, daily perceptions of both received support and satisfaction with such support were positively associated with global perceptions of support availability. Finally, although tangible, appraisal, and belonging support were all found to be positively correlated, such associations do not necessarily suggest a lack of independence between the subscales, given
individuals often receive different types of support from the same member of their social network (Cohen et al., 1985).

**Catastrophizing, perceived responses of the support provider, and pain**

A number of models were examined to determine whether catastrophizing, perceptions of supportive and unsupportive responses from the support provider prospectively predicted changes in pain. In each of the following models, previous levels of pain, prior negative mood, average levels of negative mood, and use of pain medication were included as control variables. It is worthwhile to note that for all following models (Tables 4-6), the control variable of average negative mood was a significant predictor of pain ($\beta$s = .53 to .74, $p < .05$). Those with higher average negative mood were found to have higher average levels of pain intensity.

Catastrophizing and perceptions of support provider criticism were not significant predictors of subsequent pain intensity (Table 3.4, model 1). However, a model including an interaction between perceptions of criticism from the support provider and catastrophizing (Table 3.4, model 2) found that perceptions of criticism from the support provider significantly moderated the prospective relationship between catastrophizing and subsequent pain ($\beta = .25, p < .01$). A test of simple slopes (Preacher, Curran, & Bauer, 2006) indicated the harmful effects of catastrophizing when support provider criticism was higher than average (Figure 3.1). Specifically, increases in catastrophizing were found to significantly predict increases in subsequent pain intensity when participants reported higher than average levels of criticism from the support provider (simple slope = 0.41, $p < .05$). However, when participants reported average or below average levels of criticism, catastrophizing did not significantly predict subsequent changes in pain intensity. Although support provider criticism was found to play a
role in the experience of pain, perceptions of supportive interactions were not. Tests of
independent models predicting changes in pain intensity from earlier reports of received support
and satisfaction with support were not significant. Furthermore, models examining interactions
between catastrophizing and received support or satisfaction with support on subsequent pain
also resulted in non-significant findings.

**Catastrophizing, perceptions of available support and subsequent pain**

The ways in which the perception of available support and catastrophizing might impact
the pain experience were also examined. Tangible support, belonging support and appraisal
support were each separately modeled with catastrophizing to prospectively predict pain. In each
of these and subsequently presented models, previous levels of pain, prior negative mood,
average levels of negative mood, and use of pain medication were included as control variables.
Subsequent models included a cross-level interaction between catastrophizing and each support
type to examine whether the relationship between catastrophizing and pain differed at various
levels of perceived support availability.

Findings presented in Table 3.5 suggest that belonging support was found to significantly
predict average levels of pain intensity ($\beta = -0.53, p < .05$). Individuals who perceived less
belonging support reported higher average levels of pain intensity. A significant main effect of
prior catastrophizing on pain intensity was also found ($\beta = 0.30, p < .05$), such that increases in
catastrophizing led to increases in subsequent pain (Table 3.5, model 1). Next a model was
specified in which a cross-level interaction between catastrophizing and belonging support was
examined (Table 3.5, model 2). A significant interaction between catastrophizing and belonging
support was found ($\beta = -0.25, p < .05$), in which belonging support moderated the relationship
between catastrophizing and subsequent pain (Figure 3.2). A test of simple slopes (Bauer & Curran, 2005; Preacher et al., 2006) revealed a buffering effect of belonging support in which prior catastrophizing did not significantly predict changes in subsequent pain for individuals with high levels of perceived belonging support (i.e. one standard deviation above the mean). However, for individuals with average or low levels of perceived belonging support (i.e. one standard deviation below the mean), higher levels of prior catastrophizing was a significant predictor of increased subsequent pain (simple slopes = 0.32 and 0.52, p < .05 respectively).

A main effect of tangible support was also found to predict pain intensity (β = -0.63, p < .05) such that individuals who perceived having less material aid available to them reported higher average levels of pain intensity (Table 3.6, model 1). In addition, prior catastrophizing significantly predicted changes in pain intensity (β = 0.33, p < .05), with increases in catastrophizing leading to increases in subsequent pain. Next a model was specified in which a cross-level interaction was formed between catastrophizing and tangible support (Table 3.6, model 2). A significant interaction between catastrophizing and tangible support was found (β = -0.25, p < .05), in which tangible support moderated the relationship between catastrophizing and subsequent pain (Figure 3.3). A test of simple slopes revealed a buffering effect of tangible support in which prior catastrophizing did not significantly predict changes in subsequent pain for individuals with high levels of perceived tangible support (i.e. one standard deviation above average). However, for individuals with average or low levels of perceived tangible support (i.e. one standard deviation below the mean), higher levels of prior catastrophizing significantly predicted increases in subsequent pain (simple slopes = .30, p < .05 and .62, p < .01 respectively). Models examining catastrophizing and appraisal support were not found to predict
average levels pain or changes in daily pain. The perception of having someone to discuss
problems with had neither main effects nor interactive effects with catastrophizing on pain.

3.4 Discussion

Using an intensive longitudinal design and multilevel modeling techniques, the current
study investigated the ways in which pain catastrophizing and the social environment affects the
experience of pain in a sample of individuals with SCI. Specifically, perceptions of available
support as well as perceptions of criticism and received support from a support provider were
examined for both direct and moderating effects on the prospective relationship between
catastrophizing and pain. Consistent with previous research (Buenaver et al., 2007; Giardino et
al., 2003; Holtzman & DeLongis, 2007) perceptions of the social environment were found to
play an important role in the relationship between pain and catastrophizing. Both the perceived
availability of instrumental aid (i.e., tangible support) and having people with whom to engage in
activities with (i.e., belonging support) were found to significantly predict average levels of daily
pain intensity, with lower levels of support predicting higher average pain. In addition, both
tangible and belonging support were found to interact with catastrophizing in prospectively
predicting pain. For individuals with average or below average level tangible or belonging
support, increases in catastrophizing resulted in higher levels of pain. However, higher than
average levels of tangible and belonging support were found to buffer the deleterious effects of
catastrophizing on pain such that increases in catastrophizing did not results in changes in pain.
Although different forms of support (i.e. tangible, belonging, and appraisal support) were
hypothesized to both directly and indirectly impact the pain experience, significant effects were
found for only belonging and tangible support. In contrast to the extant literature on support and
health which finds emotional support to be particularly important with respects to health
outcomes (Uchino, Cacioppo, & Kiecolt-Glaser, 1996), appraisal support was not found to play a 
role in the pain experience. The matching hypothesis of support (Cutrona & Russell, 1990) 
offers one possible explanation for the current findings that perceptions of tangible and 
belonging support are more important for individuals with SCI. It proposes that specific types of 
support may be better suited for specific events or stressors. Accordingly, perceptions of the 
availability of tangible and belonging support, compared to appraisal support, may be better 
matched to the needs of those with SCI given the functional limitations and challenges with 
activities of daily living SCI often presents (Bloemen-Vrencken et al., 2005; Kirchberger et al., 
2010). Future research with larger samples is needed to clarify and better understand which 
forms of perceived support availability are most influential for those with SCI.

In addition to perceptions of availability of support, the present study also examined the 
ways in which the pain experience was affected by perceptions both positive and negative 
responses of the support provider, twice daily across five days. Consistent with previous 
findings (Holtzman & DeLongis, 2007) neither within day perceptions of received support from 
the support provider nor satisfaction with such support was found to prospectively predict 
changes in pain, nor to interact with catastrophizing in the prediction of pain. However, within 
day perceptions of critical responses from the support provider were found to play an important 
role in the pain experience of those with SCI. Participant reports of critical remarks from the 
support provider moderated the relationship between catastrophizing and pain. Catastrophizing 
did not prospectively predict changes in pain intensity when perceptions of critical remarks were 
reported at average or below average levels. However, when perceptions of criticism from the 
support provider were high, increases in catastrophizing prospectively predicted increased pain 
intensity, even after controlling for prior levels of pain. Taken together, these findings and
others (Schuster et al., 1990; Stroud et al., 2006; Walen & Lachman, 2000) provide support for the notion that perceptions of negative responses of the support provider may be more impactful than any benefits arising from perceptions of received support. Indeed negative social interactions have been associated with a host of poor patient outcomes including psychological (Manne & Zautra, 1989) and physical well-being (Griffin, Friend, Kaell, & Bennett, 2001; Holtzman et al., 2004). The findings of the present study suggest that higher perceived criticism from the support provider amplifies the negative effects of catastrophizing on pain are consistent with previous research which suggests that negative social interactions are associated with maladaptive ways of coping that result in poorer physical outcomes. Griffin and colleagues (2001) found relationship between perceived punishing responses of support providers and a greater use of venting negative emotions which resulted in poorer disease status over time. Similarly, disappointment with received support was found to indirectly influence the pain experience through the increased use of maladaptive forms of coping and decreased use of adaptive ways of coping (Griffin et al., 2001; Holtzman et al., 2004).

Findings from the present study suggest that for individuals with SCI, global perceptions of available support may be better predictors of the pain experience compared to perceptions of support received within a day. This finding is consistent with past research that has found perceived support to be more reliably related to beneficial health outcomes than received support (Uchino, 2004, 2009; Wills & Shinar, 2000). Perceived support has been found to be relatively stable over time, even despite changes in social circumstances (Uchino, 2009). In contrast, the effectiveness of received support may depend heavily on the context of the situation in which support is sought, provided, received and perceived (Berg & Upchurch, 2007; Suls & Fletcher, 1985). As support consists of an interpersonal transaction, both the support provider and support
receiver, as well as any pre-existing dynamics between them, can influence the effectiveness of any supportive gestures (Uchino, 2009). Although attempts to provide support are usually well intentioned, it is not the case that such attempts will always be effective or even perceived as helpful by the recipient. One possible reason why perceptions of received support may be less effective arises from the matching hypothesis of support (Cutrona & Russell, 1990) which suggests that support is most effective when it is matched to the specific needs of the recipient. As a result, effectiveness of support may be reduced if the type of support provided does not adequately address the needs of the support seeker (Uchino, 2009). A second possibility is that relationship quality between the support provider and recipient may impact the effectiveness of received support. For example, individuals receiving support from relationships characterized by both positive and negative aspects did not benefit from such support in comparison to relationships characterized only in a positive manner (Holt-Lunstad, Uchino, Smith, & Hicks, 2007). Finally, received support may not be effective due to the possibility that it is perceived as a threat to the recipient’s independence or is related to a decrease in one’s self-esteem (Bolger, Zuckerman, & Kessler, 2000; Matire, Stephens, Druley, & Wojno, 2002). Bolger and Amarel, (2007) suggest that the timing of support may impact its visibility to the recipient, with less visible provisions of support more likely to help maintain the recipient’s sense of self-efficacy. Support is said to be less visible when it is provided either before it is sought by the recipient, or in a manner that goes unnoticed or is not interpreted as support. The issue of independence and self-esteem may be particularly salient for those with SCI, given the functional limitations they face as a result of their injuries (Bloemen-Vrencken et al., 2005; Kirchberger et al., 2010). As such, perceptions of received support may invoke feelings of inadequacy, thus reducing the efficacy of the supportive gesture.
Findings from the current study largely support extant literature while also making a number of advances. The present study prospectively examined the moderating role one’s social environment plays in the relationship between catastrophizing and pain in a sample of individuals with SCI. Past research examining such relationships has relied primarily on retrospective, cross-sectional designs. The current study is the first to employ an intensive longitudinal design to examine pain, catastrophizing and social support as they unfold over the day for those living with SCI. These findings suggest that perceptions of available support can buffer the negative effects of catastrophizing while perceptions of criticism from a support provider can exacerbate catastrophizing’s deleterious effects on pain intensity. One implication of these findings is that one may need to attend to the social context of pain when trying to understand and modify catastrophizing. Cognitive-behavioral approaches for the management of chronic pain have found decreases in the frequency of catastrophizing to be related to improvements in pain-related anxiety, physical disability, psychosocial disability, and physical performance, despite not directly targeting catastrophizing as a focus of treatment (Vowles, McCracken, & Eccleston, 2007). Although interventions to help patients learn to reduce pain catastrophizing have recently been developed, (Burns, Kubilus, Bruehl, Harden, & Lofland, 2003; Thorn, Boothby, & Sullivan, 2002; Thorn, 2004), such strategies focus on the patient without consideration of the social context. Interventions that involve both the patient and a primary support provider (e.g., the spouse) may prove to be an effective means to reduce pain catastrophizing and improve the experience of pain. Such protocols could not only help patients minimize the tendency to catastrophizing but also offer support providers strategies to improve the manner in which support is delivered. Teaching patients and their support providers how to effectively communicate about the pain experience and expectations for support could serve to
strengthen the relationship, reduce negative responses from the support provider and minimize the impact of catastrophizing when it occurs.

Limitations and Future Directions

The current study relied solely on self-report data, as data were reported only from the patient’s perspective. It is unclear how well perceptions of received support and criticism would have mapped onto support provider reports of how they responded to participants. Future studies examining the interactions between those living with SCI and their support providers would be well served to collect responses from both parties, in order to better understand the ways in which the manner, timing and visibility of support provision may influence perceptions of support and its efficacy.

In the present study, nominated support providers included spouses, parents, children, friends and paid support staff. Perceptions of received support and satisfaction with such support could vary greatly depending on specific relationship between support provider and recipient. For example, (Brown & Harris, 1978) highlighted the importance of support from the spouse, with the finding that support from siblings, parents or friends did not compensate for the lack of support from the spouse. Given the diversity of support providers in the current study it was difficult to draw clear conclusions about the effects of received support on catastrophizing and pain. Future research aimed at better understanding the ways in which support may be delivered in the most effective manner might instead focus on one specific type of support provider (e.g., the spouse). Despite assessing received support from a variety of support providers, the small sample size collected in the present study precluded any examination of the ways in which
support provision and perceptions of received support may differ by support provider type. Future studies could collect larger samples, comprised of different groups of support providers, in order to investigate such differences and how they may impact catastrophizing and the pain experience. Finally, although it appears that global perceptions of support availability may be more predictive of the pain experience than perceptions of received support, it is important to note that participants only assessed received support from one nominated support provider, whereas perceived support assessed perception of support availability from one’s entire support network. As individuals may receive a variety of support from a number of members of their social network each day, future research might consider assessing the total amount of support received each day, in order to better understand the relationship between received support and the experience of pain in SCI.

Although the findings of the present study are largely consistent with the extant literature on chronic pain, the etiology of SCI and the subsequent challenges facing those with SCI may differ in drastic and important ways from those living with chronic pain resulting from other causes. As such, future studies are required to determine the extent to which these findings are generalizable to other chronic pain populations.

Despite these limitations, data from the present study provides support for the importance of considering the social environment in the context of catastrophizing and pain for individuals with SCI. Future research could bolster these findings by determining whether the present findings replicate with other chronic pain populations, examining both patient and support providers factors that might impact the efficacy of support provision and receipt and by directly assessing those with SCI and their support provider in examining the timing, visibility and
manner of delivery of support to better understand the contexts in which perceptions of received support result in beneficial physical or psychological outcomes.
Table 3.1
Means, standard deviations, and frequencies for demographic and SCI variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>Overall Mean (SD)</th>
<th>Overall %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>49.29 (12.57)</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>68.40</td>
<td></td>
</tr>
<tr>
<td>Females</td>
<td>31.60</td>
<td></td>
</tr>
<tr>
<td>Education level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Some schooling</td>
<td>30.30</td>
<td></td>
</tr>
<tr>
<td>High school diploma</td>
<td>31.60</td>
<td></td>
</tr>
<tr>
<td>Bachelor’s degree</td>
<td>15.80</td>
<td></td>
</tr>
<tr>
<td>PhD/professional</td>
<td>3.90</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>18.40</td>
<td></td>
</tr>
<tr>
<td>Estimated annual pre-tax income</td>
<td>$36,581 (52,304)</td>
<td></td>
</tr>
<tr>
<td>Employment status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full-time</td>
<td>13.30</td>
<td></td>
</tr>
<tr>
<td>Part-time</td>
<td>8.40</td>
<td></td>
</tr>
<tr>
<td>Self-employed</td>
<td>13.30</td>
<td></td>
</tr>
<tr>
<td>Unemployed</td>
<td>33.30</td>
<td></td>
</tr>
<tr>
<td>Retired/disability benefits</td>
<td>31.70</td>
<td></td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caucasian</td>
<td>84.30</td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>2.60</td>
<td></td>
</tr>
<tr>
<td>Native</td>
<td>3.90</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>9.20</td>
<td></td>
</tr>
<tr>
<td>Marital status</td>
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<td></td>
</tr>
<tr>
<td>Single</td>
<td>32.90</td>
<td></td>
</tr>
<tr>
<td>Married/common-law</td>
<td>51.40</td>
<td></td>
</tr>
<tr>
<td>Divorced/separated</td>
<td>10.50</td>
<td></td>
</tr>
<tr>
<td>Widowed</td>
<td>2.60</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>2.60</td>
<td></td>
</tr>
<tr>
<td>Level of injury</td>
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<td></td>
</tr>
<tr>
<td>Cervical</td>
<td>50.00</td>
<td></td>
</tr>
<tr>
<td>Thoracic</td>
<td>43.20</td>
<td></td>
</tr>
<tr>
<td>Lumbar</td>
<td>5.50</td>
<td></td>
</tr>
<tr>
<td>Brown-Sequard Syndrome</td>
<td>1.30</td>
<td></td>
</tr>
<tr>
<td>Injury severity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complete</td>
<td>54.90</td>
<td></td>
</tr>
<tr>
<td>Incomplete</td>
<td>45.10</td>
<td></td>
</tr>
<tr>
<td>Cause of injury</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traumatic</td>
<td>88.16</td>
<td></td>
</tr>
<tr>
<td>Non-traumatic</td>
<td>11.84</td>
<td></td>
</tr>
<tr>
<td>Years since injury</td>
<td>18.30 (13.63)</td>
<td></td>
</tr>
<tr>
<td>Age when SCI occurred</td>
<td>31.81 (14.99)</td>
<td></td>
</tr>
<tr>
<td>Questionnaire completion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Independently</td>
<td>64.50</td>
<td></td>
</tr>
<tr>
<td>With assistance</td>
<td>25.00</td>
<td></td>
</tr>
<tr>
<td>Did not respond</td>
<td>10.50</td>
<td></td>
</tr>
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</table>
Table 3.2

Means, standard deviations, and frequencies for interview variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>Frequency(^a) (%)</th>
<th>Overall Mean (SD)</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain</td>
<td>89.20</td>
<td>3.38 (1.87)</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>Pain catastrophizing</td>
<td>89.27</td>
<td>1.83 (0.70)</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Negative mood</td>
<td>97.20</td>
<td>1.46 (0.73)</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Support provider criticism</td>
<td>63.40</td>
<td>1.30 (0.45)</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Satisfaction with support</td>
<td>61.90</td>
<td>4.65 (0.44)</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Received support</td>
<td>63.50</td>
<td>3.99 (0.44)</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Tangible support</td>
<td>-</td>
<td>3.17 (0.69)</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Appraisal of support</td>
<td>-</td>
<td>3.12 (0.74)</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Belonging support</td>
<td>-</td>
<td>2.91 (0.86)</td>
<td>1</td>
<td>4</td>
</tr>
</tbody>
</table>

Note. \(^a\) frequency of occurrences across 760 possible assessments
Table 3.3

Bivariate correlations between daily variables (averaged within person) and person level variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Pain</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Catastrophizing</td>
<td></td>
<td>.67**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Negative mood</td>
<td>.32*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Satisfaction with support</td>
<td>.05</td>
<td>-.20</td>
<td>-.10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Received support</td>
<td>-.06</td>
<td>-.18</td>
<td>-.11</td>
<td>.62**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Criticism from support provider</td>
<td>.20</td>
<td>.26*</td>
<td>.11</td>
<td>-.28*</td>
<td>-.50**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Appraisal of support</td>
<td>-.09</td>
<td>.02</td>
<td>-.11</td>
<td>.33**</td>
<td>.46**</td>
<td>-.13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Tangible support</td>
<td>-.23</td>
<td>-.20</td>
<td>-.23</td>
<td>.31*</td>
<td>.25</td>
<td>-.06</td>
<td>.60**</td>
<td></td>
</tr>
<tr>
<td>9. Belonging support</td>
<td>-.26*</td>
<td>-.21</td>
<td>-.37**</td>
<td>.30*</td>
<td>.36**</td>
<td>-.19</td>
<td>.56**</td>
<td>.76**</td>
</tr>
</tbody>
</table>

*Note.* *p < .05; **p < .01; ***p < .001
Table 3.4

Prior catastrophizing predicting current pain, moderated by support provider criticism

<table>
<thead>
<tr>
<th>Effect</th>
<th>Model 1</th>
<th>Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 2 predictor</td>
<td>coefficient</td>
<td>coefficient</td>
</tr>
<tr>
<td>Average negative mood</td>
<td>-0.11 0.08</td>
<td>-0.12 0.08</td>
</tr>
<tr>
<td>Level 1 predictors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prior pain</td>
<td>0.06 0.19</td>
<td>0.07 0.19</td>
</tr>
<tr>
<td>Use of pain medication</td>
<td>-0.14 0.08</td>
<td>-0.14 0.08</td>
</tr>
<tr>
<td>Prior negative mood</td>
<td>0.10 0.15</td>
<td>0.13 0.15</td>
</tr>
<tr>
<td>Prior catastrophizing</td>
<td>0.06 0.07</td>
<td>0.10 0.06</td>
</tr>
<tr>
<td>Prior criticism</td>
<td></td>
<td>0.25** 0.11</td>
</tr>
</tbody>
</table>

*Note.* SE = robust standard errors
Table 3.5

Prior catastrophizing predicting current pain, moderated by belonging support

<table>
<thead>
<tr>
<th>Level 2 variables</th>
<th>Current Pain</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model 1</td>
<td>Model 2 – cross level interaction</td>
<td></td>
</tr>
<tr>
<td></td>
<td>coefficient</td>
<td>SE</td>
<td>coefficient</td>
</tr>
<tr>
<td>Average negative mood</td>
<td>0.53*</td>
<td>0.23</td>
<td>0.56*</td>
</tr>
<tr>
<td>Belonging Support</td>
<td>-0.53*</td>
<td>0.22</td>
<td>-0.45*</td>
</tr>
<tr>
<td>Level 1 variables</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prior pain</td>
<td>-0.06</td>
<td>0.06</td>
<td>-0.07</td>
</tr>
<tr>
<td>Use of pain medication</td>
<td>0.08</td>
<td>0.19</td>
<td>0.04</td>
</tr>
<tr>
<td>Prior negative mood</td>
<td>-0.14</td>
<td>0.10</td>
<td>-0.17</td>
</tr>
<tr>
<td>Prior catastrophizing</td>
<td>0.30*</td>
<td>0.15</td>
<td>0.31*</td>
</tr>
<tr>
<td>X Belonging support</td>
<td>-</td>
<td>-</td>
<td>-0.25*</td>
</tr>
</tbody>
</table>
Table 3.6

Prior catastrophizing predicting current pain, moderated by tangible support

<table>
<thead>
<tr>
<th>Level 2 variables</th>
<th>Current Pain</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Model 1</td>
<td></td>
<td>Model 2 – cross level interaction</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>coefficient</td>
<td>SE</td>
<td>coefficient</td>
<td>SE</td>
</tr>
<tr>
<td>Average negative mood</td>
<td>0.61*</td>
<td>0.24</td>
<td>0.60*</td>
<td>0.24</td>
<td></td>
</tr>
<tr>
<td>Tangible support</td>
<td>-0.63*</td>
<td>0.30</td>
<td>-0.43</td>
<td>0.31</td>
<td></td>
</tr>
<tr>
<td>Level 1 variables</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prior pain</td>
<td>-0.07</td>
<td>0.07</td>
<td>-0.07</td>
<td>0.07</td>
<td></td>
</tr>
<tr>
<td>Use of pain medication</td>
<td>0.06</td>
<td>0.20</td>
<td>0.04</td>
<td>0.20</td>
<td></td>
</tr>
<tr>
<td>Prior negative mood</td>
<td>-0.15</td>
<td>0.10</td>
<td>-0.17</td>
<td>0.11</td>
<td></td>
</tr>
<tr>
<td>Prior catastrophizing</td>
<td>0.33*</td>
<td>0.15</td>
<td>0.30*</td>
<td>0.15</td>
<td></td>
</tr>
<tr>
<td>Prior catastrophizing X Tangible support</td>
<td>-</td>
<td>-</td>
<td>-0.45**</td>
<td>0.15</td>
<td></td>
</tr>
</tbody>
</table>
Figure 3.1. Prior catastrophizing moderated by prior support provider criticism prospectively predicting current pain
Figure 3.2. Prior catastrophizing moderated by belonging support prospectively predicting current pain
Figure 3.3. Prior catastrophizing moderated by tangible support prospectively predicting current pain.
Spinal cord injury (SCI) and the subsequent events resulting from such a life-altering tragedy can present a host of impairments, stressors and challenges in many aspects of one’s life. For individuals living with SCI, these stressors and challenges may include secondary health conditions, mobility issues, difficulties with activities of daily living, and financial strain resulting from SCI related costs and lowered rates of employment post-injury (Bloemen-Vrencken et al., 2005; Kirchberger et al., 2010). Of these stressors and medical complications, pain has been reported to be the most frequent and disabling condition that affects activities of daily living and social life (Bloemen-Vrencken et al., 2005; Jensen et al., 2005). As such the current body of research examined a number of psychosocial predictors of the pain experience in a sample of individuals with SCI. Study 1 examined the impact of mood regulation on the experience of pain, and findings indicated that the ability to regulate positive mood prospectively predicted decreases in pain. In addition, the first study also examined gender differences in mood regulation and found that in the experience of pain, the ability (or inability) to regulate one’s mood mattered for women but not for men. Study 2 examined the role of the social environment in the prospective relationship between catastrophizing and pain. Findings suggest that perceptions of support and criticism can serve to either buffer or exacerbate catastrophizing’s deleterious effects on pain.

Taken together, these studies help elucidate psychosocial processes in the experience of pain for those living with SCI. By employing an intensive longitudinal design, this research progresses beyond cross-sectional data, as it offers the ability to draw causal inferences with greater confidence while retaining ecological validity. In addition, such
modeling techniques provide an ideal framework to examine not only between person differences but also within-person changes as they unfold over time.

The following discussion offers a summary of the studies contained herein. A model of dyadic coping is presented as a framework in which to place the current findings and guide future related studies. A review of the strengths and limitations of the research follows, along with suggestions for future lines of inquiry. Finally a discussion of the implications of this research is presented.

4.1 Summary of research findings

As previously described, the lives of individuals with SCI are often fraught with challenges and stressors that have the potential to elicit negative emotions and diminish positive mood. Although many of the difficulties faced by those with SCI may be relatively entrenched, the emotions elicited by such difficulties are amenable to change. With regards to emotions, an overwhelming amount of evidence supports the central and interactive roles of affective state and sensory information in the experience of pain (Gatchel et al., 2007; Robinson & Riley, 1999; Smeets et al., 2006). Accordingly, findings from Study 1 suggest that managing one’s emotions may be one key pathway through which the experience of pain can be influenced. Although many emotion regulation strategies (e.g. distraction, cognitive reframing) have demonstrated an association with decreased pain intensity, Study 1 employed an empirically derived definition of mood regulation, based on changes in participant reports of mood over time (as described in Table 2.3 and depicted in Figure 2.1), to examine whether such changes in mood prospectively predicted changes in pain. In line with emotion regulation research using similar methods (Connelly et al., 2007; Connelly et
al., 2012; Paquet et al., 2005), findings demonstrated that when individuals were able to raise positive mood from less than desirable levels to or beyond their average (recovery), they experienced significantly lower levels of pain. This first study also examined the consequences of the inability to regulate mood by examining instances when an undesirable mood state remained across two consecutive assessments (non-recovery) or when a desirable mood state could not be sustained (non-maintenance). Results suggest that when positive mood remained below average across two consecutive time-points individuals tended to experience significantly higher pain intensity. Finally, an examination of gender differences revealed that for women, maintenance of positive mood predicted decreases in pain while the inability to recover from lower than average levels of positive mood resulted in increases in pain. For men however, changes in pain intensity were not significantly associated with either maintenance of positive mood or the inability to recover from lower than average levels of positive mood. In contrast to studies employing similar definitions of regulation (Connelly et al., 2007; Connelly et al., 2012; Paquet et al., 2005), maintenance and recovery of negative mood (and the inability to regulate negative mood) was not associated with changes in pain intensity.

Study 2 sought to examine the ways in which perceptions of support and criticism, served to both buffer and exacerbate the negative effects of catastrophizing on pain. Consistent with previous research (Buenaver et al., 2007; Giardino et al., 2003; Holtzman & DeLongis, 2007) social relationships were found to play an important role in the association between pain and catastrophizing. Global perceptions of support availability (tangible and belonging support) were found to directly predict average levels of pain intensity as well as to buffer the deleterious effects of catastrophizing on subsequent pain. Consistent with
previous findings (Holtzman & DeLongis, 2007) neither within day perceptions of received support from the support provider nor satisfaction with such support was found to prospectively predict changes in pain, nor to interact with catastrophizing in the prediction of pain. However, within day perceptions of critical responses from the support provider were found to play an important moderating role in the pain experience of those with SCI. Increases in catastrophizing were only found to prospectively predict increased pain when perceptions of criticism from the support were higher than average.

4.2 A Dyadic coping framework

The systemic–transactional model of dyadic coping (Bodenmann, 2005) lends itself well as a useful framework from which to integrate and extend the current findings. It is defined as a process in which the coping responses of one partner takes into consideration the stress signals of the other partner. Furthermore, Bodenmann’s model of dyadic coping (2005) suggests that coping efforts of both an individual and their partner (i.e. spouse), are triggered by a specific stressful event that affects both individuals. Indeed, spouses of people with SCI are also negatively impacted and must adapt and cope with the life altering changes that accompany SCI. The ability of individuals and their spouses to cope with the impact of the injury itself and the daily challenges that SCI presents when life falls back into a more regular rhythm, can have a significant impact on adjustment to SCI, the well-being of the spouse and the health of the marriage as a whole. In this formulation of dyadic coping, an appraisal of stress is communicated (verbally or non-verbally) by one partner and then perceived, interpreted and responded to through dyadic coping by the other. Positive dyadic coping responses include supportive and common dyadic coping strategies focusing on dealing with problems or emotions. Supportive dyadic coping refers to the assistance one
partner provides to the other in his/her coping attempts, whereas common dyadic coping refers to a joint coping process in response to a common stressor (Bodenmann, 2005). Clearly a great deal of problem focused supportive dyadic coping occurs in the form of providing assistance with activities of daily living for those with SCI. Emotionally supportive dyadic coping strategies include empathic understanding, helping one’s partner reframe the situation, expressing solidarity with the partner, while emotion-focused common dyadic coping includes such strategies as sharing of feelings, relaxing together, and mutual commitment (Bodenmann, 2005).

In light of the present findings on mood regulation, such emotion-focused dyadic coping strategies could have an important influence on the pain experience by assisting in the mood recovery processes which were found to predict decreases in pain intensity. In contrast to positive dyadic coping responses, Bodenmann’s theory of dyadic coping (2005) also suggests that stress communications from one partner may be met with negative forms of dyadic coping from the other. These negative forms include hostile, ambivalent and superficial dyadic coping. Of particular relevance, hostile dyadic coping refers to support which is accompanied by mocking, critical, or sarcastic remarks, disparaging, distancing, open disinterest, or minimization of seriousness of the other partner’s stress. In the present study, high levels of perceived criticism were indirectly associated with increases in pain intensity. These findings provide support for the deleterious effects of negative comments that may accompany supportive gestures; however it remains unclear under what conditions such negative responses arise. Bodenmann’s dyadic coping model suggests that specific dyadic coping responses may depend on the ways an individual appraises the stress communication of the partner. A number of cognitive appraisals have been associated with
the stress communication process, including: who initially perceived and communicated the stressor; the cause of the stressor; responsibility; and controllability of the stressor (Bodenmann, 2005). When the stressor is pain however, such appraisals may be complicated by the complex nature of pain communication. The communications model of pain (Craig, 2009; Hadjistavropoulos & Craig, 2002; Hadjistavropoulos, Craig, & Fuchs-Lacelle, 2004; Prkachin & Craig, 1995) suggests that the response of an observer to an individual’s expressions of pain depends on their ability to accurately decode such expressions of pain. The message recipient may accurately perceive the pain of the sender, or misperceive by amplifying, distorting, or minimizing the painful state of the sender (Hadjistavropoulos et al., 2011). Furthermore, an observer’s response to expressions of pain may be impacted by the relationship between the observer and the individual in pain, judgements of fairness or deservingness of the person in pain and the manner in which the pain is expressed (Hadjistavropoulos et al., 2011). Errors in decoding expressions (e.g., grimaces, winces, smiles, yelps, or sharp intakes of breath) and inaccurate inferences regarding intent of the pain behaviour may result in poor responses from the observer. Taken together the model of dyadic coping and the extensive literature on pain communication highlight the need for future research to examine the ways in which pain communication impacts dyadic coping and how these coping responses in turn influence the experience of pain.

Findings from the current research also suggest that perceptions of social support availability serve to buffer the negative effects of catastrophizing on pain. These perceptions of support availability may reflect patterns of dyadic coping that have accumulated over time to form a lasting impression of support stability that may serve a protective function. Indeed both cross-sectional and longitudinal research have provided evidence for a relationship
between dyadic coping and marital quality, such that more positive and less negative dyadic coping was associated with higher marital quality (Bodenmann, Pihet, & Kayser, 2006; Bodenmann, 2005; Wunderer & Schneewind, 2008). Research on the relationship between marital satisfaction and pain suggests that marital satisfaction may have indirect effects on the pain experience (Cano, Weisberg, & Gallagher, 2000; Kerns, Haythornthwaite, Southwick, & Giller Jr., 1990), however findings remain inconclusive, given the cross-sectional nature of these studies. As such, future research is needed in order to examine the role of marital satisfaction in the experience of pain, within a dyadic coping framework.

4.3 Limitations and future directions

Caution must be taken in generalizing the present findings to other chronic pain populations. Unlike the etiology of many chronic pain conditions such as rheumatoid arthritis and fibromyalgia, SCI more often results from engaging in risk taking behaviors. Evidence from past research has suggested that adolescent and young adult males are more likely than females or older males to engage in a host of risk taking behaviours (Byrnes et al., 1999; Turner & McClure, 2003). As the current sample of individuals with SCI was relatively young, predominantly male, and had a high proportion of traumatic causes of SCI (87.5%), it is possible that the findings are limited to those with a proclivity towards risk taking. The current research was unable to control for risk-taking. Although participants were asked about the incident that resulted in their SCI, assessing risky behaviour and attributions of responsibility or perceptions of blame for their SCI was difficult to ascertain. The majority of participants provided extremely brief responses such as “fell at work” or “motor vehicle accident” without providing details regarding attributions of responsibility or perceptions of blame. In addition, research examining self-blame in a sample of individuals
with SCI found that after controlling for causal attributions for the SCI event, self-blame was predicted by self-implicating perceptions of avoidability (Davis, Lehman, Silver, Wortman, & Ellard, 1996). As such, self-reports of risk taking behaviour related to the SCI event may be unreliable. Replication of the current findings in alternate chronic pain populations (e.g. rheumatoid arthritis), in which risk taking behaviour is not a possible confound, is needed in future research. In addition, individuals with NT-SCI could provide future researchers an alternative chronic pain population from which to assess psychosocial predictors of adjustment in SCI without the possible confounding factor of risk taking behaviour.

However, it should be noted that the findings from the present study are consistent with the larger literature on mood regulation and pain, as well as on catastrophizing and pain, suggesting that the findings may be generalizable to other chronic pain populations.

Further, the current sample of individuals with SCI included a small number of individuals whose SCI resulted from nontraumatic causes. T-tests found no significant differences on demographic and study variables between those with traumatic and nontraumatic causes, however given the relatively small sample size there was insufficient power to determine whether the current findings differed by the etiology of the injury. This highlights a limitation of the larger body of research on SCI. Although some estimates suggest the prevalence of NT-SCI to be triple that of T-SCI (McDonald & Sadowsky, 2002), research in this population has only recently emerged. Accordingly, it remains unclear whether findings that recruited samples of individual with T-SCI can generalize to those with nontraumatic causes. Findings from a recent studies comparing NT-SCI with T-SCI suggest that those with nontraumatic causes are older, more likely to be female, more likely to be paraplegic than tetraplegic and have a greater number of comorbidities (Cosar et al., 2010;
Guilcher et al., 2009; New, Simmonds, & Stevermuer, 2011). Beyond documenting demographic differences, only a small number of studies have assessed psychological outcomes in comparing those with traumatic and nontraumatic causes of SCI. One cross-sectional study examined depression, anxiety and stress and found no significant differences between those with T-SCI and NT-SCI (Migliorini, New, & Tonge, 2009). Another cross-sectional study found significantly lower levels of pain for those with NT-SCI while depression was not found to differ by etiology (Tate, Forchheimer, Karana-Zebari, Chiodo, & Thomas, 2012). Despite these recent studies, there is currently very little research on psychosocial processes and the ways in which they impact adjustment in individuals with NT-SCI. Future research is needed to determine the possible ways in which such psychosocial contributions might differ depending on the etiology of the injury and whether findings from one cause could be generalized to the other. Such research might also provide insight on the generalizability of SCI research to other chronic pain populations.

The broader study from which data used here were drawn included support providers nominated by the participant. With the exception of SCI related variables, these support providers completed questionnaire packages similar to those provided to participants with SCI and participated in all three phases of the study. Of particular interest, support providers completed twice daily telephone diaries assessing mood, interactions with the patient (i.e. support provision and criticism), stressful events and coping strategies used to address such stressors. Unfortunately, data from the support providers were not utilized for a number of reasons. First, in many instances, daily diary assessments of the patient and the support provider were not collected in a synchronized fashion as interview times were often difficult to coordinate due to conflicting schedules of the patient and the support provider. As a
result, it would be unclear how well perceptions of received support and criticism (as an example) would have mapped onto support provider reports of how they responded to participants, given such mismatches in temporal frames of reference. Second, as only 40 support providers participated in all phases of the study, power to analyze current or expanded models which include support provider variables would have thus been greatly reduced. Finally, and most importantly, nominated support providers included spouses, parents, children, friends and paid support staff. An examination of the psychosocial contributions of the support provider using such a heterogeneous group could be akin to comparing apples and oranges. For example, the majority of spouses reported living with the patient and having daily contact. In contrast patient contact varied greatly amongst the remaining support providers. Patient contact ranged from living with the support provider and seeing each other daily, to having phone conversations a few times a week. Of greater import, interactions within a conjugal relationship are likely to differ greatly and in important ways from those with other types of support providers. For example, Brown and Harris, (1978) highlighted the importance of support from the spouse, with the finding that support from siblings, parents or friends did not compensate for the lack support from the spouse. Although 23 nominated support providers were spouses, such a small sample precluded analysis of any models that might extend from the current research findings.

Future research employing an intensive longitudinal design and recruiting a much larger sample of individuals with SCI and their spouses would advance research in this field in a number of important ways. First, inclusion of the support provider would provide the opportunity to progress beyond a reliance on self-report data from the patient (Lam, Lehman, Puterman, & DeLongis, 2009; Porter, Keefe, Wellington, & de Williams, 2008). Reliance on
self-report data reveals only the perceptions of the patient, making it unclear whether
behaviours of the spouse, patient perceptions of such behaviour, or both matter in predicting
patient outcomes. Second, a large sample assessing both patient and spouse would allow a
thorough examination of pain communication and spousal support in a dyadic coping
framework. Given the interpersonal and dynamic nature of these constructs, collecting data
from both patient and spouse using an intensive longitudinal design would be ideal. For
example, information about the pain experience (e.g. intensity, catastrophizing, expectations
for support, and intentionality of the expressions of pain) from the patient’s perspective could
be compared to spouse perceptions of the patient’s pain expressions (e.g. estimates of pain
intensity, perceptions of fairness and deservingness). An examination of agreement or
discordance between patient and spouse on could reveal important information about the
ways in which spouses appraise and respond to expressions of pain. In addition, collecting
responses from both parties would allow for a more nuanced investigation of such dyadic
coping responses in terms of manner, timing and visibility of support and how these gestures
are perceived by the support recipient. Similarly, the mood of one partner may be found to
affect his or her own appraisals of stress and dyadic coping responses, as well as the coping
processes, mood and mood regulation of the other partner. Finally, such a design would
permit the examination of the interplay between mood, pain, dyadic coping, and
catastrophizing, shedding light on possible mediating or moderating pathways. For example,
future research could examine specific individual or dyadic coping strategies that result in
successful emotion regulation and whether these changes predict changes in the experience
of pain.
Although the present findings were limited to self-report, obtaining twice-daily measures close to their real time occurrence aided in reducing potential retrospective bias (Bolger & Laurenceau, 2013). More importantly, the use of an intensive longitudinal design allowed for a more nuanced understanding of the temporal ordering of variables and for causal inferences to be made. Future research utilizing random experience sampling methods to collect data at multiple times throughout the course of a day would be ideal in examining pain, pain communication, mood and spousal support in a dyadic coping framework. In consideration of the difficulties with activities of daily living that individuals with SCI often face (e.g. mobility, feeding, toileting, washing, and dressing), the current research carefully weighed the balance of increasing participant burden with the methodological benefits of multiple assessments within a day. While increasing sampling frequency within days (e.g. four or more assessments) would allow future research to examine such relationships in greater detail, alternative pain populations might be better suited for the rigors of such designs.

4.4 Implications of research findings

Over the past 25 years, advances in the fields of biochemistry, pharmacology, medicine, physiology, genetics, psychology, physical and occupational therapy, and bioengineering have resulted in novel and innovative research in SCI (Tate, Boninger, & Jackson, 2011). As a result of such research, numerous advances in clinical practice have led to improvements in many aspects of SCI. For example, biomedical advances have led to a substantial decline in mortality after the first two years following SCI (Strauss, DeVivo, Paculdo, & Shavelle, 2006). In addition such advances have resulted in reduced morbidity, as evidenced by decreases in hospital length of stay (DeVivo, 2007); reduced number of
rehospitalizations in follow-up years (DeVivo, 2007; Sipski & Richards, 2006); elimination of renal failure as a major cause of death following SCI (Sipski & Richards, 2006); and more effective treatments for spasticity (Tate et al., 2011). Furthermore, advances in biomedical engineering have led to the development of assistive technologies to restore movement and sensation, to enhance rehabilitation and to replace movement (Tate et al., 2011). For example, the development of technologies such as functional electrical stimulation (e.g. Hobby, Taylor, & Esnouf, 2001) and exoskeletal orthoses (e.g. Zeilig et al., 2012) seek to move paralyzed limbs and restore normal sensations using mechanical aids. The incorporation of robot assisted treadmills to support repetitive training regimens (Hornby, Zemon, & Campbell, 2005) and utilization of video gaming to keep patients focused on such repetitive tasks (Fitzgerald et al., 2003) are becoming commonplace in rehabilitation settings (Tate et al., 2011). Technologies to replace movement have also seen dramatic advances in the past 25 years. For example, state-of-the-art wheelchairs are being developed with the ability to navigate curbs and climb obstacles (Cooper & Cooper, 2010). In addition, brain-computer interfaces, which allow individuals to control external devices with conscious changes in brain wave activity (Wolpaw, Birbaumer, McFarland, Pfurtscheller, & Vaughan, 2002), have been developed and successfully tested by individuals with SCI (e.g. Ikegami, Takano, Saeki, & Kansaku, 2011). Finally, although a substantial amount of research is now focused on improving the experience of living with SCI, the search for a “cure” remains a critical research focus. Research in the fields of neuroscience and genetics have identified numerous opportunities and therapeutic targets that increase the potential for central nervous system regeneration and repair (Joy, Altevogt, Liverman, & Johnson, 2005).
Although there is cautious optimism for a day when those with SCI can once again function at close to pre-injury levels, such a “cure/reversal” is likely decades away (Tate et al., 2011). Until such a day, the findings of the current research may play an important role in reducing pain, and improving the overall well-being of those with SCI. These findings suggest that clinical interventions teaching response focused emotion regulation skills and including support providers to help patients manage the challenges of living with SCI (e.g. reducing pain catastrophizing) may significantly improve the experience of pain. Although advances in research have resulted in new treatments, therapies, and assistive technologies to enhance rehabilitation and to restore and replace movement, engagement with such interventions may be stress provoking and elicit negative emotional responses. As such, the ability to regulate one’s emotions and the availability of proper support from close others may be critical in predicting successful outcomes for those adopting such new technology, treatment, or therapy.


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