

RELATIONSHIPS AMONG ILLNESS REPRESENTATION, AFFECTIVE
REACTIONS, AND LIFESTYLE PHYSICAL ACTIVITY IN ADULTS
WITH (NON-CANCER) PERSISTENT CHRONIC
AND NEUROPATHIC PAIN

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ABSTRACT OF THE DISSERTATION

Relationships among Illness Representation, Affective Reaction, and Lifestyle Physical Activity in Adults with (Non-Cancer) Persistent Chronic and Neuropathic Pain

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Purpose: The purpose of this study was to investigate the relationships among illness representations, affective reaction and lifestyle physical activity in community dwelling adults who experience symptoms of (non-cancer) persistent chronic and neuropathic pain.

Rationale: Using the framework of the Common Sense model of self-regulation, theoretically derived antecedents to the adaptation of coping behaviors consistent with participation in lifestyle physical activity included illness representations of identity, consequences, personal control, treatment control and level of pain catastrophizing.

Methods: The sample population consisted of 115 adults, age 21 through 64, who were scheduled for an intervention pain management procedure at an outpatient surgical center between April and September 2013. Data were collected using a modified Taylor Design Method. Hypotheses were tested using correlational and hierarchical multiple regression analyses.

Results: Significant correlations were revealed between several illness representation dimensions (illness identity and illness consequences) and lifestyle physical activity. All dimensions of illness representations tested were significantly correlated with pain catastrophizing. Regression analysis revealed a significant and independent effect of illness consequence representations on lifestyle physical activity and of illness identity

(number of symptoms), illness consequence, and personal control representations on pain catastrophizing.

Conclusions: The experience of persistent chronic and neuropathic pain with its varied symptom profile is different from that of stable chronic pain and has a negative effect on illness representations. Negative illness representations are highly associated with pain catastrophizing and independently associated with depression and anxiety. Pain catastrophizing may have a greater effect on work-activity rather than life style physical activity. Additional investigations are needed improve nursing assessment of chronic pain and to develop interventions that reduce negative affective reactions and improve work engagement for adults living with persistent, chronic and neuropathic pain.

Keywords: chronic pain; common sense model; pain catastrophizing; neuropathic pain

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CHAPTER 1: THE PROBLEM

Chronic pain affects at least 116 million American adults and, according to the Institute of Medicine (IOM), more than the total number of persons affected by heart disease, cancer, and diabetes mellitus combined (IOM, 2011). In addition, pain treatment, management and general productivity loss can cost the nation up to \$635 billion each year. A unique subset of persons with persistent chronic pain may also experience transitory incidents of exacerbations with painful symptoms that occur in addition to their otherwise stable persistent pain. The episodic nature of this breakthrough pain in persons with chronic pain is a major problem that is both difficult to classify and has been poorly studied (American Pain Foundation, 2011; Mercadante et al., 2002). The most common type of breakthrough pain is associated with intentional movements, resulting in increased pain intensity. It can be defined as a transitory escalation in chronic pain, characterized as highly intense which suggests limited periods of uncontrolled breakthrough pain that is similar in character to the baseline chronic pain. The pain associated with neuropathy however, can vary in characteristics, intensity, frequency and duration. In general, breakthrough pain of any type has been associated with a reduced likelihood for adequate pain control (American Pain Foundation, 2011; Mercadante et al., 2002; McCaffery & Pesaro, 2003).

Neuropathic pain is a class of breakthrough pain that is qualitatively different than the episodic pain escalations commonly associated with intentional movement (Caraceni, Martini, Zecca, & Portenoy, 2004; Mercadante et al., 2002) associated with conditions such as rheumatoid arthritis. Unlike the more commonly experienced visceral or nociceptive symptoms associated with persistent chronic pain, neuropathic pain typically

results from a primary lesion, irritation, or malfunction within the central or peripheral nervous system. Neuropathic pain may be characterized as radiating, typically associated with sensations along the affected nerve root. It is pain that has been described as aching, burning, gripping, pinching, pulling, sharp, shooting, stabbing, stinging, or throbbing (Lovejoy, Turk, Morasco, 2012). According to May and Serpell (2009), neuropathic pain can be simultaneously associated with one or more varying characteristics. Neuropathic pain may be associated with numbness, tingling and hypoesthesia in the affected area. In addition, neuropathic pain can be accompanied by motor weakness, changes in skin temperature and localized hypersensitivity along the affected nerve distribution making it difficult for the individual who experiences it to pinpoint or conceptualize the anatomic origin or cause of the pain. In patients with underlying nerve root compression, due to compressive pathology involving the spine, transient episodes of spontaneous lancinating or burning sensations along the affected nerve root are common manifestations.

In the context of daily life and health maintenance, intentional movement in the form of routine lifestyle physical activity is important for adults living with persistent chronic and neuropathic pain. According to Mercadante et al. (2002), breakthrough pain is generally unpredictable, sudden in onset, and reaches its peak intensity within minutes. The unpredictability and often uncontrollability of persistent, chronic and neuropathic pain, a subset of breakthrough pain, with its varied characteristic may profoundly interfere with the successful development of lifestyle strategies, such as engagement in routine lifestyle physical activity, adopted by individuals who experience this type of pain.

The Role of Lifestyle Physical Activity in Persons with Chronic Pain

According to the guidelines for physical activity (DHHS, 2008), lifestyle physical activity is a term used to encompass daily activities that can contribute to sizeable energy expenditure, and includes occupational, leisure-time or recreational, household, and self-care activities. Lifestyle physical activity also includes transportation or commuting activities, such as taking the stairs instead of using the elevator, walking to do errands instead of driving, getting off one bus stop earlier, or parking further away than usual in order to walk to a destination. Persistent chronic and neuropathic pain is a serious causative factor for reduced lifestyle physical activity (Huijnen et al., 2011). According to the National Pain Foundation survey of 2007, 65% of chronic pain sufferers acknowledged reduced participation in recreational activities, 46% avoided leaving the house to run errands, 59% had difficulty taking care of their home and doing chores, and 41% expressed difficulty taking care of themselves and their family members. Thus, persistent chronic and neuropathic pain may lead to severe reductions in health, independence, and lifestyle physical activity limitations (Rimmer, 2005). Yet, little is known of the extent to which an individual's interpretation of their pain experience and their emotional reactions to the pain may affect their level of participation in lifestyle physical activities.

Representations of Persistent Chronic and Neuropathic Pain

When confronted with a health threat such as persistent chronic and neuropathic pain, theorists postulate that a person forms a representation or set of beliefs about the pain including its characteristics (e.g., bothersome, intense), its cause, its timeline (acute, intermittent, chronic), how long it will last, its short- and long-term consequences, and whether it can be controlled or cured (Leventhal, Leventhal & Breland, 2011). The

symptoms of neuropathic pain, in particular pain that originates from injury, irritation, or pathology of the spine, can wax and wane in intensity, frequency, and duration making it difficult for the individual to form or sustain accurate representations of their pain.

Importantly, a person's beliefs about or representations of persistent chronic and neuropathic pain may directly affect health behaviors such as level of engagement in lifestyle physical activity (Cameron & Leventhal, 2003; Petrie & Pennebaker, 2004; Leventhal, et al., 2011). For the patient with persistent chronic and neuropathic pain, noxious sensations may be difficult to interpret and faulty representations of pain may have a negative impact on health behaviors such as a lack of engagement in lifestyle physical activities (Cameron & Leventhal, 2003; Dunn, Anderson & Jakicic, 1998; Leventhal, Brissette, Leventhal, 2003; Leventhal, Diefenbach & Leventhal, 1992; Leventhal et al., 2011). Associations between representations of painful symptoms and reduced physical activity have been supported empirically by studies on a number of chronically ill populations, such as patients with cancer, rheumatoid arthritis, chronic obstructive lung disease (COPD), chronic fatigue syndrome, and psoriasis (Boot, Heijmans, Van der Gulden, & Rijken, 2008; Graves, Scott, Lempp, & Weinman, 2009; Hagger & Orbell, 2003). For example, research findings by Scharloo and colleagues (2010) revealed that patients with head and neck cancer who interpreted or represented their illness as one with multiple symptoms, a chronic timeline, and serious consequences demonstrated lower levels of lifestyle physical and social activity, and reduced social role functioning. However, there were no empirical investigations identified that examined the relationship between illness representations and lifestyle physical activity in persons with persistent, chronic and neuropathic pain.

Affective Reactions and Lifestyle Physical Activity

Theorists propose that, when confronted with a chronic illness, such as one that results in persistent, chronic and neuropathic pain, people are likely to have affective (emotional) reactions to their to their pain. These emotional reactions directly influence health behaviors, such as level of participation in lifestyle physical activities (Leventhal, Leventhal & Cameron, 2005).

An individual's catastrophic thinking about their pain may be conceptualized as an affective reaction or emotional response to the persistent, chronic and neuropathic pain experience. Catastrophizing is described as an intense affective reaction which results in rumination about the pain, magnification of the underlying condition, and increased feelings of helplessness associated with a perceived lack of control over the pain intensity, sensation, and duration (Sullivan, Bishop & Pivik, 1995). Research has consistently revealed catastrophic thinking as one of the most important factors that influences negative outcomes of pain experiences (Ellis & D'Eon, 2002), such as increased pain intensity (Edwards et al., 2010), depression and disability (Keefe, Brown, Wallston, & Caldwell, 1989; Roth, Geisser, Theeisen, Goodvich, & Dixon, 2005; Roth, Lowery & Hamill, 2004; Sullivan & D'Eon, 1990). In fact, findings from an investigation of persons with chronic back pain revealed that catastrophizing played a significant role in the avoidance of usual daily activities (Elfving, Andersson, & Grooten, 2007; Huijnen et al., 2011). Therefore, it is plausible that one's affective reaction to persistent, chronic and neuropathic pain may play an important role in the extent to which an individual engages in lifestyle physical activities.

Pain Representations and Catastrophizing

Theorists also postulate that representations or beliefs about pain, that is, pain representations, may influence affective reactions, such as catastrophic thinking about pain (Leventhal, Breland, Mora & Leventhal, 2010). For example, research conducted by Stuifeberger, Phillips, Voelmeck, and Browder (2006) revealed greater emotional distress responses in patients with chronic pain from fibromyalgia who characterized or interpreted their characteristic symptoms as very painful and unstable with a fluctuating, or cyclic patterns of occurrence. Hence, the nature of a person's beliefs or representations of chronic and neuropathic pain may be affected by catastrophizing reactions to this type of pain. Inasmuch as no empirical investigations of this relationship in persons with persistent, chronic and neuropathic pain have been conducted, there is a need to gain an understanding of the extent to which these specific pain representations influence catastrophic thinking and respective affective responses in this chronic pain population.

Mediator Role of Pain Catastrophizing

A multitude of studies examined the association between illness representations and health behaviors in persons with chronic illnesses. However few, if any, have examined operant mechanisms for these relationships. Theorists posit that illness representations can directly influence emotional responses that, in turn, affect level of engagement in lifestyle physical activities that persons may adopt to cope with or manage the emotional reactions (Leventhal et al., 2010). Thus, it is plausible that pain catastrophizing as an emotional response to representations of persistent, chronic and neuropathic pain may mediate the relationship between pain representations and lifestyle physical activity behaviors (see Figure 1) in adults with painful health conditions

(Leventhal et al., 2003) that originate from injury, irritation or pathology emanating from the spine.

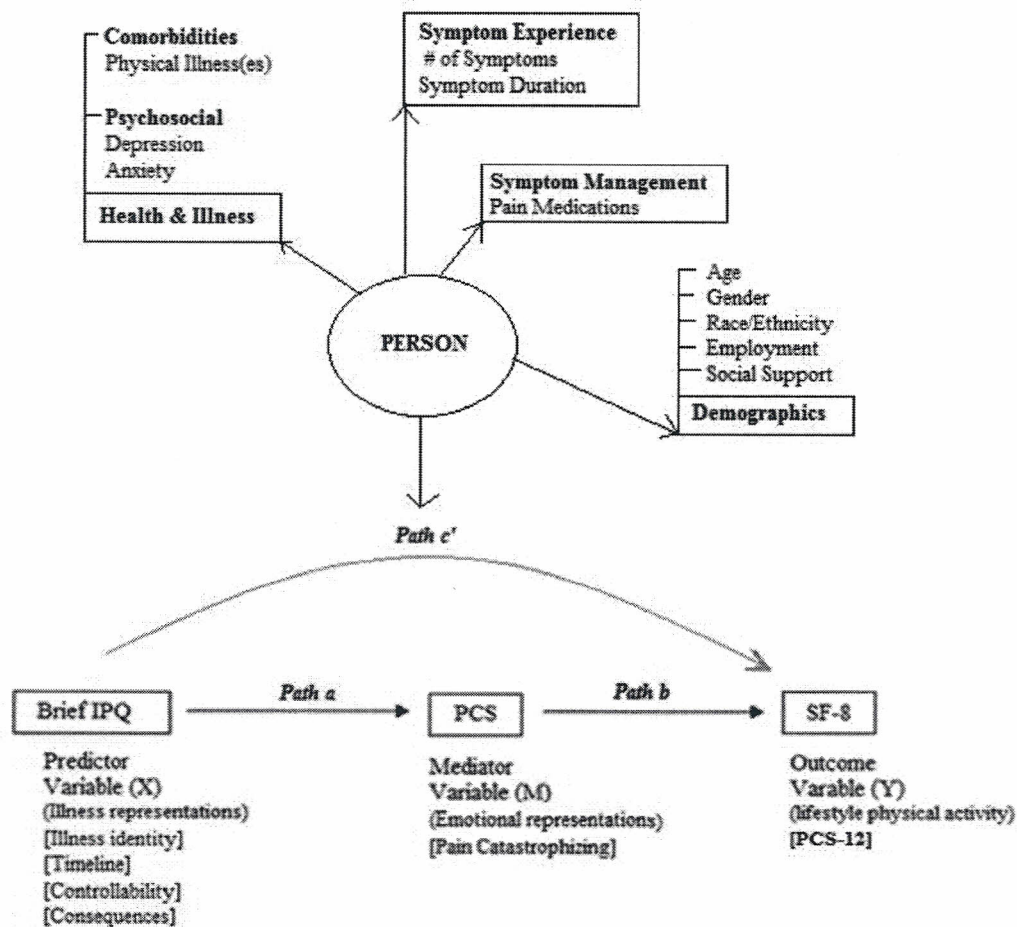


Figure 1. The Mediator Role of Pain Catastrophizing

Study Purpose

One of the goals of health research is to identify and further understand factors that influence adherence to prescribed treatment and illness management. There was no research that had previously examined the interrelationships among illness representations, affective reactions, and lifestyle physical activity in adult individuals with persistent, chronic and neuropathic pain. Therefore, the purpose of this study was to investigate theorized relationships among illness representations, catastrophic thinking

about pain, and participation in lifestyle physical activity among adults with persistent, chronic and neuropathic pain.

Research Question

The following question was posed regarding the theoretical relationships among variables to be studied within the framework of the common sense theory of self-regulation: *“What are the interrelationships among pain representations, pain catastrophizing, and lifestyle physical activity in adults who experience persistent, chronic and neuropathic pain?”*

Sub Question(s)

1. What is the relationship between pain representations and lifestyle physical activity in adults who experience (non-cancer) persistent, chronic and neuropathic pain?
 - a. *What is the relationship between pain identity representations and lifestyle physical activity in adults who experience persistent, chronic and neuropathic pain?*
 - b. *What is the relationship between pain timeline representations and lifestyle physical activity in adults who experience persistent, chronic and neuropathic pain?*
 - c. *What is the relationship between pain consequence representations and lifestyle physical activity in adults who experience persistent, chronic and neuropathic pain?*
 - d. *What is the relationship between pain control/cure representations and lifestyle physical activity in adults who experience persistent, chronic and neuropathic pain?*

- e. What is the relationship between emotional representations (pain catastrophizing) and lifestyle physical activity in adults who experience persistent, chronic and neuropathic pain?*
- 2. What is the relationship between pain representations and pain catastrophizing in adults who experience persistent, chronic and neuropathic pain?
 - a. What is the relationship between pain identity representations and pain catastrophizing in adults who experience persistent, chronic and neuropathic pain?*
 - b. What is the relationship between pain timeline representations and pain catastrophizing in adults who experience persistent, chronic and neuropathic pain?*
 - c. What is the relationship between pain consequence representations and pain catastrophizing in adults who experience persistent, chronic and neuropathic pain?*
 - d. What is the relationship between pain control/cure representations and pain catastrophizing in adults who experience persistent, chronic and neuropathic pain?*
- 3. What is the relationship between emotional representation (pain catastrophizing) and lifestyle physical activity in adults who experience persistent, chronic and neuropathic pain?
- 4. Does pain catastrophizing mediate the relationship between pain representations and lifestyle physical activity in adults who experience persistent, chronic and neuropathic pain?

Significance of the Study

Pain affects more than one hundred million Americans and chronic pain is an unpleasant experience that may continue throughout an individual's lifespan. These facts underscore the importance of research aimed at improving our understanding of pain experiences and assisting individuals to cope effectively with chronic pain (IOM, 2011). For example, in the elderly population, the Federal Medicare program generates 25% of the U.S. expenditures for pain which in 2008 was 14% of all Medicare costs, roughly \$65.3 billion dollars. Chronic pain as an illness in adulthood can often be controlled, but not eliminated. When combined with the often episodic escalations and varying symptoms of neuropathic pain, the overall control of persistent chronic pain is diminished and the pain experience becomes more dominant than any underlying disease (IOM, 2011), thus increasing the risk for disability over time due to impaired physical function. An important challenge for this research was to gain an understanding of how persons with persistent chronic and neuropathic pain represent their pain experience and the extent to which their pain representations and emotional responses influenced level of engagement in lifestyle physical activities. Moreover, illness and emotional representations are considered modifiable, and the knowledge gained from this research is designed to assist in the development and testing of clinical interventions with an aim to alter negative representations of pain and emotional reactions and increase participation in lifestyle physical activity.

Interventions designed to sustain lifestyle physical activity, promote and encourage routine physical function are important for the achievement of healthy longevity and reduced risk of disability through impaired physical function (DHHS,

2008; Sui, Laditka, Hardin, & Blair, 2007). Such interventions are especially important for adults living with persistent chronic and neuropathic pain. Reducing the impact of persistent chronic and neuropathic pain in adults improves lifestyle physical activity and reduces subsequent risks for co-morbid health conditions associated with decreased lifestyle physical activity (Wade, Riddle, Price, & Dumenci, 2010). Thus, an examination of theory-based cognitive and emotional determinants of lifestyle physical activity in adults with persistent, chronic and neuropathic pain should provide a guiding framework that encourages thoughtful reflection and stimulates the development of appropriately targeted interventions (Thorn, Boothby, & Sullivan, 2002). These potential interventions would be aimed at fostering less negative interpretations of pain, reduced pain catastrophizing, and increased level of engagement in lifestyle physical activity in this population. The information gained from this research should prompt future research directed at modifying identified antecedents to reduced lifestyle activity, that is, faulty or negative illness representations and the influence of affective reactions in persons with persistent, chronic and neuropathic pain.

CHAPTER 2: REVIEW OF THE LITERATURE

This chapter presents a discussion of the theoretical framework that guides this study and a synthesis and analysis of empirical literature as it relates to the determinants of lifestyle physical activity in adults living with persistent, chronic and neuropathic pain. The theoretical discussion in this chapter provides an overview of the Common Sense Model (CSM) of Self-Regulation and its theoretical constructs and determinants of physical activity including the dimensions of illness representations (identity, timeline, cause, control/cure, and consequence) and emotional representation in adults with persistent chronic and neuropathic pain. Following a discussion of the CSM, a review of empirical literature in support of proposed relationships among these concepts is presented. The first section of the literature review presents empirical evidence on the relationship between illness representations and lifestyle physical activity. The second section includes empirical evidence in support of the relationship between illness representations and emotional representations. The third section presents empirical studies that support the relationship between emotional representations and lifestyle physical activity. The final section presents a discussion of gaps in the literature to support the logic and plausibility of hypothesized relationships to be tested.

Theoretical Framework

The Common-Sense Model of Self-Regulation

The CSM provides a particularly efficient explanation of how and why people respond to various health conditions, and it provided a framework for explaining variations in physical activity behaviors in persons who experience persistent chronic and neuropathic pain. The CSM is an information-processing model built on the proposition

that individuals construct their own “common-sense” representations or lay models of an illness. A basic assumption of the CSM is that individuals are active problem solvers when faced with an illness. According to the CSM, a health threat, such as chronic pain, is actively processed via two parallel arms that include cognitive and emotional representations that are comprised of (1) cognitive interpretations of the meaning of the illness and its symptoms and (2) emotional or affective reactions to the health threat and its interpretations. Cognitive interpretations of an illness or health threat are referred to as illness representations, defined as a set of beliefs about an illness – whether medically sound or unsubstantiated – that guide the individual’s selection and execution of strategies for illness self-management, such as participation in lifestyle physical activities (Leventhal et al., 2010). Research has consistently shown that illness representations consists of up to five core dimensions or attributes (Leventhal, Meyer, & Nerenz, 1980) including identity, timeline, consequences, cause, and controllability (Leventhal et al., 2010).

Illness identity reflects beliefs about what the threat is called, that is, the label an individual attaches to the illness, and its associated symptoms. Timeline is defined as the individual’s beliefs about the onset, duration, and trajectory of the illness or its symptoms characterized as acute, chronic, or cyclical in nature. The cause dimension represents beliefs about the cause of an illness or its symptoms. Consequences are the beliefs about the physical, emotional, social, and/or economic outcomes of the illness. The final dimension, controllability, refers to one’s anticipated beliefs and perceived responsiveness to self-treatment and expert intervention (Leventhal et al., 2010). According to the CSM, emotional representations comprise the second arm of

information-processing and are comprised of emotional reactions and experiences in response to health threats, such as chronic pain (Leventhal et al., 2005) as depicted in Figure 2. For this study, four illness representation dimensions were examined: identity, timeline, consequence, and control/cure dimensions. Cause representations were not examined, because no uniform method for assessing this dimension across illness groups had been established, making it difficult to interpret 'cause' data in relation to other illness representation dimensions (Hagger & Orbell, 2003). In addition, there has been overlap in the individual items used to assess causal and emotional representational dimensions, such as stress and anxiety. This overlap has posed a problem due to collinearity in cause and emotional representation variables in research (Hagger & Orbell, 2003).

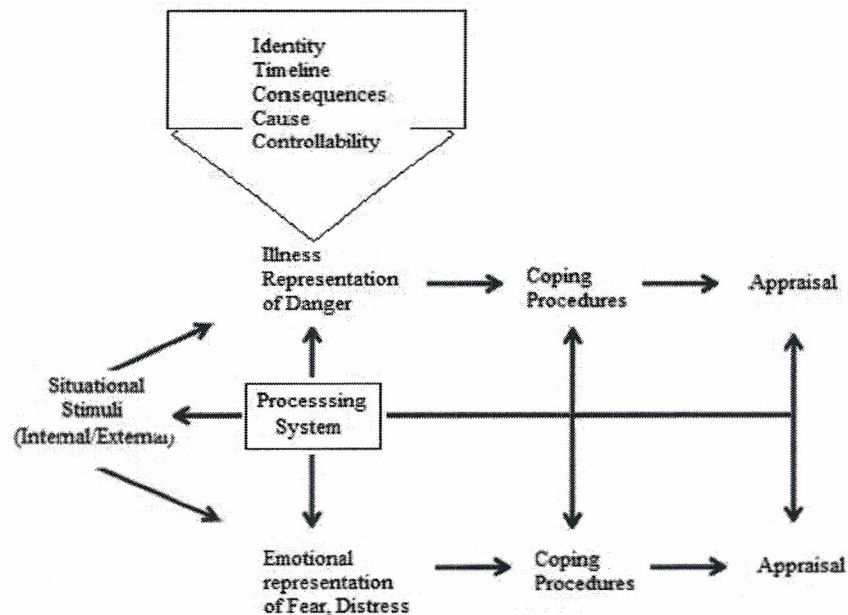


Figure 2. Common Sense Model of Self-regulation

A core relational proposition of the CSM is that one's illness representations and emotional responses are directly related to illness self-management strategies.

Specifically, the CSM proposes that an individual decides how best to respond to their “representations” of an illness threat by (1) developing and implementing procedures or strategies (i.e., coping procedures) to cope with the illness, such as reductions in lifestyle physical activities; (2) evaluating or appraising the effectiveness of illness management strategies, and (3) revising his or her understanding or interpretation of the illness threat (i.e., illness representations), thus entering successive cycles of self-regulation. This problem solving process depends heavily on the individual’s interpretation or representations of the illness; that is, their lay models of illness (Leventhal et al., 2005). Another core proposition of the CSM is that illness and emotional representations interact to affect coping procedures.

According to the CSM, when health conditions, such as chronic pain, are cognitively interpreted as a negative illness, these interpretations become powerful stimuli for emotional representations (i.e., affective responses), such as rumination about pain, a conceptual dimension of catastrophizing. Thus, it is plausible that an individual’s negative interpretations of persistent chronic and neuropathic pain are associated with negative affective reactions, such as catastrophic thinking about their pain. In addition, one’s pain representations may have an indirect effect on the selection of adaptive procedures for coping, such as a reduced level of engagement in lifestyle physical activity.

In summary, Leventhal and others postulate that pain and emotional representations influence self-regulative behaviors, that is, coping procedures (Cameron, Leventhal & Leventhal, 1993; Leventhal et al., 2011). A relationship between pain representations and pain catastrophizing is also a premise of the CSM. Lastly, a third

proposition of the CSM is that pain representations and emotional representations interact to influence coping procedures. These are the theoretical propositions that were tested in the current study as depicted in Figure 3.

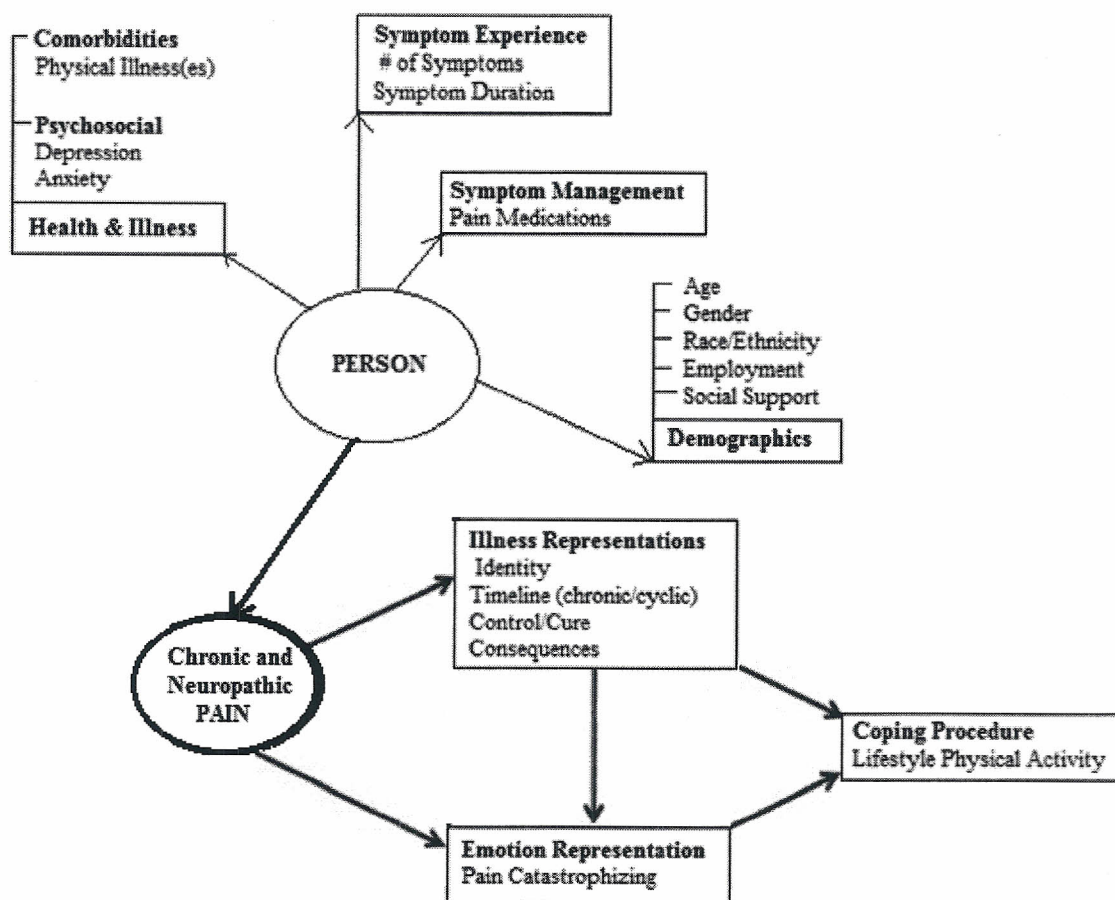


Figure 3. CSM Relationships Tested in the Proposed Study

Literature Review

Illness Representations and Lifestyle Physical Activity

In this section, a synthesis and analysis of empirical evidence that support the theorized relationship between illness representations and life style physical activity in adults with chronic pain is presented. The literature search was delimited to studies that examined relationships between illness representations and functional outcomes (i.e.,

lifestyle activities, physical function, role function, social function, disability, work participation) in samples of persons with chronic pain or other chronic illnesses characterized by painful or unpleasant symptoms. The search yielded ten studies for review. For each study, the chronic illness sample, study design, sample characteristics, variables and measures relevant to this study, and relevant study findings are summarized in Table A1.

The CSM stipulates that individuals interpret the meaning of an illness threat, such as chronic pain, by forming beliefs about the illness “label” and/or its associated symptoms, its cause, how long it will last, its consequences, and whether it can be controlled or cured. Strongly held negative beliefs that an illness has multiple symptoms, a long-term timeline, negative consequences, and cannot be controlled or cured is postulated by the CSM to lead to negative or maladaptive health behaviors and health outcomes. Conversely, strongly held positive beliefs that an illness is associated with few or no symptoms, a short timeline, mild or no consequences, and is controllable or curable is postulated by the CSM to lead to positive or adaptive health behaviors and health outcomes. Findings from two comparative studies support these theoretical tenets. In one study (Boot, Heijmans, Van der Gulden, & Rijken, 2008), persons with chronic illnesses who were fully work disabled held more negatively-oriented representations of their illness compared to the more positively-oriented illness representations of chronically ill persons who were employed. Similarly, findings from Hobro and colleagues’ (2004) comparative study of adaptors, that is, those participants with chronic pain who reported positive illness representations, and non-adaptors, that is, participants with chronic pain

who reported negative illness representations, revealed that adaptors had higher levels of physical function compared to non-adaptors.

Across the studies reviewed, the nature of the relationship of illness representation dimensions to functional behaviors and outcomes varied. Illness identity representations, that is beliefs about the number of symptoms associated with the illness, had the biggest effect on health outcomes in persons with painful chronic conditions. Most significant relationships were of moderate to large magnitude, with correlation and standardized regression coefficients in the expected direction and ranging from -0.20 to -0.75. In five of the ten studies, illness identity representations were significantly associated with functional outcomes in persons with psoriasis, rheumatoid arthritis, multiple sclerosis, and chronic physical illnesses. Specifically, negative illness identity representations were significantly associated with lower levels of physical, social, and role functioning (Graves, Scott, Lempp, & Weinman, 2009; Hagger & Orbell, 2003; Scharloo et al., 2000; Scharloo et al., 1998; Spain, Tubridy, Kilpatrick, Adams, & Holmes, 2007). In four of the studies, multivariate analyses revealed that negative illness identity was independently associated with lower levels of functioning (Graves et al., 2009; Scharloo et al., 1998; Scharloo et al., 2000; Spain et al., 2007), even when the effects of medical (level of pain, disease activity) and psychological (depression, anxiety) variables on functioning were controlled for (Graves et al., 2009; Spain et al., 2007). In addition, one of the studies (Scharloo et al., 2000) examined the effects of illness representations on functioning over time, and negative illness identity at baseline predicted low levels of physical functioning one year later. These findings underscore the importance of one's beliefs about their illness and its symptoms for functional behaviors and outcomes. Importantly, illness

identity was not associated with function in studies with samples comprised of persons with chronic pain as the primary illness problem (Foster et al., 2008; Hobro, Weinman, & Hankins, 2004; Moss-Morris et al., 2007).

In four of ten studies reviewed, timeline representations were significantly and inversely related to functional outcomes, and the magnitude of the effect of timeline representations were small to moderate with correlation and standardized regression coefficients ranging from -0.11 to -0.31. In these studies, negative timeline representations, that is, beliefs that the illness or symptom was chronic in nature, were associated with lower levels of participation in physical, social, or role functioning in persons with chronic pain (Moss-Morris et al., 2007) and psoriasis (Scharloo et al., 1998). Additionally, findings from a meta-analytic review of studies in persons with chronic illnesses revealed significant and inverse associations between timeline representations and physical functioning (Hagger & Orbell, 2003). Similarly, in a study of participants with non-specific low back pain, those participants who believed that their pain would last well into the future were nearly twice as likely to experience pain-related disability compared to participants who endorsed a shorter timeline representation for their pain (Foster et al., 2008).

Five of ten studies supported the theorized relationship between strongly held beliefs that an illness has negative consequences and low levels of physical functioning. The magnitude of the effects of these relationships were small to large, that is, correlation and standardized regression coefficients ranged from (-0.10 to -0.49). In one study (Boot et al., 2008) negative consequence representations were significantly associated with work disability in persons with chronic physical illnesses. In fact, work disabled

participants in this study were five times more likely to report negative illness consequences compared to participants who were employed, even when differences in medical health status between employed and disabled persons were controlled for. Similarly, persons with nonspecific low back pain who believed that their back problems had serious consequences were nearly twice as likely to experience pain-related disability compared to persons with more positively-oriented consequence representations (Foster et al., 2008). Additionally, negative illness consequence representations were significantly associated with low levels of physical, social, and role functioning in other studies (Graves et al., 2009; Hagger & Orbell, 2003; Hobro et al., 2004; Moss-Morris et al., 2007).

Lastly, in six of ten studies, beliefs that an illness or its symptoms were controllable or not controllable were directly related to functional outcomes, and the magnitude of these effects (i.e., correlation coefficients and standardized regression coefficients) were small to moderate ranging from 0.13 to 0.28. In the study of persons with nonspecific low back pain, participants who had weaker beliefs that their back pain was controllable were one and one-half times more likely to experience pain related disability compared to persons who had more positive control beliefs (Foster et al., 2008). In another study of persons with rheumatoid arthritis (Graves et al., 2009), univariate analysis revealed significant associations between beliefs that arthritis was controlled by treatment and higher levels of physical function, but these effects disappeared in multivariate analysis. Of interest, joint disease activity, a medical covariate in the study, remained significantly related to physical function in multivariate analysis, suggesting that disease activity may be more important for functioning in persons with rheumatoid

arthritis than their beliefs about the extent to which treatment can control their illness. Finally, positive control representations were related to higher levels of physical and social functioning in persons with chronic physical illness, chronic pain, and psoriasis (Hagger & Orbell, 2003; Hobro et al., 2004, Moss-Morris et al., 2007; Scharloo et al., 1998).

In summary, empirical research on illness representations in patients with chronic painful conditions consistently demonstrate associations between dimensions of illness representations and participation in lifestyle physical activity in persons with chronic illness, though the nature of the relationships between illness representation dimensions and functioning varied among the studies. The strongest associations were demonstrated between the dimensions of illness identity, consequences, and timeline representations and function outcomes. Notably illness identity, that is, beliefs about illness and its associated symptoms was not associated with functioning in studies comprised of persons with chronic pain. One plausible reason is that identity beliefs in these studies were elicited on the Brief Illness Perception Questionnaire measure by asking participants to identify the number of symptoms associated with their chronic pain condition. For persons with a primary problem of chronic pain, there is likely little to no variability demonstrated on this measure since only one symptom is experienced. Alternatively, an assessment of “pain identity” representations, such as beliefs about pain intensity, quality, and symptom severity would yield a more accurate measure of pain identity representations in persons with persistent chronic and neuropathic pain (Barsevick, Whitmer, & Walker, 2001; Cameron et al., 1993; Donovan, Ward, Sherwood, & Serlin, 2008). Accordingly, representations of neuropathic pain quality and symptoms are

assessed in this study. Lastly, the studies reviewed varied by health condition, and only two studies included persons with chronic pain, specifically low back pain and pain of unspecified type. Because the pain representations of persons with persistent chronic and neuropathic pain differed potentially in important ways from persons with other pain types, there was an important need to gain an understanding of the extent to which illness representations in these persons influenced their level of participation in lifestyle physical activities through this study.

Illness Representations and Emotional Representations (Affective Reactions)

In this section, a synthesis and analysis of empirical evidence that supports the theorized relationship between illness representations and emotional representations in adults with chronic pain is presented. The literature review was delimited to studies that examined relationships between illness representations and affective reactions in chronically ill populations with illnesses characterized by symptoms that are unpleasant or painful. Seven studies that met these criteria are included in this aspect of the literature review and summarized in Table A2.

According to the CSM, negative representations of pain may influence negative responses or reactions to these representations (Leventhal et al., 2005). That is, strongly held negative beliefs that an illness has multiple symptoms, a long-term (chronic) timeline, negative consequences, and cannot be controlled or cured personally or by treatment is postulated by the CSM to lead to negative emotional responses. In this study, pain catastrophizing is conceptualized as a negative affective response to a person's negative representation of chronic neuropathic and breakthrough pain. This conceptualization is consistent with the premise that pain catastrophizing is an

information processing error that results from a negative illness schema or model and a tendency to be overly focused on this schema (Ingram, 1990). Findings from a comparative study support these theoretical tenets. In Hobro and colleagues' (2004) comparative study of adaptors, that is, those participants with chronic pain who reported positive illness representations, and non-adaptors, that is, participants with chronic pain who reported negative illness representations, findings revealed that adaptors had lower levels of anxiety, depression, and negative emotional responses to illness compared to non-adaptors.

Across the seven studies reviewed, the associations between illness representations and emotional representations were moderate to large with correlation and standardized regression coefficients ranging from 0.17 to 0.54. Emotional representations in the studies reviewed varied and were conceptualized as anxiety, depressive symptoms, pain catastrophizing, psychological distress, and self-reports of being emotionally affected by the illness.

Findings from only one study revealed a significant relationship between illness identity representations and pain catastrophizing (Moss-Morris et al., 2007), and correlational analysis indicated the magnitude of this relationship was moderate. Multivariate analyses were not reported in this study. Thus, the independent effects of illness identity representations on pain catastrophizing, controlling for the effects of the other illness representation dimensions, were not determined.

In three of seven studies, timeline representations were significantly associated with affective reactions, including depression and anxiety (Grace et al., 2005; Hobro et al., 2004; Moss-Morris et al., 2007). Specifically, beliefs that illness symptoms were

cyclical and unpredictable in nature was associated with pain catastrophizing in patients with fibromyalgia (Van Wilgren et al., 2008). Timeline representations were also associated with pain catastrophizing in patients with chronic pain in another study (Moss-Morris et al., 2007), but the nature of the timeline assessed (e.g., acute, cyclical, chronic) was not reported. In a third study, chronic timeline representations were significantly associated with depressive symptomatology in men and women with coronary artery disease (Grace et al., 2005).

In four of seven studies reviewed, consequence representations were significantly related to affective reactions (Grace et al., 2005; Stafford, Berk, & Jackson, 2009; Stuifbergen et al., 2006; Van Wilgren et al., 2008). Univariate analysis were conducted in two studies and revealed that strongly held beliefs that the illness had serious consequences was significantly associated with anxiety (Van Wilgren et al., 2008) and self-reports of being emotionally affected by the illness (Stuifbergen et al., 2006) in persons with fibromyalgia. In three of these studies, multivariate analyses were conducted and revealed that negative consequence representations were independent predictors of depressive symptoms, controlling for the effects of the other illness representation dimensions in the model (Grace et al., 2005; Stafford et al., 2009; Van Wilgen et al., 2008).

Lastly, strongly held beliefs that illness was not controllable (e.g., control representations) was significantly associated with affective reactions in five of seven studies. Univariate analyses were reported in three of the studies and revealed significant associations between uncontrollable illness beliefs and self-reports of being emotionally affected by the illness in persons with fibromyalgia (Stuifbergen et al., 2006),

psychological distress in persons with chronic illnesses (Hagger & Orbell, 2003), and pain catastrophizing in persons with chronic pain (Moss-Morris et al., 2007). In one study that controlled for the effects of other dimensions of illness representations in multivariate analysis, beliefs that the illness was not controllable independently predicted depressive symptoms in persons with coronary artery disease (Stafford et al., 2009).

In summary, empirical research supports the theoretical premise that strongly held negative representations of illness are associated with negative emotional responses. However, the emotional responses that were examined varied across studies and populations. Anxiety and/or depressive affect were specifically examined across five studies. Emotional representations were examined in three studies, and pain catastrophizing was examined in only two studies; one in persons with fibromyalgia and the other in persons with chronic pain. Findings from these studies reviewed indicated that negative illness representations are significantly associated with maladaptive affective reactions, including anxiety depressive symptoms, pain catastrophizing, and psychological distress. However, the dimensions of illness representations that elicited negative emotional reactions were not consistent. In addition, several studies only employed univariate analyses. Hence, it was not possible to compare all independent associations between illness and emotional representations across the studies. Moreover, these relationships were not conducted in persons with persistent chronic and neuropathic pain. Although limited, the research reviewed did provide support for the further assessment of the theorized relationship between illness and emotional representations specific to persons with persistent, chronic and neuropathic pain, in particular, the emotional reactions that may accompany representations of cyclical and fluctuating

painful sensations that characterize the neuropathic component of the chronic pain experience.

Emotional Representations (Affective Reactions) and Lifestyle Physical Activity

In this section, a synthesis and analysis of empirical evidence that supports the theorized relationship between emotional representations and lifestyle physical activity in adults with chronic pain is presented. The literature review is delimited to studies that examined relationships between affective reactions and functional outcomes such as level of participation in lifestyle physical activity or activities of daily living, and physical disability in chronically ill populations characterized by painful symptoms. Six studies met these criteria and are summarized in Table A3.

A CSM theoretical proposition stipulates that negative emotional responses to an illness threat are associated with the adoption of maladaptive or negative coping procedures, such as reduced participation in lifestyle physical activities. Emotional representations that were measured varied from study to study and were conceptualized as depression, anxiety, worry, fear-avoidance beliefs, feeling emotionally affected by illness, and pain catastrophizing.

Pain catastrophizing was significantly related to physical disability in two of the six studies (Sullivan, Lynch & Clark, 2005; Van Vleiger et al., 2006). Sullivan and colleagues (2005) found that, in the final adjusted logistic regression model, catastrophic thinking independently accounted for 13% of the total variance in physical disability in patients who experienced chronic neuropathic pain. Similarly, Van Vlieger and colleagues (2006) found that, in correlation analysis, worry and catastrophic thinking were significantly related to reductions in lifestyle physical activity in persons with

chronic pain of nonspecific origin. In multivariate analysis, when both catastrophizing and worry were in the regression model, catastrophizing was the only significant predictor of disability and accounted for 8% of the variance in functioning. These findings underscore the importance of pain catastrophizing for physical activity in persons with chronic pain, including pain of neuropathic origin. In the four remaining studies, worry, anxiety, fear-avoidance, depressive symptoms, and self-reports of being extremely emotionally affected by the illness were significantly associated with reduced levels of participation in daily activities in persons with illnesses associated with painful symptoms (Motl & McAuley, 2009; Piva et al., 2009; Scopaz et al., 2009; Van Vlieger, Crombez, & Eccleston, 2006).

In summary, the six studies reviewed provide empirical support for the theorized relationship between emotional representations and coping procedures, conceptualized in the study as participation in lifestyle physical activity. Importantly, pain catastrophizing as an emotional representation was examined in two studies, and findings supported the premise that this phenomenon was likely to be an important antecedent to participation in lifestyle physical activities in persons with persistent, chronic and neuropathic pain.

Catastrophic Thinking as a Mediator of Illness Representations

In this final section, only one empirical study was found in the literature to support the potential for catastrophic thinking as a mediator between representations of an illness and procedures adopted for coping with the illness. In a study by Crombez and colleagues (2004), researchers examined the role of pain catastrophizing as a mediator in the relationship between two independent diagnostic groups. One group consisted of patients with fibromyalgia pain and another group involved patients with chronic low

back pain. Hypervigilance to pain was identified as a coping strategy in this study and conceptualized as an individual's strong inclination to attend to pain at the expense of other environmental information. Fibromyalgia was characterized as an illness with widespread pain, fatigue, stiffness, and multiple musculoskeletal tender points, involving symptoms that varied and were difficult to control. Patients with persistent chronic low back pain (localized and non-radiating) were used as a comparison group. Findings in this study revealed that patients with the fluctuating symptoms associated with fibromyalgia reported higher intensity pain ($t(107) = 4.58, p < .01$), higher levels of pain catastrophizing ($t(107) = 3.34, p < .01$), and greater vigilance to pain ($t(108) = 1.97, p < .05$) compared to patients with chronic low back pain. Using a partial correlation approach, the relationship between diagnostic group and vigilance to pain was significantly reduced when the effects of pain catastrophizing was partialled out ($p < .05$). The researchers concluded that the widespread and vacillating pain symptoms associated with fibromyalgia likely interferes with daily tasks and the ability to fulfill long-term goals and personal aspirations to a greater degree than the more localized symptoms experienced with chronic low back pain alone. Therefore, pain in fibromyalgia may be viewed as a more fundamental threat to self and identity making the varied symptom profile an important predisposing factor to catastrophic thinking about the pain that, in turn, mediates the effect of the illness perceptions on the strategies adopted to cope with the pain. These findings are consistent with the CSM premise that relationships among CSM concepts are complex, and suggest that pain catastrophizing may mediate the relationship between pain representations and the strategies adopted to manage

participation in lifestyle physical activity in persons with persistent chronic and neuropathic pain.

Covariates in Chronic Pain Populations

A tenet of the CSM is that illness representation and self-regulation are nested within a larger personal, social, and cultural context (Leventhal et al., 2005), and that contextual factors such as age, gender, and physical health status may influence illness representations, the affective reactions they evoke, and the procedures adopted to manage the symptom and affective responses. Five of the studies reviewed that examined the relationship of illness and emotional representations to functioning were conducted in samples of persons with chronic pain as the primary problem. In three of these studies, contextual factors were considered and controlled for in the analyses. Foster and colleagues (2008) controlled for age, gender, and duration of pain in multivariate regressions models in their examination of illness representations in persons with low back pain. They did not report univariate associations between these contextual variables and function. However, adjusted models revealed no independent associations of these covariates with function. Similarly, Piva and colleagues (2009) adjusted for age and gender a-priori in regression models to control for unexplained variability even though univariate analysis revealed no significant associations between these variables and functioning in persons with patella-femoral pain syndrome. Moreover, Sullivan and colleagues (2010) controlled for the effects of age and gender on level of disability in persons with symptoms of neuropathic pain, and these contextual variables were not significant in multivariate analysis. Demographic variables and pain duration were not found to be related to lifestyle physical activity in this study, and thus were not entered

into multivariate analyses. Lastly, anxiety and depressive affect, as affective reactions to illness, were independently related to physical function three studies reviewed. Piva and colleagues (2007) found that anxiety, as an affective reaction to patella-femoral pain syndrome, was independently associated with disability in persons with this condition. Anxiety often accompanies the experience of chronic pain, and is a potential contextual factor in persons with chronic neuropathic pain. Likewise, depressive symptoms, as an affective reaction to illness, was found to be significantly related to functional outcomes in univariate analysis in persons with multiple sclerosis (Motl & McAuley, 2009) and osteoarthritis (Scopaz et al., 2009), two conditions that are characterized by painful symptoms. Chronic pain has been linked to depression and the conditions are known to coexist (Huijnen et al., 2010, Covic, Tyson, Spencer & Howe, 2006). Consideration of anxiety and depression as covariates were omitted from the multivariate analyses as each affective reaction exhibited significant collinearity with pain catastrophizing.

Current State of Knowledge and Gaps

Theorists and findings from the empirical literature indicate that illness representations are important predictors of the strategies that one adopts to cope with the illness. Specifically, the small group of studies discussed in this literature review indicates that negative illness representations are associated with lower levels of functioning in persons with chronic illness characterized by painful symptoms. Specifically, findings from the empirical literature suggest that persons who experience painful chronic illnesses and represent the illness as one with multiple symptoms, a chronic timeline, serious consequences, and as uncontrollable, typically tend to adopt a physical activity strategy of reduction or little to no engagement in lifestyle physical

activities. Similarly, persons who represent their illnesses as described above may also experience negative emotional reactions to their illness. Both the CSM and empirical findings suggest that the interrelationships among illness representations, emotional reactions, and physical activity are complex. There was a paucity of studies that examined the theorized direct relationships in persons with chronic illnesses associated with painful symptoms, and no studies were found that examined the operant mechanisms by which illness representations and pain catastrophizing, a significant affective reaction found in persons with chronic pain, exert their influence on participation in lifestyle physical activity.

The literature, while small, suggests that illness and emotional representations were important predictors of engagement in lifestyle physical activities in adult persons with persistent, chronic and neuropathic pain and affective reactions, such as pain catastrophizing, could mediate the relationship between illness representations and lifestyle physical activity. The purpose of this study was to examine the complex associations among illness representations, emotional representations, and lifestyle physical activity in this population.

Hypotheses

The following hypotheses were examined in adults between the ages of 20 and 65 with persistent chronic and neuropathic pain:

1. Negative pain representations are inversely related to level of participation in physical activity in persons with persistent chronic and neuropathic pain.

- a. Negative pain identity representations are associated with low levels of participation in lifestyle physical activity in persons with persistent chronic and neuropathic pain.
 - b. Negative pain timeline representations are associated with low levels of participation in lifestyle physical activity in persons with persistent chronic and neuropathic pain.
 - c. Negative pain consequence representations are associated with low levels of participation in lifestyle physical activity in persons with persistent chronic and neuropathic pain.
 - d. Negative pain control/cure representations are associated with low levels of participation in physical activity in persons with persistent chronic and neuropathic pain.
2. Pain catastrophizing (i.e., emotional representation) is inversely associated with level of participation in physical activity in persons with persistent chronic and neuropathic pain.
3. Negative pain representations are positively related to pain catastrophizing (i.e., emotional representation) in persons with persistent chronic and neuropathic pain.
 - a. Negative pain identity representations are positively related to pain catastrophizing in persons with persistent chronic neuropathic pain.
 - b. Negative pain timeline representations are positively related to pain catastrophizing in persons with persistent chronic and neuropathic pain.

- c. Negative pain consequences representations are positively related to pain catastrophizing in lifestyle physical activity in persons with persistent chronic and neuropathic pain.
 - d. Negative pain control/cure representations are positively related to pain catastrophizing in persons with persistent chronic and neuropathic pain.
4. Pain representations independently predict level of participation in lifestyle physical activity in persons with persistent chronic and neuropathic pain.
- a. When controlling for the effects of anxiety, depression, pain catastrophizing and other illness representation dimensions (timeline, consequences, control/cure), negative pain identity representations independently predict low levels of lifestyle physical activity in persons with persistent chronic and neuropathic pain.
 - b. When controlling for the effects of anxiety, depression, pain catastrophizing and other illness representation dimensions (identity, consequences, control/cure), negative pain timeline representations independently predict low levels of lifestyle physical activity in persons with persistent chronic and neuropathic pain.
 - c. When controlling for the effects of anxiety, depression, pain catastrophizing and other illness representation dimensions (identity, timeline, control/cure), negative pain consequences representations independently predict low levels of lifestyle physical activity in persons with persistent chronic and neuropathic pain.

- d. When controlling for the effects of anxiety, depression, pain catastrophizing and other illness representation dimensions (identity, timeline, consequences), negative pain control/cure representations independently predict low levels of lifestyle physical activity in persons with persistent chronic and neuropathic pain.
5. Negative pain representations independently predict pain catastrophizing in persons with persistent chronic and neuropathic pain.
- a. When controlling for the effects of anxiety, depression, and other illness representation dimensions (timeline, consequences, control/cure) on lifestyle physical activity, negative pain identity representations independently predict pain catastrophizing in persons with persistent chronic and neuropathic pain.
 - b. When controlling for the effects of anxiety, depression, and other illness representation dimensions (identity, consequences, control/cure) on lifestyle physical activity, negative pain timeline representations independently predict pain catastrophizing in persons with persistent chronic and neuropathic pain.
 - c. When controlling for the effects of anxiety, depression, and other illness representation dimensions (identity, timeline, control/cure) on lifestyle physical activity, negative pain consequences representations independently predict pain catastrophizing in persons with persistent chronic and neuropathic pain.

- d. When controlling for the effects of anxiety, depression, and other illness representation dimensions (identity, timeline, consequences) on lifestyle physical activity, negative pain control/cure representations independently predict pain catastrophizing in persons with persistent chronic and neuropathic pain.
6. When controlling for the effects of anxiety, depression, and pain representations on level of participation in physical activity, pain catastrophizing independently predicts low levels of participation in physical activity in persons with persistent chronic neuropathic pain.
7. Pain catastrophizing mediates the relationship between illness representations and level of participation in lifestyle physical activity in persons with persistent chronic neuropathic pain.
- a. When the effect of pain catastrophizing on physical activity is partialled out, there is a reduction in the magnitude and significance of the relationship between illness identity representation and level of engagement in lifestyle physical activity (mediating effect) in persons with persistent chronic and neuropathic pain.
 - b. When the effect of pain catastrophizing on physical activity is partialled out, there is a reduction in the magnitude and significance of the relationship between timeline representation and level of engagement in lifestyle physical activity (mediating effect) in persons with persistent chronic and neuropathic pain.

- c. When the effect of pain catastrophizing on physical activity is partialled out, there is a reduction in the magnitude and significance of the relationship between consequences representation and level of engagement in lifestyle physical activity (mediating effect) in persons with persistent chronic and neuropathic pain.
- d. When the effect of pain catastrophizing on physical activity is partialled out, there is a reduction in the magnitude and significance of the relationship between control/cure representation and level of engagement in lifestyle physical activity (mediating effect) in persons with persistent chronic and neuropathic pain.

Theoretical and Operational Definitions

Physical activity is a universal term defined as bodily movement produced by contraction of skeletal muscles to increase energy expenditure (DHHS, 2008) above a basal level (Dunn et al., 1998). Persistent chronic and breakthrough neuropathic pain interferes with the ability to perform even modest physical activity such as bathing or showering, dressing, eating, getting in or out of bed or chairs, using the toilet, and navigating within the home.

Lifestyle Physical Activity. Lifestyle physical activity is a term used to encompass daily activities that can contribute to sizeable energy expenditure including occupational, leisure-time or recreational, household, self-care. It also includes transportation or commuting activities such as taking the stairs instead of using the elevator, walking to do errands instead of driving, getting off one bus stop earlier, or parking further away than usual to walk to a destination (DHHS, 2008). For the purpose of this study, lifestyle

physical activity was operationally defined by the physical component summary (PCS) score of the *Short Form-12 (SF-12)* health survey (Larson, Schlundt, Patel, Beard, & Hargreaves, 2008; Luo, et al., 2003; Tabolli et al., 2011; Ware, Kosinski, & Keller, 1996).

Illness Representations. Illness representations are theoretically defined as the individual perceptions formed from cognitive efforts to organize, analyze, and interpret diverse types of information about an illness and its symptoms including the dimensions of the illness identity, timeline, cause, controllability and consequence (Leventhal et al., 2010). Illness identity is a statement that represents the illness threat and how it is experienced including physical signs, symptoms, and changes in lifestyle activity (Leventhal et al., 2003). Illness identity reflects beliefs about what the threat is called and its associated symptoms. The cause dimension represents beliefs about the cause of the illness or its symptoms. Timeline is defined as the individual's beliefs about the onset, duration, and trajectory of the illness or its symptoms characterized as acute, chronic, or cyclical in nature (Leventhal et al., 2003; Leventhal et al., 2010). Consequences are the beliefs about the physical, emotional, social, and/or economic outcomes of the illness. The final dimension, controllability, refers to one's anticipated beliefs and perceived responsiveness to self-treatment and expert intervention (Leventhal et al., 2010). Illness representations were operationalized as participants' scores on the illness representation items of the *Brief Illness Perception Questionnaire (BIPQ)* (Broadbent, Petrie, Main & Weinman, 2006).

To provide additional clarity, illness identity (characterized as pain intensity/quality) was operationalized as participants' score on the *Short Form McGill Pain Questionnaire version 2* (Lovejoy, et al., 2012).

Pain Catastrophizing. Pain catastrophizing is theoretically defined as an emotional response to a painful experience and is characterized by an irrational anticipation of negative outcomes regardless of pain intensity, frequency or causality and a tendency to (a) increase attention and focus on pain-related thoughts, (b) exaggerate the threat value of the painful stimuli, and (c) adopt a helpless orientation towards coping with painful situations (Keefe, Rumble, Scipio, Giordano & Perri, 2004; Sullivan et al., 1995; Sullivan, Rogers, & Kirsch, 2001). Pain catastrophizing is further characterized as a maladaptive or negative affective response (Sullivan et al., 1995). Pain catastrophizing was operationalized as the participant's combined score obtained across the domains of rumination, magnification and helplessness on the *Pain Catastrophizing Scale* (Sullivan et al., 1995).

Adults. According the literature, persons with persistent chronic and neuropathic pain are typically adults above the age of 20 years. Many adults under the age of 65 have pain originating from traumatic injury, irritation or pathology originating from the spine, whereas older adults may indeed have similar symptoms with more progressive onset overtime and more likely associated with pain from degenerative overuse or underlying physical health conditions involving the musculoskeletal system. Adults were defined as those individuals aged 20 to 64 years with symptoms consistent with persistent (non-cancer) chronic and neuropathic pain. Elderly adults, age 65 and older, were excluded from the study.

Chronic pain. The International Society for the Study of Pain (IASP) defines chronic pain as an unpleasant sensory and emotional experience associated with or without actual tissue damage (Merskey & Bogduk, 1994). According to International Society for the Study of Pain, pain that persists for more than 3 months and alters normal function may be considered chronic (Nicholson, 2003). For the purpose of this research participants were those adults who have met the criteria for outpatient interventional anesthesia pain management which included but was not limited to established chronic pain of at least 3 months duration. Participants were actively seeking treatment for their persistent chronic and neuropathic pain in the form steroid injections, nerve blocks, and radiofrequency ablation, also called rhizotomy.

Neuropathic pain. Neuropathic pain is initiated or caused by a primary lesion or dysfunction in the central nervous system and is characterized as unpleasant sensations of aching, burning, gripping, numbness, pinching, pulling, sharp, shooting pains, stabbing, stinging, throbbing, and tingling (Merskey & Bogduk, 1994). Breakthrough pain that is neuropathic in character may be associated with changes in skin temperature, and hypersensitivity. Neuropathic pain tends to be experienced along the distribution of affected peripheral nerves and can be psychologically disturbing as the symptoms may fluctuate in intensity and duration with or without relation to lifestyle physical activity or body positioning.

Depressive affect. Depression has received considerable attention in the study of chronic pain as depressive symptoms often accompany the chronic pain experience (Covic et al., 2006; Grace et al., 2005; Huijnen et al., 2010; Sullivan, Rodgers, & Kirsch, 2001). As a potential covariate, the presence of depressive affect was determined by a

score of 10 or greater on the PHQ-8 subscale of the *Patient Health Questionnaire* (Kroenke & Spitzer, 2002; Kroenke, Spitzer, Williams, 2001; Kroenke, Spitzer, Williams, & Löwe, 2010).

Anxiety. Anxiety symptoms often accompany the chronic pain experience (Scopaz et al., 2009; Shih et al., 2006; Piva et al., 2009; Young et al., 2009). As a potential covariate, the presence of anxiety was determined by a score of five or greater on the GAD-7 subscale of the *Patient Health Questionnaire* (Kroenke, Williams, 1999; Kroenke, Spitzer, Williams, & Löwe, 2006).

CHAPTER 3: METHODS

This chapter describes the research design and methods used for this study. The research setting, sample size and sampling method, population characteristics including delimitations, and procedures for data collection and analysis are described in detail. The study employed a cross-sectional, correlational design to investigate the relationships among illness representations, emotional representations and lifestyle physical activity in adults with persistent, chronic and breakthrough neuropathic pain.

Sample and Sampling Methods

Participants were recruited from two ambulatory care surgical centers serving southern New Jersey where up to five regional pain practice providers perform interventional procedures. During fiscal years 2010 through 2012, these two ambulatory care surgical centers serviced a combined 2,480 patients who required interventional anesthesia pain management procedures for the treatment of conditions associated with chronic persistent neuropathic pain. Sampling was achieved through invitation to all patients who meet the following inclusion criteria: (1) scheduled anesthesia pain management procedure for treatment of chronic and neuropathic pain; (2) community-dwelling adults aged 21 through 64; (3) persistent, chronic and neuropathic pain of at least 3 months duration for which treatment was actively being sought; and (4) the ability to read, write and understand English. Persons excluded from the study were under the age of 21 years and older than 64 years.

Potential subjects who meet the eligibility criteria for a scheduled anesthesia pain management procedure for the treatment of chronic and neuropathic pain were provided an informational flyer for the study and a response card by the ambulatory care surgical

center registrar at the time of registration for the anesthesia pain management procedure. The response card solicited the following information from the participants: name, age, mailing address, telephone number, and permission to be contacted by the principal investigator (PI). Completed response cards were collected from the surgical center at the end of each interventional anesthesia pain management day by the PI. Within one week of the pain intervention procedure, the PI sent the survey via first class mail/return postage along with a cover letter that described and explained the study to potential participants who completed the response card. Completion of the survey instrument(s) served as participants' consent to participate.

Sample Size

Power analyses for correlational and multiple regression analysis was calculated to determine the appropriate sample size. For correlational analyses, using a moderate effect size ($r = .34$) derived from a review of the literature (Graves et al., 2009; Hagger & Orbell, 2003; Moss-Morris et al., 2007; Stuifbergen et al., 2006), a sample size of 88 was needed to obtain an estimated power of .90 at a .05 significance level (Cohen, 1988). For multiple regression analyses, using a moderate effect size ($f^2 = .15$), based on a review of the literature (Piva et al., 2009; Scharloo et al., 1998; Spain et al., 2007; Stafford et al., 2009; Stuifbergen et al., 2006; Sullivan et al., 2005; Van Vlieger et al., 2006), and eight predictor variables, a minimum sample size of 115 was needed to obtain an estimated power of .90 at a significance level of .05 (Cohen, 1988). Based on an estimated response rate of 50% to 74% with repeated survey mailings, a minimum sample of 230 participants were recruited and mailed surveys in order to yield more than sufficient power for statistical analyses (Dillman et al., 2009).

Modified Tailored Design Method (TDM)

Each participant received a brief pre-notice about the study in the form of the respondent post card on the day of their scheduled interventional anesthesia pain management procedure. For those who affirmed that they could be contacted, a survey questionnaire was mailed on Monday (designated week one) following receipt of the response card that was submitted at the ambulatory care surgical center. According to Dillman, Smythe and Christian (2009) nearly one-half of returned envelopes are post marked within two to three days of their receipt by recipients. Therefore, at week two (the next Monday), and one week following the initial survey mailing, a follow-up post card was mailed to thank the participant for their completion of the survey and to convey the importance of returning the survey, if they have not already done so. On Monday, at week three (two weeks after the initial reminder post card mailing), a replacement questionnaire was sent with a modified cover letter to non-responders to convey the importance of returning the completed questionnaire. To reduce respondent burden, certified mail was not used since it required someone to be at home to sign for the delivery (Dillman et al., 2009). On the next Monday (week four), a final contact was made. Each non-respondent was sent a replacement questionnaire using a different colored envelop to bring renewed attention to the survey.

Instruments

Brief-Illness Perception Questionnaire (BIPQ)

The *Brief-Illness Perception Questionnaire* (BIPQ) (Broadbent et al., 2006) was used to measure illness representations. The BIPQ is a 9-item measure of illness and emotional representations. Eight items measure illness identity, timeline, consequence,

personal control, treatment control, coherence, and emotional representations. These items are scored on 10-point visual analog scale, and each item is independent and scored separately. For the cause dimension, persons are asked to list the top three reasons they think is the cause of their pain. According to Broadbent and colleagues (2006), the scale allows for ease of interpretation since single item scores represent linear increases in each dimension measured. Higher scores on the identity, timeline, and consequences dimensions represent strongly held beliefs about the number of symptoms attributed to the illness, the chronicity of the condition, and the negative consequences of the illness or condition. Higher scores on personal control, treatment control dimensions represent positive beliefs about the controllability of the illness. The BIPQ is designed for modification for specific conditions by substituting the word “illness” on the generic scale with a specific diagnosis (e.g. *your pain*).

BIPQ test-retest reliability, concurrent validity, discriminant validity, and predictive validity were evaluated using a sample representing six chronic illness groups, including myocardial infarction ($n = 103$), renal disease ($n = 132$), type 2 diabetes ($n = 119$), asthma ($n = 309$), minor illness (allergies, colds, headaches) ($n = 166$) and a group with chest pain undergoing diagnostic testing ($n = 62$) (Broadbent et al., 2006). Test-retest reliability was established for out-patients with renal disease, with one half of the sample retested at three weeks post-visit and the other half at 6 weeks post initial visit. Pearson correlations between baseline and 3-week BIPQ scores were significant ($p < .001$) for all illness representations and ranged from $r = .55$ to $r = .70$. At 6-weeks illness representation dimensions correlations with baseline scores ranged from $r = .42$ to $r = .75$. Concurrent validity was determined by asking participants with renal disease,

diabetes and asthma to complete both the BIPQ and the IPQ-R resulting in moderate to large correlations (identity, $r = .48, p < .001$, timeline, $r = .53, p < .001$, consequences, $r = .62, p < .001$, personal control, $r = .33, p < .001$, treatment control, $r = .32, p < .001$, emotional representation, $r = .63, p < .001$, and coherence, $r = .46, p < .001$).

Discriminant validity was determined among the various illness groups using one-way ANOVA. Results demonstrated expected mean differences between the illness categories including diabetes (mean = 9.2, SD = 1.9), asthma (mean = 8.8, SD = 2.2), colds (mean = 5.4, SD = 3.1), myocardial infarction (mean = 7.2, SD = 3.1) and non-specific chest pain (mean = 4.5, SD = 3.0). Predictive validity was also tested among patients who were post-myocardial infarction. Findings revealed that lower return to work was associated with higher consequence ($r = .43, p = .03$) and higher treatment control representations ($r = .44, p = .03$) was significantly associated with return to work.

In conclusion, the BIPQ has well established and acceptable test-retest reliability, good predictive and discriminant validity. The instrument has been widely used in persons with chronic illness, is easy to understand, reduces respondent burden, and can be completed in only a few minutes by most patients (Petrie, Jago & Devcich, 2007). For the this study, the entire BIPQ, excluding the cause dimension was administered, but only scores for the five items that examine pain identity, pain timeline, pain consequences, and pain control (personal and treatment) representations were used for hypothesis testing.

Short Form-McGill Pain Questionnaire-2 (SF-MPQ-2).

The *Short McGill Pain Questionnaire-2 (SF-MPQ-2)* (Breivik et al., 2008) a pain assessment instrument, was used as a second measure of pain identity representations (i.e., beliefs about pain quality and intensity). The SF-MPQ-2 assesses the degree of pain

quality/intensity (symptom severity) for 22 sensations that characterize chronic pain on a 10-point scale ranging from 0=none to 10=worst possible. According to Dworkin et al. (2009), the SF-MPQ-2 is a valid and reliable expanded version of the SF-MPQ (Mason, et al., 2008) that can be used to estimate pain intensity and characterize symptom intensity. The expanded version resulted from the addition of seven sensations relevant to neuropathic pain (Appendix D). In addition, the four-point rating scale was modified to a 0 to 10 numerical rating scale (NRS) for all 22 items. This change provided increased responsiveness in longitudinal studies and clinical trials. Initial development was based on focus groups and a sample of 882 participants who had experienced chronic pain of over eight years. These subjects completed a preliminary web-based version of the SF-MPQ-2. From this sample population, a group of patients ($n = 226$) with painful diabetic peripheral neuropathy (DPN) were enrolled in a randomized control trial (RCT) with mean age = 55.6 (SD = 10.2) years; 46.0% were female and 97.3% had Type 2 diabetes and DPN for a mean of 2.4 (SD = 2.4) years. Internal consistency reliability for the total score was high (.90) and acceptable for the four subscale scores of continuous pain (.73), intermittent pain (.85), neuropathic pain (.78), and affective descriptors (.77). To assess construct and predictive validity, the SF-MPQ-2 total and subscale scores were significantly correlated with multiple measures including the Brief Pain Inventory (BPI) average pain intensity and interference scale scores, Multidimensional Pain Inventory (MPI) interference scale scores, the SF-12 physical component summary (PCS) scale and mental component summary (MCS) scale scores, number of activity limitations, and days in bed. The SF-MPQ-2 is designed to be a comprehensive assessment and characterization of both neuropathic and non-neuropathic pain. The instrument takes

approximately five minutes to complete. The higher the total score, the more the pain experience increases, that is, higher scores represent negative perceptions of neuropathic pain sensations and pain intensity beliefs.

Pain Catastrophizing Scale

Emotional representations, represented as pain catastrophizing in this study, were assessed using the *Pain Catastrophizing Scale* (PCS), a 13-item self-report measure that describes different thoughts and feelings about individual experience when they are in pain (Sullivan, 2009). Individuals are asked to reflect on past painful experiences and to provide a rating of the degree to which they experience 13 thoughts or feelings about their pain on five-point Likert scales with 0 = 'not at all' to 4 = 'all the time.' The PCS yields a total score from three subscale scores assessing rumination, magnification and helplessness. Higher scores indicate greater catastrophizing.

Psychometric properties of the PCS were established from a sample of 438 introductory psychology students. Test items were derived from interview-based examples of catastrophizing ideation found in the literature (Appendix B). Principal components analysis yielded a three factor with good internal consistency reliabilities (Cronbach's coefficient alpha) for rumination ($r = .87$) magnification ($r = .60$), and helplessness ($r = .79$). Moderate correlations for the components and total PCS ($r = .87$) suggest high internal consistency. The PCS has been shown to have adequate to excellent internal consistency with coefficient alphas for the total PCS ($r = .87$) (Sullivan et al., 1995; Moss-Morris et al., 2002).

Construct validity, temporal stability (test-retest reliability), and predictability were evaluated by comparing PCS scores to interview-based responses to the PCS during

cold pressor (ice water immersion). Forty introductory psychology students with a mean age of 18.8 years ($SD = 4.6$) were grouped into catastrophizers (those scoring 25 and higher) and noncatastrophizers (those scoring 24 and below). Cut-points corresponded to upper and lower thirds of the PCS score distribution. Analysis revealed significant main effect group [$F_{(1,28)} = 15.6, p < .001$], qualified by Group x Thought Type interaction, [$F_{(1,28)} = 30.9, p < .001$]. Catastrophizers experienced greater emotional distress during cold pressor theory than noncatastrophizers [$F_{(4,26)} = 5.0, p < .1$]. Test-retest correlations among the 40 participants indicated a high degree of stability across 6-weeks ($r = .75, p < .001$).

Construct validity of the PCS as an index of catastrophizing ideation in a clinical sample was administered to patients referred for electrodiagnostic evaluation, a procedure associated with physical discomfort. Twenty women and eight men were subject to a semi-structured interview following their electrodiagnostic testing. Responses were analyzed as a two-way mixed factorial design. Results identified a significant Group x Thought interaction [$F_{(1,26)} = 3.9, p < .05$]. Simple effects revealed that catastrophizers reported a higher frequency of catastrophizing thought compared to noncatastrophizers ($t_{(26)} = 3.5, p < .01$). The study demonstrated the PCS as a valid measure of catastrophizing in clinical samples.

Discriminant validity was determined using 60 introductory students who volunteered in exchange for course credit. The PCS was correlated with several instrument measures including Fear of Pain Questionnaire (FPQ) and the Positive-Affect Negative-Affect Scale (PANAS), the Beck Depression Inventory (BDI), and the State-Trait Anxiety Inventory (STAI). The PCS significantly correlated with depression ($r =$

.26, $p < .05$), trait anxiety ($r = .32$, $p < .05$), negative affectivity ($r = .32$, $p < .05$), and fear of pain ($r = -.80$, $p < .001$). Multiple regression analysis demonstrated that only the PCS contributed unique variance to the prediction of pain [$F_{(1,56)} = 5.4$, $p < .00$]. PCS screening scores obtained 10-weeks prior to testing showed a high degree of temporal stability across the 10-week period ($r = .70$, $p < .01$). Predictive validity was also strengthened as scores obtained at 10 weeks was highly correlated with pain ratings during ice water immersion ($r = .33$, $p < .01$).

The PCS has been shown to be a valid and reliable measure of catastrophic thinking associated with chronic pain in clinical populations, and several studies support the continued reliability and validity of the PCS as a measure of pain-related catastrophic thinking in persons with chronic pain or chronic illnesses characterized by painful symptoms (Sullivan, Bishop & Pivik, 1995; Sullivan, Stanish, Waite, Sullivan, & Tripp, 1998; Stuifbergen et al., 2006; Van Damme, Crombez, Bijttebier, Goubert, & Van Houdenhovec, 2002). The PCS can be completed in less than five minutes and requires a reading level of approximately grade six (Sullivan, 2009).

Short Form—12v2 Health Survey: Physical Component Summary (PCS)

The SF-12v2 is a 12-item self-report of health status (Ware et al., 1996). Responses to questions are dichotomous (yes/no), ordinal (excellent to poor) or expressed by a frequency (always to never). Two composite scores can be calculated: a Physical Component Summary (PCS-12) and a Mental Component Summary (MCS-12).

Survey data obtained from 2,520 university spine clinic patients with low back pain was used for reliability testing of the SF-12 (Luo et al., 2003). The Cronbach's alpha coefficient revealed good SF-12v2 reliability coefficient for PCS-12 ($r = .77$) and MCS-

12 ($r = .80$) each exceeding the recommended level of .70 (Lou et al., 2003). To establish construct validity, the PCS-12 subscale was significantly and negatively correlated with Back Pain Severity scale ($r = -.405$, $p < .0001$), and MCS-12 scores ($r = -.326$, $p < .0001$). Similar construct validity was demonstrated with the Oswestry Back Disorder Index was significantly and negatively correlated with PCS-12 ($r = -.63$, $p < .0001$), and MCS-12 scores ($r = -.55$, $p < .0001$). Measure for higher levels of overall well-being was significantly correlated with higher PCS-12 ($r = -.283$, $p < .0001$), and higher MCS-12 scores ($r = -.29$, $p < .0001$). Age was significantly and negatively correlated with PCS-12 ($r = -.167$, $p < .0001$). Depression was significantly correlated with PCS-12 ($r = -.127$, $p < .0001$), and to a greater degree with MCS-12 scores ($r = -.31$, $p < .0001$). Alternately, stress was significantly correlated with PCS-12 ($r = -.067$, $p = .0008$), and more strongly with MCS-12 scores ($r = -.328$, $p < .0001$). The SF-12 was also significantly correlated with change in back pain intensity. However the correlation between subscales for PCS-12 change and back pain change ($r = -.27$, $p < .0001$) was stronger than that of MCS-12 change with back pain change ($r = -.11$, $p = .014$). For patients who reported back pain was worse (at 3 to 6 months), a significant decrease was observed for PCS-12 scores ($p = .019$), and no significant change was observed for MCS-12 scores ($p = .56$) (Lou et al., 2003).

Additionally, Larson and colleagues (2011) tested for alpha reliability in a cross-sectional study with a random residential sample of 1,721 African Americans with mean age 53 years, and various chronic health conditions including diabetes mellitus (11%) and obesity (31%), in Nashville, Tennessee. The SF-12v2 demonstrated adequate PCS and MCS scores with alpha coefficients of .80 and .78, respectively (Larson et al., 2008).

Larson et al., (2008) examined construct validity using the method of extreme groups. Convergent and discriminate validity were assessed by multitrait analysis and yielded satisfactory coefficients. Item-convergent validity was met for all items with item–scale correlations greater than or equal to ($r = .40$) the standard established for the SF-36 from which the SF-12v2 was derived. In addition, concurrent validity was demonstrated by strong correlations with number of days reported in poor mental (MCS range .49 to .65, $r = -.51$) and physical health (PCS range .41 to .55); significant differences were found for the health conditions of obesity ($F=5.23_{(1,1452)}, p < .01$) and diabetes ($F=.12_{(1,1557)}, p < .01$) (Larson et al., 2008).

Similarly, Tabolli and colleagues (2011) observed statistically significant differences in the PCS-12 and MCS-12 mean scores between multiple acute ($n = 900$; 36%) and chronic ($n = 1568$; 63%) skin conditions among 2,732 respondents. Statistically significant mean difference scores were noted between PCS-12 acute and chronic (50.4(8.0) vs. 51.6 (7.9), $p < .0001$) and MCS-12 acute and chronic (48.11(10.9) vs. 46.6 (11.0), $p = .008$) skin conditions. High correlations were found between MCS-12 score and the 12-item General Health Questionnaire (GHQ-12) ($-.690, P < .001$) for single skin disease.

The SF-12v2 is a practical, reliable, and valid measure of physical and mental functioning that takes approximately two to three minutes to complete and requires a 6th grade reading level (Ware et al., 1996). Only the physical component summary (PCS-12) score, conceptualized as lifestyle physical activity was used for hypothesis testing in this study.

Covariates

The Patient Health Questionnaire (PHQ)

The Patient Health Questionnaire (PHQ) was developed from a sample of 3000 adult primary care patients recruited from eight primary care sites (Kroenke & Spitzer, 2002). The PHQ contains a 9-item module that is designed for screening, diagnosing and monitoring the severity of depression. The depression-related items are exclusively focused on diagnostic criteria for DSM-IV depressive disorders (Kroenke & Spitzer, 2002). Adequate internal reliability (alpha coefficient = .89) was demonstrated in the PHQ primary care (n = 3000) data set and again in the OB-GYN (n = 3000) sample (alpha coefficient = .86). Test-retest reliability ($r = .84$) was demonstrated between patient self-report (mean = 5.08) and telephone (mean = 5.03) administration by a mental health professional completed within 48 hours (Kroenke, Spitzer, & Williams, 2001). To establish criterion validity, correlations among approximately 150 intervention patients with concurrent PHQ-9 and Symptom Checklist-20 (SCL-20) scores at baseline ($r = .46$) was compared to a similar sample of patients with concurrent scores after 3 months of treatment ($r = .63$). Construct validity was determined when change in PHQ-9 was found to be similar or greater than change in SCL-20 scores ($r = .50$) over time. A higher score represents higher level of depression. Approximately 28% of the total primary care sample (n = 3000) and 29% of those with at least one primary mental health PHQ diagnosis, including depression, demonstrated correlations between the instrument (PHQ) score and the mental health provider diagnosis with 85% overall accuracy, 75% sensitivity, and 90% specificity. Additional testing determined construct validity by examining PHQ-9 correlations with SF-20 (mental component summary) scales for minimal ($r = .81$), mild ($r = .65$), moderate ($r = .51$), moderately ($r = .43$), and severe (r

= .29) level of depression ($p < .05$) in the primary care sample ($n = 3000$). Scores less than five signified the absence of depression (likelihood ratio = 6.0) and scores of 15 or more indicated major depression (likelihood ratio = 13.6). A majority of the patients (93%) without depression scored less than 10 compared with most patients formally diagnosed with depression (88%) who scored 10 or greater (likelihood ratio = 7.1). For construct validity, there were significant correlations between PHQ-9 depression severity score and worse function on all mental component summary scales of the SF-20 ($r = .73$, $p < .05$). Greater depression severity score was also correlated with disability days ($r = .39$), physician visits ($r = .24$), and symptom-related difficulty ($r = .55$) (Kroenke et al., 2001).

Depression scores on the 9-item PHQ module are categorized using five cutpoints with ranges 0 to 4, 5 to 9, 10 to 14, 15 to 19, and 20 or more (Kroenke & Spitzer, 2002; Kroenke et al., 2010). Each score of the PHQ-9 ranges from zero (not at all) to three (nearly every day). Depression severity can range from 0 (no depression) to 27 (major depressive disorder). The instrument discriminates well between persons with and without depression and takes less than 3 minutes to complete. Only eight items of the PHQ (PHQ-8) were used for this study, omitting the ninth response item that indicated thoughts of death or self-harm as there was no back-up system for the very rare response to the ninth item (Kroenke et al., 2010).

The General Anxiety Disorder-7 (GAD-7)

The GAD-7 was used to measure for the presence of anxiety. Spitzer, Kroenke, and Williams (1999), recruited respondent from a research network of 15 primary care sites located across 12 states. The 7-item general anxiety scale (GAD-7) is an

independent module of the larger Patient Health Questionnaire (PHQ). Items for the GAD-7 were selected by rank ordering the highest correlation of each item ($r = .75$ to $.85$) with 13 potential GAD score items. The sample population ($n = 2149$) was 65% female, 80% white non-Hispanic with a mean age of 48 years. Spitzer and colleagues (2006) found that the internal consistency of the GAD-7 (Cronbach's $\alpha = .92$) and test-retest reliability (intraclass correlation = $.83$) were adequate. Comparison of GAD-7 self-report scales with MHP-administered versions yielded an intraclass correlation of $.83$, indicating good procedural validity. Sensitivity and specificity exceeded 0.80; as the cut point increases, sensitivity decreases and specificity increases in a continuous fashion.

Item-total score correlations were reexamined in two independent replication samples ($n = 965$ and $n = 591$) (Spitzer et al, 2006). There was a strong association between increasing GAD-7 severity scores and worsening function ($r = .75$, $p < .05$) on the MCS subscale of the SF-20. To assess construct validity, an analysis of covariance was used to examine associations between higher GAD-7 scores and self-reported disability days ($r = .27$), physician visits ($r = .22$), and with symptom-related difficulty ($r = .63$). Convergent validity was demonstrated by GAD-7 correlations with the Beck Anxiety Inventory ($r = .72$) and the Symptom Checklist-90 anxiety subscale ($r = .74$). Factorial validity using confirmatory factor analyses in a sample of patients ($n = 1877$) determined that more than 50% of patients with high anxiety scores on the GAD-7 did not have high depression scores on the PHQ-9 reflecting distinctly different mental health dimensions.

Spitzer, Kroenke, Williams, and Löwe (2006) reported the GAD-7 had good reliability, as well as criterion, construct, and divergent validity. The internal consistency

of the GAD-7 was excellent (Cronbach's $\alpha = .92$). The mental health diagnosis of general anxiety disorder (GAD) as diagnosed by a mental health professional was used as the criterion standard. To establish test re-test reliability, a comparison of scores between self-report scales and those derived from the MHP-administered versions of the same scales yielded demonstrated intraclass correlation=0.83. To test construct validity, the GAD-7 strongly correlated with the mental health component summary of the Sf-290 scale ($r = .75$). Additionally, the GAD-7 was correlated with disability days ($r = .27$), physician visits ($r = .22$), and with symptom difficulty ($r = .63$). Divergent validity was assessed by calculating the difference between GAD-7 item correlations with the 13-item anxiety score and the eight item Patient Health Questionnaire (PHQ-8) depression score. Factor analysis confirmed GAD-7 and depression as distinct dimensions with all anxiety items having the highest factor loadings on the second factor (.69 to .81). Six of the seven GAD-7 items demonstrated the greatest divergent validity from the PHQ-8 ($r = .16$ to .21). Convergent validity was demonstrated by examining correlations between the GAD-7, the Beck Anxiety Inventory ($r = .72$) and the anxiety subscale of the Symptom Checklist-90 ($r = .74$) (Spitzer et al., 2006). At a cutpoint of 10 or more, both sensitivity and specificity exceeded .80, and sensitivity is nearly maximized (Kroenke et al., 2010), that is, sensitivity (82%) and specificity (89%) (Spitzer et al., 2006).

Each GAD-7 item is scored from 0 to 3 with total scale score ranges from 0 to 27 (Spitzer, 2006). Cutpoint scores for the GAD-7 total scores represent mild (5), moderate (10) and severe levels of anxiety symptoms (Kroenke et al., 2010). A cut point of 15 or greater maximizes specificity for severe anxiety with 9% prevalence, but sensitivity at

this high cutpoint is reduced (48%). The GAD-7 is a brief self-report measure that can be completed in a few minutes.

Demographic Questionnaire

A demographic questionnaire was used to collect the following baseline data from study participants: age, gender, race/ethnicity, pain duration, marital status, education level. Table 1 illustrates the instruments used for the respective hypotheses tested in this study.

Table 1.

Hypotheses and Instruments Used for Hypothesis Testing

Hypotheses	Instruments used for hypothesis tests
1. Negative pain representations are inversely related to level of participation in physical activity in persons with persistent chronic and neuropathic pain.	Brief Illness Perception Questionnaire SF-McGill Pain Questionnaire-2 SF-12 (PCS-12)
2. Pain catastrophizing (i.e., emotional representation) is inversely associated with level of participation in physical activity in persons with persistent chronic and neuropathic pain.	Pain Catastrophizing Scale SF-12 (PCS-12)
3. Negative pain representations are positively related to pain catastrophizing (i.e., emotional representation) in persons with persistent chronic and neuropathic pain.	Brief Illness Perception Questionnaire SF-McGill Pain Questionnaire-2 Pain Catastrophizing Scale
4. Pain representations independently predict level of participation in lifestyle physical activity in persons with persistent chronic and neuropathic pain.	Brief Illness Perception Questionnaire SF-McGill Pain Questionnaire-2 Pain Catastrophizing Scale SF-12 (PCS-12) PHQ-8 GAD-7
5. Negative pain representations independently predict pain	Brief Illness Perception Questionnaire SF-McGill Pain Questionnaire-2

Hypotheses	Instruments used for hypothesis tests
catastrophizing in persons with persistent chronic and neuropathic pain.	Pain Catastrophizing Scale PHQ-8, GAD-7
6. When controlling for the effects of anxiety, depression, and pain representations on level of participation in physical activity, pain catastrophizing independently predicts low levels of participation in physical activity in persons with persistent chronic neuropathic pain.	Brief Illness Perception Questionnaire SF-McGill Pain Questionnaire-2 Pain Catastrophizing Scale SF-12 (PCS-12) PHQ-8 GAD-7
7. Pain catastrophizing mediates the relationship between illness representations and level of participation in lifestyle physical activity in persons with persistent chronic neuropathic pain.	Brief Illness Perception Questionnaire SF-McGill Pain Questionnaire-2, Pain Catastrophizing Scale SF-12 (PCS-12)

Data Analysis

A statistical database was created by the PI using the using IBM Statistical Package for the Social Sciences (SPSS) version 21.0 for Windows (1989/2012), and survey response data were entered into the SPSS database by the PI. Initially, raw data was reviewed for inconsistencies, omissions and outliers. A descriptive analysis of the demographic data was conducted to describe the sample characteristics. Descriptive characteristics of the sample were quantified using means, standard deviations and frequencies. Distributions and residual plots of all variables were examined to assess for assumptions of models, and skewness. Scatterplots were generated to assess for outliers. Frequencies, histograms, scatterplots, skewness and kurtosis statistics were examined to assess study variables for approximation of normal distribution. Since variable scores were found to be normally distributed, data transformation was not necessary to meet

normality assumptions. A coded data set with all data transformations was stored in an electronic spreadsheet format along with copies of the raw data and the cleaned data sets, descriptive statistics, correlations, regression analyses, syntax and output files. A document file was appended to the electronic database with PI notes regarding the analysis file.

Correlational analysis of the study variables was conducted using Pearson Product Moment Correlation. In line with a conservative approach, a two-tailed test of significance set at .05 level was used (Polit & Beck, 2010), even when the hypothesized relationship was considered directional. The correlation matrix was examined and demonstrated the covariates (depression, anxiety) were significantly correlated with the dependent variable and thus omitted from subsequent analyses due to collinearity. That is, for subsequent analyses, those covariates found to be statistically associated with the key study variable (pain catastrophizing) were not entered into the regression models during the first step as control variables. Similarly, point biserial correlational analysis of dichotomized demographic variables was conducted. The correlation matrix was examined and demonstrated two demographic variables (employment and absenteeism) were also significantly related to pain catastrophizing, and thus, entered into the regression models during the first step as control variables.

The correlation matrix was used to test hypotheses one through three and examine the relationships among illness representations, pain catastrophizing, and lifestyle physical activity scores. To test hypotheses four through six, hierarchical multiple regression analysis was used. To test hypothesis four, SF-12/PCS-12 scores were entered as the dependent variable (DV) and the illness representation variables related to SF-

12/PCS-12 scores were entered in the first step of the hierarchical regression analysis. Individual illness representation variable scores were entered in the 2nd step. To test hypothesis five, pain catastrophizing scores were entered as the DV. The illness representation variables related to pain catastrophizing scores were entered in the first step of the hierarchical regression analysis. Individual illness representation variable scores were then entered in the 2nd step.

To test hypothesis six, hierarchical regression analysis was required. However, hypothesis six was not tested because no significant relationship was found to exist between SF-12/PCS-12, illness representations and pain catastrophizing scores. Thus, the assumptions for the test were not met.

To test the seventh hypothesis two statistical tests of mediation were required. Complete mediation would be determined using Baron and Kenny's causal steps method (1986) if after controlling for the effects of the mediating variable on the dependent variable, the effect of the independent variable and the dependent variable became zero, or in partial mediation, the effect of the independent variable on the dependent variable diminished and the intervening variable became more significant, and then the Joint Significance Test would follow pending negative results. Hypothesis seven was not tested because no significant relationship was found among study variables. Thus, the assumptions of the test were not met.

Data Collection Procedures

Patients with chronic and neuropathic pain are scheduled for pain intervention procedures at the outpatient surgical center on specific days of the week in each recruitment site. Each patient with chronic and neuropathic pain was provided a study

informational flyer and a recruitment response card by the surgical center receptionist at the time of registration on the day of their scheduled procedure. Response cards were returned to the registrar for collection by the PI at the end of each day. The response card provided permission to be contacted by the PI or notice of a decline to participate. The response card also provided contact information from each eligible participant and a question that screened for age appropriate eligibility. Eligible volunteer participants were contacted by mail.

Survey and demographic questionnaires were mailed in accordance with a modified Tailored Design Method (TDM) (Dillman, et al., 2009). Each participant was sent via first class mail the research survey packet along with a written informational cover letter that contained the elements of informed consent: 1) that the study involved research; 2) an explanation of the study purpose; 3) knowledge that there would be no anticipated benefits or risks to their participation; 4) assurance of personal confidentiality and anonymity; 5) of their right to refuse or terminate participation at any time during the data collection; 6) a summary of potential risks and benefits; 7) and instructions regarding how to return the completed instrument(s) in the enclosed stamped, self-addressed to the PI. Participants were also informed that the information collected was confidential and that any personal information provided would not be shared with any of the surgical center staff or health care providers involved in their care. Participants were advised that they could drop out of the study at any time without fear or concerns of repercussion. Participants were informed in the cover letter that completion of the survey would serve as their consent to participate. Each survey was pre-coded with a unique identifier known only to the PI to facilitate tracking of survey returns and follow-up

mailings to non-responders. A record of non-responders was maintained with the raw data. Follow-up reminders and /or surveys were mailed at scheduled intervals in accordance with the modified TDM.

Human Subjects Protection

This study was submitted to the Institutional Review Boards (IRB) of Rutgers, The State University of New Jersey to ensure that the rights of human subjects are protected prior to data collection. Expedited review was requested as the design of this study involved only minimal risk to subjects, that is, the magnitude of harm or discomfort anticipated was no greater than would be ordinarily encountered in daily life. Survey questionnaires were self-administered. Participants were advised in writing of the purpose of the study and their rights in a cover letter supplied with the survey instrument.

The investigator maintained an electronic list of participants' contact information including names, addresses, and telephone numbers. The computer and database files were password protected. Only the PI maintained access to the password. Data collected from this study was entered into SPSS with only coded unique identifiers used to identify participants' responses. Computer files were backed on an external drive and secured in a locked file cabinet of which only the PI maintains access. Data collected from this study was reported only in the aggregate both verbally and in print. Participant confidentiality was be maintained. Following the mandatory three year IRB data maintenance period, all associated electronic files will be deleted.

CHAPTER 4: DATA ANALYSIS

The purpose of this study was to investigate theorized relationships among illness representations, catastrophic thinking about pain, and participation in lifestyle physical activity among adults with persistent, chronic and neuropathic pain. A sample of 115 community-dwelling adults, age 21 to 64, scheduled for interventional anesthesia pain management procedures from two ambulatory care surgical centers participated in the study. Instruments used in the analysis included (1) a demographic questionnaire developed by the principle investigator (PI) to collect data on participants' age, gender, marital status, social support, employment, ethnicity, education, absenteeism, duration of pain, medications taken for pain and history of comorbid health conditions; (2) dimensions of illness representations (identity, timeline, consequences, personal control, treatment control) measured by respective items on the Brief Illness Perception Questionnaire (BIPQ) (Broadbent et al., 2006); (3) pain identity representation measured using The Short-form McGill Pain Questionnaire-2 (SF-MPQ-2) (Breivik et al., 2008); (4) level of pain catastrophizing measured by the Pain Catastrophizing Scale (PCS) (Sullivan et al., 1995); and (5) lifestyle physical activity measured with the physical component summary scale of the SF-12v2 Health Survey (Ware, Kosinski, & Keller, 1996).

Data management for this study included a process of initial contact and recruitment of prospective subjects in accordance with a modified Tailored Design Method (TDM) (Dillman et al., 2009). Each subject who agreed to participate during registration at the surgical center was sent via first class mail (on the first Monday after the initial contact) a research survey packet with a cover letter containing elements of informed consent. Each survey was pre-coded with a unique identifier known only to the PI to facilitate tracking and follow-up mailings to non-responders. Subsequent contacts

included a thank you, a second survey when indicated, and a reminder post card which varied in size, shape and color, as enhanced stimuli to improve the likelihood of a returned questionnaire. A record of non-responders was maintained with the collection of raw data. Follow-up reminders and surveys were mailed at scheduled weekly intervals (each respective Monday) in accordance with the modified TDM (Dillman et al., 2009). An electronic list of participants' contact information including names, addresses, and telephone numbers (when provided) was stored and password protected. Data collected for this study were entered into SPSS version 21 using the pre-coded unique identifier located on the survey questionnaire. Analyses of the data are presented in this chapter.

Demographics of the Study Sample

A description of the study sample is presented in Table 2. The final sample for the study included 115 men and women who were scheduled for a pain intervention procedure. The mean age of the sample population was 48 ($SD=.938$) ranging from 21 through 64 years. The majority of participants were female (67%), married (57%), white/Caucasian (58%) with at least a high school education ($M=13$ yrs.) ranging from 6 to 16 years. Most (51%) of the participants worked outside of the home and most had some level of social support (86%) as only 14% lived alone. Most participants reported having chronic pain for greater than 2 years (51%) and having missed work due to their chronic pain condition (64%). Most patients used some combination of medications to manage their pain including, anti-inflammatory agents (78%), muscle relaxants (68%), narcotic analgesics (58%), over-the-counter products (49%), other agents (12%). The Charlson Comorbidity Index (CMI) mean score ($M=2.17$, $SD=1.80$) indicated a low index of comorbidity in this sample population.

Table 2.

Sample Demographic Characteristics (N= 115)

Variable	(mean, SD)	<i>n</i>	%
Age	(48, .938)	115	
Male		38	33%
Female		77	67%
Marital Status		113*	
Not married		35	43%
Married		65	57%
Social Support		115	
Live alone		16	14%
Living with someone		99	86%
Employment		115	
Working		59	51%
Not working		56	49%
Race/Ethnicity		113*	
American Indian		0	0%
Asian/Pacific Islander		1	1%
Black/African American		33	29%
Hispanic/Latino		11	10%
White/Caucasian		66	58%
Other		2	2%
Years of Education	(13.43, .205)		
Absenteeism		111*	
No absence due to pain		36	34%
Absent ever due to pain		65	66%
Duration of pain			
2 years or less		56	49%
More than 2 years		59	51%
Number of Medications		115	
Anti-inflammatory agent		90	78%
Muscle relaxant		78	68%
Narcotic analgesic		79	69%
Over-the-counter		48	42%
Other		14	12%
Charlson Comorbidity Index	(2.17, 1.80)	115	

Note. *N* = sample total; **n* may vary among variables based on number of missing items; % = percentage of sample population

Description of Study Variables

Descriptive statistics (mean, standard deviation, range) for study variables are presented in Table 3. The mean score for the dependent variable ($M=36.8$) indicated reduced lifestyle physical function (SF12-PCS12) in this sample when compared to the

general U.S. population. Persons in this study functioned at a level less than 91% of the SF-12-PCS12 mean scores for the general population ($z=1.32$) (ALC CARE Program, 1995-2014).

The mean score for illness identity ($M=6.64$, $SD=2.21$) as measured by the BIPQ indicated that, on average, participants had strongly held beliefs that the symptoms experienced were associated with their chronic pain. Similarly, the total mean score for pain identity ($M=4.84$, $SD=2.82$), as measured by the MPQ2, indicates that on average participants perceived their pain as moderately severe. MPQ2 total scores ranged from 0 to 10 with higher score indicating greater pain severity. Normative data for the MPQ2 in persons with pain (Katz & Melzack, 2011) indicate that participants in this study demonstrated perceived degree of pain severity in the 24th percentile ($z=.07$). The timeline representation mean score ($M=8.14$, $SD=2.44$) indicated that participants, on average, felt that their pain would last a long time. Participants also reported strongly held beliefs that their pain severely affected their life, as indicated by the illness consequence mean score of 7.58 ($SD=2.08$). Participants, on average, believed that they had little personal control ($M=3.67$, $SD=2.63$) over the pain, and they had only a modest belief that treatment ($M=5.98$, $SD=2.53$) would help to control their pain despite being treated with medications and procedures for interventional anesthesia pain management. This sample reported an average level of catastrophizing ($M=29.45$, $SD=13.73$) with a range of PCS scores of zero to 52. Lastly, the sample mean PHQ8 ($M=13.45$, $SD=7.20$) and GAD7 ($M=10.82$, $SD=6.47$) scores demonstrated moderate to moderately severe levels of depression and severe levels of anxiety.

Table 3.

Descriptive Statistics of the Study Variables

Variable	Mean	SD	Score	
			Minimum	Maximum
Physical functioning (SF-12 PCS)	36.8	3.40	27.95	47.32
Illness identity	6.64	2.21	1	10
Illness timeline	8.14	2.44	1	10
Illness consequences	7.59	2.08	1	10
Illness control (personal)	3.67	2.63	1	10
Illness control (treatment)	5.98	2.53	1	10
Pain representations (SF-MPQ-2)	4.84	2.22	0.27	9.68
Pain Catastrophizing Scale (PCS total score)	29.45	13.73	0	52
Depression (PHQ8)	13.45	7.20	0	26
General Anxiety (GAD7)	10.82	6.47	0	21

Reliability

Internal consistency reliability coefficients for the study variables are presented in Table 4. A study variable that achieves a reliability coefficient alpha of .70 or greater demonstrates an acceptable level of reliability; coefficients greater than .80 are preferred (Polit & Beck, 2010). Reliability was not calculated for the BIPQ as it represents multiple single item measures. The reliability coefficients for each instrument used were all greater than .80, demonstrating good internal consistency reliability for each variable.

Table 4.

Alpha Coefficients for Study Instruments

Study Instrument	Cronbach's alpha coefficient
Short-Form McGill Pain Questionnaire v2 (SF-MPQ-2)	.941
Pain Catastrophizing Scale (PCS)	.943
SF-12v2 Physical Component Summary (PCS-12)	.825
PHQ-8 (Patient Health Questionnaire Depression Scale)	.909
GAD-7 (Patient Health Questionnaire General Anxiety Scale)	.927

Data management consisted of a series of data checking methods. The data were cleaned and verified as recommended by Polit and Beck (2011). Data were inspected and checked for invalid and missing values, and identifiable patterns of expectancy, such as inconsistencies in individual variable range. The SF-12 component summary scores were calculated using an algorithm based on transformed and recoded items of the SF-12. Two respondents with insufficient data to calculate SF-12 physical composite summary scores were omitted from the analysis, one male and one female. One additional survey, a female, was omitted from the analysis as it demonstrated missing values across 46% of the PCS scale and 64% of the MPQ2 scale. Thus, data from these three participants were not included in the analysis for hypothesis testing. Of the remaining 115 participants, 51 participants ranged a maximum of one to three missing values for individual study variables on their returned surveys. An analysis of missing variable scores for these participants revealed less than 5% of scores were missing for illness representation, depression, and anxiety variables; 10% of pain representation and SF-12 PCS scores were missing; and 26% of pain catastrophizing scores were missing. Because the incomplete survey data for these participants resulted in reduced statistical power for hypothesis testing (Tabachnick & Fidell, 2007), missing item values were imputed by replacing each missing value with the mean of the observed values for the specified dimension. SF-12 items are considered to be interval level data. Therefore, each item mean was calculated and rounded to the nearest whole number to represent the missing interval score. A T-test for comparison of groups, consisting of participants with true variable scores and participants with imputed variable scores, is presented in Table 5.

Table 5.

T-Test of Variable True Mean versus Imputed Mean

Variable	True Variable Scores			Variable Scores with Imputed Item Values		
	N	Mean	SD	N	Mean	SD
SF12-PCS-12	104	36.84	3.93	11	36.45	4.84
BIPQ-Illness Identity	113	6.64	2.20	2	6.64	-
BIPQ-Timeline	114	8.14	2.44	1	8.14	-
BIPQ-Personal control	114	3.67	2.63	1	3.67	-
BIPQ-Treatment control	114	5.98	2.53	1	5.98	-
PCS	85	29.42	14.18	30	29.56	12.30
MPQ2	106	4.81	2.21	12	5.16	2.39
PHQ8	113	13.5	7.24	2	9.31	2.68
GAD7	111	10.76	6.50	4	12.35	6.05

Item recode and transformation was performed on specific SF12 items according to the scoring algorithm (Spritzer, 2003). Data quality was further examined to assess variable scores for symmetry, approximation to normal distributions, and extreme skewness. The distribution of scores for all study variables were examined by visually inspecting for skewness (evidence of central tendency) and kurtosis (evidence of tail heaviness relative to the total variance in the distribution). Fisher's skewness coefficient (measure of skewness/standard error of skewness) resulted in a z statistic to indicate the seriousness of the skew. Z statistic values between +1.96 and -1.96, presented in Table 6, suggested that the distribution of scores for all but one study variable was not significantly different than a normal distribution (Pett, 1997). For non-normally distributed data, as was the case for timeline representation scores, data transformation was considered. However, Tabachnick and Fidell (2007) stated that data transformation is not universally recommended as transformed data may be more difficult to interpret. The degree of skewness for timeline representation scores was considered mild, thus these scores were not transformed (Tabachnick & Fidell, 2007). A description of the study variables is presented in Table 6.

Table 6.

Distribution of Scores for Study Variables

	Consequences	Timeline	Personal Control	Treatment Control	Identity	SF12-PCS12	PCS	MPQ2	PHQ8	GAD7
Skewness	-.729	-1.328	.294	-.440	-.424	.178	-.153	.009	-.207	.025
S.E Skewness	.226	.226	.226	.226	.226	.226	.226	.226	.226	.226
Kurtosis	.458	.885	-.574	-.225	.073	-.332	- 1.139	-.709	-1.140	-1.191
S.E. Kurtosis	.447	.447	.447	.447	.447	.447	.447	.447	.447	.447
Fisher's Skewness Coefficient (Z-score)	-.323	-5.88	1.30	-1.88	-1.88	.788	-.677	-.217	-.916	.111

Results of Hypothesis Testing

A correlation matrix of the main study variables for hypothesis testing is presented in Table 7. Pearson product-moment correlations were computed to examine the hypothesized relationships between illness representations (identity, timeline, consequences, personal control and treatment control), pain identity (MPQ-2), pain catastrophizing (PCS), lifestyle physical function (SF-12/PCS-12: physical component summary), and hypothesized covariates depression and anxiety.

Table 7. *Correlation Coefficients for Study Variables*

		5.Illness Identity	2.Illness timeline	1.Illness consequences	3.Personal Control	4.Treatment Control	0.MPQ2-PAIN IDENTITY/SEVERITY (MPQ2_TOT)	0.PAIN CATASTROPHIZING (PCS_TOT)	0.PHYSICAL COMPONENT SUMMARY	DEPRESSION (PHQ8_TOT)	GENERAL ANXIETY (GAD7_TOT)
5.Illness Identity	Pearson Correlation	1									
	Sig. (2-tailed)										
2.Illness timeline	Pearson Correlation	.306 ^{**}	1								
	Sig. (2-tailed)	.001									
1.Illness consequences	Pearson Correlation	.504 ^{**}	.394 ^{**}	1							
	Sig. (2-tailed)	.000	.000								
3.Personal Control	Pearson Correlation	-.107	-.197 [*]	-.268 ^{**}	1						
	Sig. (2-tailed)	.257	.035	.004							
4.Treatment Control	Pearson Correlation	.033	-.243 ^{**}	-.142	.362 ^{**}	1					
	Sig. (2-tailed)	.726	.009	.130	.000						
0.MPQ2-PAIN IDENTITY/SEVERITY	Pearson Correlation	.538 ^{**}	.376 ^{**}	.530 ^{**}	-.330 ^{**}	-.191 [*]	1				
	Sig. (2-tailed)	.000	.000	.000	.000	.041					
0.PAIN CATASTROPHIZING	Pearson Correlation	.454 ^{**}	.354 ^{**}	.512 ^{**}	-.382 ^{**}	-.240 ^{**}	.797 ^{**}	1			
	Sig. (2-tailed)	.000	.000	.000	.000	.010	.000				
0.PHYSICAL COMPONENT	Pearson Correlation	-.193 [*]	-.080	-.268 ^{**}	.163	.136	-.176	-.164	1		
	Sig. (2-tailed)	.039	.392	.004	.082	.146	.059	.079			
DEPRESSION (PHQ8_TOT)	Pearson Correlation	.438 ^{**}	.289 ^{**}	.509 ^{**}	-.213 [*]	-.154	.713 ^{**}	.717 ^{**}	.036	1	
	Sig. (2-tailed)	.000	.002	.000	.022	.101	.000	.000	.703		
GENERAL ANXIETY (GAD7_TOT)	Pearson Correlation	.403 ^{**}	.258 ^{**}	.454 ^{**}	-.245 ^{**}	-.192 [*]	.738 ^{**}	.781 ^{**}	.037	.851 ^{**}	1
	Sig. (2-tailed)	.000	.005	.000	.008	.040	.000	.000	.692	.000	

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

A correlation matrix of demographic variables and main study variables is presented in Table 8. Five nominal level demographic variables were recoded into dichotomous variables for bivariate correlation analysis for ease of interpretation of the nature of bivariate relationships as follows: 1) Marital status consisted of six categories which were dichotomized with married and remarried coded as “1” (57% of participants) and all others coded as “0” (43% of participants); 2) Social support consisted of eight categories with living alone recoded as “0” (14% of participants) and all other categories recoded as “1.” (86% of participants); 3) Employment status consisted of six categories with working fulltime and part time recoded as “1” (51% of participants) and all other categories recoded as “0” (49% of participants); 4) Ethnicity/race consisted of seven categories and was recoded based on frequency distribution that revealed more than half of the study the participants (58%) were white/Caucasian. Thus, white/Caucasian was recoded as “1”, and non-white participants (29% Black/African American, 10% Hispanic/Latino, 3% Asian and other) were recoded as “0”; and 5) Duration of pain consisted of five categories and was dichotomized based on a frequency distribution that revealed 48.7% of participants had experienced pain lasting less than 2 years. Thus, duration of pain was recoded as “0” for pain duration of 2 years or less and recoded as “1” for pain duration greater than 2 years (51.3% of participants).

Ordinal (absence from work due to pain) and interval (age, education) level variables were not dichotomized for bivariate analysis. Pearson correlations were computed to examine potential demographic confounders of the hypothesized relationships between main study variables.

Table 8.

Correlation Coefficients for Demographics and Study Variables

		5.Illness Identity	1.Illness consequences	2.Illness timeline	3.Personal Control	4.Treatment Control	0.PHYSICAL COMPONENT SUMMARY	0.PAIN CATASTROPHIZING (PCS_TOT)	0.MPO2-PAIN IDENTITY/SEVERITY (MPO2_TOT)	DEPRESSION (PHQ8_TOT)	GENERAL ANXIETY (GAD7_TOT)	T-Married	T_Support	T_employed	T_White_Caucasian	absenteeism	T_Duration_2years	age	education
5.Illness Identity	Pearson Correlation	1																	
	Sig. (2-tailed)																		
1.Illness consequences	Pearson Correlation	.504**	1																
	Sig. (2-tailed)	.000																	
2.Illness timeline	Pearson Correlation	.306**	.394**	1															
	Sig. (2-tailed)	.001	.000																
3.Personal Control	Pearson Correlation	-.107	-.268**	-.197	1														
	Sig. (2-tailed)	.257	.004	.035															
4.Treatment Control	Pearson Correlation	.033	-.142	-.243*	.362**	1													
	Sig. (2-tailed)	.726	.130	.009	.000														
0.PHYSICAL COMPONENT SUMMARY	Pearson Correlation	-.193*	-.288**	-.080	.163	.138	1												
	Sig. (2-tailed)	.039	.004	.392	.082	.146													
0.PAIN CATASTROPHIZING (PCS_TOT)	Pearson Correlation	.454**	.512**	.354**	-.382**	-.240**	-.164	1											
	Sig. (2-tailed)	.000	.000	.000	.000	.010	.079												
0.MPO2-PAIN IDENTITY/SEVERITY (MPO2_TOT)	Pearson Correlation	.538**	.530**	.376**	-.330**	-.191*	-.176	.797**	1										
	Sig. (2-tailed)	.000	.000	.000	.000	.041	.059	.000											
DEPRESSION (PHQ8_TOT)	Pearson Correlation	.438**	.509**	.289**	-.213*	-.154	.036	.717**	.713**	1									
	Sig. (2-tailed)	.000	.000	.002	.022	.101	.703	.000	.000										
GENERAL ANXIETY (GAD7_TOT)	Pearson Correlation	.403**	.454**	.258**	-.245**	-.192*	.037	.781**	.738**	.861**	1								
	Sig. (2-tailed)	.000	.000	.005	.008	.040	.692	.000	.000	.000									
T-Married	Pearson Correlation	-.141	-.058	-.188	.040	-.052	-.076	-.128	-.132	-.164	-.205*	1							
	Sig. (2-tailed)	.135	.541	.074	.671	.579	.419	.175	.162	.081	.029								
T_Support	Pearson Correlation	.015	.129	.015	.024	.102	-.165	.033	.160	.055	.015	.584**	1						
	Sig. (2-tailed)	.876	.171	.872	.802	.277	.079	.729	.088	.561	.876	.000							
T_employed	Pearson Correlation	-.300**	-.150	-.319**	.009	.132	.079	-.192*	-.315**	-.206*	-.229*	.119	-.088	1					
	Sig. (2-tailed)	.001	.108	.001	.925	.161	.403	.039	.001	.027	.014	.207	.349						
T_White_Caucasian	Pearson Correlation	-.147	-.027	.022	.089	-.247**	.030	-.144	-.193*	-.110	-.068	.120	-.052	.148	1				
	Sig. (2-tailed)	.120	.779	.821	.348	.003	.756	.129	.040	.245	.475	.206	.586	.117					
absenteeism	Pearson Correlation	.225	.293**	.228*	-.105	-.123	-.160	.277*	.283**	.271*	.197*	.053	.071	-.031	-.002	1			
	Sig. (2-tailed)	.016	.001	.014	.266	.190	.088	.003	.002	.003	.034	.578	.451	.746	.985				
T_Duration_2years	Pearson Correlation	.136	.127	.257*	.131	.083	-.013	.020	.079	.062	.025	-.002	.076	-.218*	-.118	-.009	1		
	Sig. (2-tailed)	.148	.176	.006	.163	.377	.890	.831	.399	.511	.788	.979	.419	.019	.212	.922			
age	Pearson Correlation	-.067	.016	-.046	-.137	-.147	-.016	-.083	-.148	-.127	-.139	.257*	.177	-.060	.145	-.118	.084	1	
	Sig. (2-tailed)	.476	.869	.627	.144	.118	.868	.377	.114	.177	.140	.006	.058	.522	.125	.208	.373		
education	Pearson Correlation	-.018	-.096	-.156	-.026	.247**	.020	-.154	-.162	.008	-.149	.023	-.009	.228*	-.044	-.015	.150	.012	1
	Sig. (2-tailed)	.855	.324	.108	.786	.010	.837	.111	.095	.937	.124	.811	.923	.017	.653	.875	.122	.900	

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

As noted in Table 8, there were no demographic characteristics significantly related to lifestyle physical activity. However, four demographic characteristics (employment status, ethnicity/race, pain duration, education) were significantly related to illness representation variables. Employment status was significantly and inversely related to three illness representation variables including illness identity ($r = -.300, p = .001$), timeline ($r = -.319, p = .001$), and pain ($r = -.316, p = .001$) representations, indicating that “not working” was associated with participants’ strongly held beliefs that 1) symptoms experienced were associated with their pain, 2) their pain was chronic or long-term, and 3) their pain was severe. Ethnicity/race was significantly and inversely related to treatment control ($r = -.247, p = .008$) and pain ($r = -.193, p = .040$) representations, indicating that non-white race was associated with 1) strongly held beliefs that treatment would control the pain, and 2) the pain was severe. Education was significantly and directly related to treatment control representations ($r = .247, p = .010$), indicating that higher levels of education were associated with strongly held beliefs that treatment would control the pain. Pain duration was also significantly and directly related to illness timeline ($r = .257, p = .006$), indicating that a pain duration of greater than two years was associated with beliefs that pain was chronic. Since employment status, ethnicity/race, pain duration, and education were not significantly related to physical activity, these variables were not entered into regression models that tested the independent relationships between illness representations and physical activity. However, ancillary analyses were conducted to test the interactive effects of these variables on the hypothesized relationship between illness representations and physical activity.

Lastly, two demographic characteristics (employment status, absenteeism from work due to pain) were significantly related to pain catastrophizing. Employment status was inversely related to pain catastrophizing ($r = -.192$, $p = .039$), indicating that “not working” was associated with higher levels of pain catastrophizing. In addition, absenteeism was directly related to pain catastrophizing ($r = .277$, $p = .003$), indicating that being absent from work due pain at least one day in the past 30 days was associated with higher levels of pain catastrophizing. Thus, employment status and absenteeism were controlled for in multivariate analyses that examined the independent effect of illness representations on pain catastrophizing.

Hypotheses 1

Hypothesis 1 indicated that illness representation variables (identity, timeline, personal control, treatment control, consequences, pain representations) were significantly and inversely related to lifestyle physical activity in persons with persistent chronic and neuropathic pain. As shown in Table 7, two of six illness representation variables were significantly related to physical activity, and the direction of the relationships were in the theoretically expected direction. Illness identity ($r = -.193$, $p = .039$) and illness consequences ($r = -.268$, $p = .004$) were significantly related to physical activity. Illness timeline, personal control, treatment control, and pain representations were not significantly related to physical activity. Thus, hypothesis 1 was partially supported, indicating that negative beliefs about number of pain-associated symptoms and consequences of pain are inversely related to level of participation in physical activity in persons with persistent chronic and neuropathic pain. Depression ($r = .036$, $p = .703$) and anxiety ($r = .037$, $p = .692$) were not significantly related to physical activity

and were not entered as covariates in multivariate analysis conducted to determine independent effects of illness identity and consequences on physical activity. Moreover, since employment status and race were significantly related to several illness representation variables (i.e., identity and timeline), the role of these demographic characteristics as moderators of the relationships between illness representation variables and physical activity was conducted as an ancillary analysis.

Hypothesis 2

Hypothesis 2 indicated that emotional representation, as represented by pain catastrophizing, was inversely associated with level of participation in physical activity in persons with persistent chronic and neuropathic pain. Bivariate analysis revealed that pain catastrophizing was inversely, but not significantly related to physical activity ($r = -.164, p = .079$). Therefore, hypothesis 2 was not supported. However, since employment status and absenteeism were significantly related to pain catastrophizing in bivariate analyses, the role of these demographic characteristics as moderators in the relationship between pain catastrophizing and physical activity was examined as ancillary analyses.

Hypothesis 3

Hypothesis 3 indicated that illness representations (identity, timeline, personal control, treatment control, consequences, pain representations) were significantly related to pain catastrophizing. Findings revealed that all dimensions of illness representations examined in this study were significantly related to pain catastrophizing in the theoretically expected direction (Table 7). Specifically, illness identity ($r = .454, p = .000$), illness timeline ($r = .354, p = .000$), illness consequences ($r = .512, p = .000$), personal control ($r = -.382, p = .000$), treatment control ($r = -.240, p = .010$), and pain

representation ($r = .797$, $p = .000$) were significantly related to pain catastrophizing in adults with persistent chronic and neuropathic pain. Thus, hypothesis three was supported. The strong association between pain representation (MPQ2 scores) and pain catastrophizing suggests that extreme negative chronic neuropathic pain experience is accompanied by increasing levels of catastrophizing about the pain. Because of the strong association between these two variables, MPQ2 scores were not used in the same analyses with pain catastrophizing scores in multivariate analyses to avoid multicollinearity (Tabachnick & Fidell, 2007). In addition, pain catastrophizing was highly correlated with depression ($r = .717$, $p \leq .000$) and anxiety ($r = .781$, $p \leq .000$), thus these two variables were also not entered as covariates in multivariate analysis. Lastly, employment status and absenteeism were entered as covariates in the regression model since they were significantly related to pain catastrophizing in bivariate analyses.

Hypotheses 4a-4d

Since illness timeline, personal control, and treatment control were not significantly related to physical activity, hypotheses 4b and 4d were not supported. Hierarchical regression analyses were conducted to examine the independent effects of the two illness representation dimensions significantly related to physical activity (i.e., illness identity and illness consequences) on level of participation in lifestyle physical activity in persons with persistent chronic and neuropathic pain. As previously noted, pain catastrophizing was highly correlated with depression ($r = .717$, $p \leq .000$) and anxiety ($r = .781$, $p \leq .000$), thus these two variables were not entered as covariates in multivariate analysis.

Hypotheses 4a indicated that illness identity representation was an independent predictor of physical activity when the effect of illness consequences was controlled for.

Illness consequences scores were entered into the regression model in the first step, and illness identity scores were entered in the 2nd step. As shown in Table 9, illness consequences uniquely explained 7% of the variance in physical activity when in the model alone. However, illness identity ($\beta = -.077$, $p = .464$) was not independently associated with lifestyle physical activity when the effects of illness consequences were controlled for and contributed little additional variance in physical activity above the variance contributed by illness consequences. Therefore, hypothesis 4a was not supported.

Hypotheses 4c indicated that illness consequences was independently associated with physical activity when the effects of other illness representation dimensions significantly related to physical activity were controlled. Illness identity scores were entered into the regression model in the first step, and illness consequence scores were entered in the 2nd step. As shown in Table 9, illness identity contributed nearly 4% of the variance in physical activity when in the regression model alone. In the 2nd model, illness identity was no longer significant, and illness consequences independently predicted physical activity ($\beta = -.229$, $p = .031$), explaining an additional 4% of the variance in physical activity score. Moreover, in the final model, for every unit increase in illness consequences score there was a decrease of .22 in physical activity scores, holding all other variables constant. Hypothesis 4c was supported.

Table 9.

Independent Effect of Illness Representation Variables on Lifestyle Physical Activity

Hypothesis 4a: Independent Effects of Illness identity on SF-12/PCS-12			
Model 1	Standard β	R ² change	Sig.
<i>Illness consequences</i>	-.268	.072	.004

Model 2	-.229	.004	.031
<i>Illness consequences</i>	-.077		.464
<i>Illness Identity</i>			
Hypothesis 4c: Independent Effects of Illness consequences on SF-12/PCS-12			
Model 1	Standard β	R² change	Sig.
<i>Illness identity</i>	-.193	.037	.039
Model 2			
<i>Illness identity</i>	.077	.039	.464
<i>Illness consequences</i>	-.229		.031

Hypothesis 5a-5d

A series of hierarchical regression analyses were conducted to examine the independent effects of illness representation variables (identity, timeline, personal control, treatment control, consequences) on pain catastrophizing when the effects of the other illness representation variables are controlled for. Since, absenteeism from work ($r = .277, p = .003$) and employment status ($r = -.192, p = .039$) were significantly related to pain catastrophizing in bivariate analysis, they were entered in the regression models as a covariates. Absenteeism was dichotomized for regression analysis in the following manner. The absenteeism item value "1 = none" was recoded to "0" to indicate no absences from work due to pain (36%). Item values "2 = 1 to 2 days in the past month" (33%) and "3 = more than 2 times in the past month" (31%) were each recoded to "1" to indicate any absence from work due to pain. Due to the previously discussed potential effect of multicollinearity with pain catastrophizing, depression and anxiety were not entered as covariates in multivariate analysis.

Hypotheses 5a indicated that illness identity was independently associated with pain catastrophizing when the effects of other illness representation dimensions significantly related to physical activity were controlled for. Illness representation variables significantly related to pain catastrophizing (illness timeline, personal control, treatment

control, illness consequences) as well as the dichotomized absenteeism and employment variables were entered simultaneously into the regression model in the first step, and illness identity scores were entered in the 2nd step. As shown in Table 10, the control variables, taken together, explained nearly 37% of the variance in pain catastrophizing. Illness identity ($\beta = .250$, $p = .007$) was independently associated with pain catastrophizing, explaining 5% additional variance in pain catastrophizing. In the final model, for every unit increase in illness identity score there was a .25 corresponding increase in pain catastrophizing scores ($p < .01$), holding all other variables constant. Thus, hypothesis 5a was supported.

Hypotheses 5b indicated that illness timeline was independently associated with pain catastrophizing when the effects of other illness representation dimensions and absenteeism and employment status were controlled for. The control variables were entered simultaneously into the regression model in the first step, and illness timeline scores were entered in the 2nd step. As shown in Table 10, the control variables, taken together, contributed nearly 41% of the variance in pain catastrophizing. However, illness timeline ($\beta = -.070$, $p = .421$) was not independently associated with pain catastrophizing, explaining little additional variance in pain. Therefore, hypothesis 5b was not supported.

Hypotheses 5c indicated that illness consequences was independently associated with pain catastrophizing when the effects of other illness representations significantly related to pain catastrophizing (illness identity, illness timeline, personal control, treatment control) and absenteeism and employment status were controlled for. The control variables were entered into the regression model in the first step, and illness consequence scores were entered in the 2nd step. As shown in Table 10, the control

variables, taken together, explained 38% of the variance in pain catastrophizing. Illness consequence was independently associated with pain catastrophizing ($\beta = .237$, $p = .013$), explaining 3% additional variance in pain catastrophizing. For every unit increase in illness consequences score there was a .24 corresponding increase in pain catastrophizing scores ($p < .05$), holding all other variables constant. Thus, hypothesis 5c was supported.

Hypotheses 5d-1 indicated that personal control representations was independently associated with pain catastrophizing when the effects of other illness representations significantly related to pain catastrophizing (illness identity, illness timeline, consequences, treatment control) and absenteeism and employment status were controlled for. The control variables were entered into the regression model in the first step, and personal control representation scores were entered in the 2nd step. As shown in Table 10, the control variables, taken together, explained 37% of the variance in pain catastrophizing. Personal control was independently associated with pain catastrophizing ($\beta = -.237$, $p = .005$), explaining 4% additional variance in pain catastrophizing. Additionally, for every unit increase in illness personal control score there was a .24 corresponding decrease in pain catastrophizing scores ($p < .01$), holding all other variables constant. Thus, hypothesis 5d-1 was supported.

Hypotheses 5d-2 indicated that treatment control representations was independently associated with pain catastrophizing when the effects of the effects of other illness representations significantly related to pain catastrophizing (illness identity, illness timeline, consequences, personal control) and absenteeism and employment were controlled for. The control variables were entered into the regression model in the first step, and treatment control scores were entered in the 2nd step. As shown in Table 10, the

control variables, taken together, explained 41% of the variance in pain catastrophizing. However, treatment control was not independently associated with pain catastrophizing ($\beta = -.088$, $p = .293$), explaining little variance in pain catastrophizing. Thus, hypothesis 5d-2 was not supported.

Table 10.

Independent Effect of Illness Representation Variables on Pain Catastrophizing

Hypothesis 5a: Independent Effect of Illness Identity on Pain Catastrophizing			
Model 1		R ² change	Sig.
<i>Illness timeline, Illness consequences, Personal control, Treatment Control, Absenteeism, Employment</i>		.374	.000
Model 2	Standard. β	R ² change	Sig.
<i>Illness Identity</i>	.250	.041	.007
Hypothesis 5b: Independent Effect of Illness Timeline on Pain Catastrophizing			
Model 1		R ² change	Sig.
<i>Illness identity, Illness consequences, Personal control, Treatment control, Absenteeism, Employment</i>		.411	.000
Model 2	Standard. β	R ² change	Sig.
<i>Illness Timeline</i>	.070	.004	.421
Hypothesis 5c: Independent Effect of Illness Consequences on Pain Catastrophizing			
Model 1		R ² change	Sig.
<i>Illness identity, Illness Timeline, Personal control, Treatment control, Absenteeism, Employment</i>		.380	.000
Model 2	Standard. β	R ² change	Sig.
<i>Illness consequences</i>	.237	.035	.013
Hypothesis 5d--1: Independent Effect of Personal Control on Pain Catastrophizing			
Model 1		R ² change	Sig.
<i>Illness identity, Illness Timeline, Illness consequences, Treatment control, Absenteeism, Employment</i>		.370	.000
Model 2	Standard. β	R ² change	Sig.
<i>Personal control</i>	-.237	.045	.005
Hypothesis 5d-2: Independent Effect of Treatment Control on Pain Catastrophizing			
Model 1		R ² change	Sig.
<i>Illness identity, Illness Timeline, Illness consequences, Personal control, Absenteeism, Employment</i>		.409	.000

Model 2	Standard. β	R ² change	Sig.
<i>Treatment control</i>	-.088	.006	.293

Hypothesis 6

Hypothesis six indicated that pain catastrophizing was independently associated with physical activity, controlling for the effects of the four illness representation dimensions significantly related to physical activity (identity, timeline, personal control, consequences) and demographic variables (employment, absenteeism). Since pain catastrophizing was not related to physical functioning in bivariate analysis, this hypothesis was not tested.

Hypotheses 7

Hypothesis 7 proposed that, when the effects of pain catastrophizing (the mediator) are controlled for, the level of significance and magnitude of the relationships between illness representation variables that are significantly related to physical activity (illness identity, illness timeline, personal control, consequences) will diminish. Since pain catastrophizing was not related to physical activity, the condition for mediation testing was not met. That is, the mediator was not related to the dependent variable. Hence, this hypothesis was not tested.

Ancillary Analysis

Relationships between illness representations and depression and anxiety

Four of five illness representation variables (illness identity, illness timeline, illness consequences, and personal control) were significantly related to depression and anxiety in correlational analysis as shown in Table 7. Since depression and anxiety are illness outcomes, particularly in association with chronic pain, the Common Sense Model postulates the illness representations directly influence the occurrence of these outcomes.

Multiple linear regression analysis was conducted to determine the extent to which each illness representation variable was significantly associated with depression and again for anxiety when the effects of other illness representation dimensions were controlled. The magnitude of the relationships between illness representation variables, anxiety, and depression were moderate to large (Table 7). Therefore, a sample of 115 participants in this study yielded sufficient statistical power for these ancillary examinations of regression models with six variables (four predictor and two control), since the power analysis for hypothesis testing was based on the entry of eight predictor variables in regression models and a moderate effect size.

Illness representation variables were entered into the regression model simultaneously. Since employment status and absenteeism were significantly related to depression and anxiety (Table 8), these variables were entered in the regression models as covariates. As shown in Table 11, findings revealed that, taken together, the four illness representation variables explained 21% of the variance in depression above the variance accounted for by absenteeism and depression ($p < .001$). Two illness representations, illness identity ($\beta = .209$, $p = .031$) and illness consequences ($\beta = .321$, $p = .002$), were each significantly associated with depression, when controlling for the effects of other illness representation variables in the model. In the final model, for every unit increase in illness consequence score, there was a .32 corresponding increase in depression scores, holding all other variables constant ($p < .01$). For every unit increase in illness identity score, there was a .21 corresponding increase in depression scores, holding all other variables constant ($p < .05$). Thus, strongly held beliefs that pain is associated with multiple symptoms, and a belief that the pain would be present for a prolonged duration

of time, are associated with depression in persons with chronic persistent and neuropathic pain. On the other hand, illness timeline ($\beta = .024$, $p = .793$) and personal control ($\beta = -.092$, $p = .270$) were not significantly associated with depression when the effects of other illness representation dimensions were controlled for in the model (Table 11).

The independent effect of illness representation variables on anxiety was also examined, controlling for the effects of absenteeism and employment status. Ancillary findings revealed that, taken together, the four illness representation variables explained 18% of the variance in anxiety above the variance accounted for by the covariates. Illness identity ($\beta = .232$, $p < .05$) and illness consequences ($\beta = .269$, $p < .01$) were each significant correlates of anxiety, when controlling for the effects of other illness representation variables in the model (Table 11). Thus, strongly held beliefs about pain associated with multiple symptoms and severe illness representation of consequences is associated with anxiety in persons with chronic persistent and neuropathic pain. For every unit increase in illness identity score there was a .23 corresponding increase in anxiety scores, holding all other variables constant ($p < .05$). For every unit increase in illness consequences score there was a .27 corresponding increase in anxiety scores, holding all other variables constant ($p < .01$). Alternately, the representations for illness timeline ($\beta = .049$, $p = .589$) and personal control ($\beta = -.135$, $p = .115$) were not significant correlates of anxiety when the effects of other illness representation dimensions were controlled as shown in Table 11.

Table 11.

Effect of Illness Representation Variables on Depression and Anxiety

Effect of Illness Representation Variables on Depression			
Model 1	Standard. B	R ² change	Sig.
Absenteeism, employment status			

	--	.118	.001
Model 2	--	.211	.000
Illness identity	.209		.031
Illness timeline	.024		.793
Illness consequences	.321		.002
Personal control	-.092		.270
Effect of Illness Representation Variables on Anxiety			
Model 1	Standard. β	R ² change	Sig.
Absenteeism, employment status	--	.108	.002
Model 2	--	.179	.000
Illness identity	.232		.017
Illness timeline	.049		.589
Illness consequences	.269		.010
Personal control	-.135		.115

Moderating Effect of Demographic Characteristics on Relationship between Illness Representations and Physical Activity

Four demographic characteristics of the sample (employment status, ethnicity/race, education, pain duration) were significantly related to three illness representation variables (timeline, treatment control, pain representations). Specifically, employment status was significantly related to illness timeline ($r = -.319$, $p < .01$) and pain representations ($r = -.316$, $p < .01$). Ethnicity/race was related to treatment control ($r = -.247$, $p < .01$) and pain representations ($r = -.193$, $p < .05$). Education was related to treatment control ($r = .247$, $p < .01$). Pain duration was related to illness timeline ($r = .257$, $p < .01$). In addition, employment status ($r = -.192$, $p < .05$) and absenteeism ($r = .277$, $p < .01$) were significantly related to pain catastrophizing in this study.

Surprisingly, only two of six illness representation variables (illness identity and consequences) were significantly related to physical activity in this study. Moreover, a significant relationship between pain catastrophizing and physical activity was expected, but was not significant. Since demographic factors significantly interacted with three

illness representation variables and pain catastrophizing, the role of employment status, ethnicity/race, education, and pain duration as moderators in the relationship between 1) illness (timeline, treatment, pain) representations and physical activity and 2) pain catastrophizing and physical activity was explored. Baron and Kenny (1986) propose that moderator variables can be considered when there is an unexpectedly weak or inconsistent relationship between an independent and dependent variable. Baron and Kenny also stipulate that the independent variable or the moderator does not have to be significantly related to the dependent variable to test for moderation, and that the interaction of a moderator with an independent variable can account for additional variance in the outcome variable that is not explained by either single variable alone (Baron & Kenny, 1986). Thus, it is plausible that the interaction of demographic and illness representation variables may have affected the relationship between illness representations and physical activity. Specifically, full-time employment, white race, higher levels of education, and pain duration less than two years may have lessened the effect of negative illness representations (timeline, pain, treatment control) on physical activity.

To test the moderating effect of demographic variables significantly associated with illness representation variables, six interaction terms were created including 1) employment status x illness timeline; 2) employment status x pain representations; 3) ethnicity/race x treatment control; 4) ethnicity/race x pain representations; 5) education x treatment control; and 6) pain duration x illness timeline. Next, a series of six, two-step hierarchical regression analyses were conducted to test for moderation (Baron & Kenny, 1986). In the first step, the illness representation variable and the moderator were entered

simultaneously, and the interaction term only was entered in the second step. According to Baron and Kenny, if the interaction term explains a statistically significant amount of variance in the dependent variable, then a moderating effect is present. As indicated previously, the power analysis for hypothesis testing was based on a moderate effect size and eight predictor variables. Only three variables (illness representation, demographic variable, and interaction term) were entered into the regression models. However, a limitation of these ancillary analyses to test moderation is that a sample size of 115 may not have detected small interaction effects in the final model for each regression.

The results of moderation testing are presented in Table 12. As shown, the interactions between employment status, race, education, pain duration and illness representation variables were not statistically significant and did not explain the negative bivariate relationships between illness timeline, pain representations, and treatment control in this study.

Table 12.

Moderating Effect of Demographic Variables by Illness Representation on Lifestyle

Physical Activity

Moderating Effect of Illness Timeline x Employment on Lifestyle Physical Activity			
Model 1		R ² change	Sig.
Illness timeline, Employment		.010	.582
Model 2	Standard. β	R ² change	Sig.
Illness timeline x Employment	.179	.002	.644
Moderating Effect of Employment x Pain Representation on Lifestyle Physical Activity			
Model 1		R ² change	Sig.
Employment, Pain representation		.032	.164
Model 2	Standard. β	R ² change	Sig.
Employment x Pain representation	-.246	.010	.277
Moderating Effect of Ethnicity/Race x Treatment control on Lifestyle Physical Activity			
Model 1		R ² change	Sig.
Ethnicity/Race, Treatment control		.024	.267
Model 2	Standard. β	R ² change	Sig.
Ethnicity/Race x Treatment control	.294	.012	.245
Moderating Effect of Ethnicity/Race x Pain Representation on Lifestyle Physical Activity			

Model 1		R ² change	Sig.
Ethnicity/Race, Pain Representation		.028	.000
Model 2	Standard. β	R ² change	Sig.
Ethnicity/Race x Pain Representation	.220	.008	.357
Moderating Effect of Education x Treatment Control on Lifestyle Physical Activity			
Model 1		R ² change	Sig.
Education, Treatment control		.031	.499
Model 2	Standard. β	R ² change	Sig.
Education x Treatment control	-1.294	.032	.066
Moderating Effect of Duration of pain x Illness timeline on Lifestyle Physical Activity			
Model 1		R ² change	Sig.
<i>Duration of pain, Illness timeline</i>		.007	.692
Model 2	Standard. β	R ² change	Sig.
<i>Duration of pain x Illness timeline</i>	.307	.005	.440

Lastly, two demographic characteristics were significantly related to pain catastrophizing, employment status and absenteeism. It is plausible that the interaction between these demographic characteristics and pain catastrophizing affected the relationship between pain catastrophizing and physical activity. That is, full-time employment and no absences from work may have lessened the negative effect of pain catastrophizing on physical activity. To test the potential moderating effect of demographic variables significantly associated with pain catastrophizing on the relationship between pain catastrophizing and physical activity, two interaction terms were created: employment status (dichotomized) x pain catastrophizing and absenteeism (dichotomized) x pain catastrophizing. Two-step regression analyses were conducted. In the first regression, employment status as a moderator of the relationship between pain catastrophizing and physical activity was examined. Employment status and pain catastrophizing were entered in the first step, and the interaction term was entered in the second step. A second regression was conducted pain catastrophizing and physical activity. In this regression, absenteeism and pain catastrophizing were entered in the first step, and the interaction term was entered in the second step. As shown in Table 13, the

interaction between employment status, absenteeism and pain catastrophizing did not explain the negative bivariate relationship between pain catastrophizing and lifestyle physical activity in this study.

Table 13.

Moderating Effect of Demographic Variables by Pain Catastrophizing on Lifestyle

Physical Activity

Moderating Effect of Employment x Pain Catastrophizing on Lifestyle Physical Activity			
Model 1		R ² change	Sig.
Employment, Pain Catastrophizing		.029	.582
Model 2	Standard. β	R ² change	Sig.
Employment x Pain Catastrophizing	-.179	.002	.430
Moderating Effect of Absenteeism x Pain Catastrophizing on Lifestyle Physical Activity			
Model 1		R ² change	Sig.
Absenteeism, Pain Catastrophizing		.036	.129
Model 2	Standard. β	R ² change	Sig.
Absenteeism x Pain Catastrophizing	-.018	.000	.949

CHAPTER 5: DISCUSSION OF THE FINDINGS

This chapter provides a summary and interpretation of findings as they relate to the Common Sense Model (CSM) of Self-Regulation (Leventhal, Leventhal, & Cameron, 2005). In general, as any illness episode unfolds, such as chronic pain, a person makes cognitive sense of the illness episode by forming illness representations that evoke both affective reactions and coping procedures, such as level of participation in lifestyle physical activity. A CSM theoretical proposition stipulates that negative cognitive and emotional responses to an illness threat are associated with the adoption of maladaptive or negative coping procedures, such as reduced participation in lifestyle physical activities. In this sample population, the illness episode was persistent chronic and neuropathic pain. The findings of this study illustrate the extent to which an individual's interpretation of their pain experience and their emotional reactions to pain, in particular pain catastrophizing, affect their level of participation in lifestyle physical activities. Because affective reactions can be elicited by symptom-induced pain or discomfort, interpretation of an illness label, and the presumed consequences of an illness threat, multiple analyses were conducted to determine the relationships among illness representations, pain catastrophizing and lifestyle physical activity. Using the framework of the CSM of Self-Regulation, a discussion of findings related to the theorized relationships among specific illness representation dimensions and individual variables (depression and anxiety), catastrophic thinking about pain, and participation in lifestyle physical activity, among adults with persistent, chronic and neuropathic pain is presented.

Illness Representations and Lifestyle Physical Activity

The mean level of lifestyle physical activity in the study participants was well below the level of physical functioning in the U.S. general population, and it was

hypothesized that negative illness representations would explain, in part, the lower levels of physical activity in persons with persistent chronic and neuropathic pain. The mean scores for illness representation dimensions in this study indicated that, on average, study participants had strongly held beliefs that their pain was associated with multiple symptoms, a chronic timeline, and had severe consequences. On average, participants also believed that they had little personal control over their pain, but they were generally neutral about the extent to which their treatment was effective in controlling their pain. This finding is similar to that revealed by Graves et al. (2009) who found that personal control and treatment control representations were significantly associated with reduced levels of physical function in persons with rheumatoid arthritis. In addition, findings were consistent with those of Foster et al. (2008) who demonstrated that persons who believed their pain would last well into the future, had serious consequences or demonstrated weaker beliefs about controllability of their pain were more likely to have higher level so disability, e.g., reduced physical activity.

A person's representations of persistent chronic and neuropathic pain may directly affect health behaviors such as level of engagement in lifestyle physical activity (Cameron & Leventhal, 2003; Petrie & Pennebaker, 2004; Leventhal, et al., 2011). The CSM postulates that strongly held negative beliefs that an illness has multiple symptoms, a long-term timeline, negative consequences, and cannot be controlled or cured leads to negative or maladaptive outcomes, such as lower levels of engagement in lifestyle physical activity (Boot, Heijmans, Van der Gulden, & Rijken, 2008). In univariate analysis test of hypothesis 1, that is, negative representations of pain are inversely related to level of participation in physical activity in persons with persistent chronic and

neuropathic pain, only two of six illness representations (illness identity and illness consequences) were significantly related to level of participation in lifestyle physical activity. Additionally, in multivariate analyses, consequences representation was the only variable independently associated with lifestyle physical activity in the study sample. All participants in this study had a clinical diagnosis of chronic pain associated with injury or disease of the spine. As expected, most participants were aware of their diagnosis and had strongly held beliefs that their pain was associated with multiple symptoms (i.e., illness identity). Participants who held these negative beliefs also reported lower levels of participation in lifestyle physical activity. Also as expected, participants who had strongly held beliefs that their pain was associated with severe consequences reported reduced participation in lifestyle physical activity, and negative consequence representations independently predicted lower levels of participation in lifestyle physical activity in the study sample. These findings are consistent with research findings in other chronic illness populations who experience pain as a component of their illness indicating that negative illness identity and consequence representations are associated with low levels of physical, social, and role functioning (Boot, Heijmans, Van der Gulden, & Rijken, 2008; Graves, Scott, Lempp, & Weinman, 2009; Hagger & Orbell, 2003; Hobro et al., 2004; Moss-Morris et al., 2007).

Alternately, illness timeline, personal control, treatment control, and pain representations were not significantly related to level of participation in lifestyle physical activity in this study. Interestingly, the second measure of illness identity in this sample (pain representations), operationalized as participants' scores on the McGill Pain Questionnaire v2 (MPQ2), was not significantly related to physical activity, but

approached significance ($r = -.176$, $p = .059$). Individual pain rating was not addressed in this study as persons with persistent chronic and neuropathic pain were not characterized as persons having stable levels of pain intensity. In this study, MPQ2 scores were not used as a measure of pain rating, but as a measure of pain identity characterized by symptom severity. Other studies utilizing the McGill Pain Questionnaire have included a separate Visual Analog Scale to measure pain rating (Burckhardt & Jones, 2003; Hawker, Mian, Kenzerska, & French, 2001; Katz and Melzack, 2011). Importantly, the effect of having multiple pain symptoms, as measured by the MPQ2, was small in this study. A larger sample size would have likely yielded sufficient power to detect a significant, but small, effect of pain symptoms on level of physical activity as reported by participants in this study. Moreover, the mean score for illness timeline was high ($M = 8.14$), indicating an average endorsement of a chronic timeline by this sample population. Most participants in this study had experienced their chronic pain for two years or more which likely contributed to their beliefs about the illness timeline, that is, their beliefs about a chronic duration and trajectory of their pain. Meta-analysis on illness representations across chronic conditions by Hagger and Orbell (2003) revealed that timeline representations were significantly related to role and social functioning, but not physical functioning. In a similar population to this study, Foster et al. (2008) demonstrated that persons with nonspecific low back pain who believed that their pain would last well into the future (timeline representation) were more likely to have higher levels of disability compared to persons who held positive illness beliefs at baseline. Also, the mean score for personal control ($M = 3.67$) indicated participants' reduced belief about their ability to control pain without expert intervention, which in turn, was underscored by the

sample's scheduled participation in an interventional anesthesia pain management procedure. In addition, previous research on persons with rheumatoid arthritis (RA) demonstrated significance between beliefs in treatment-control with measures of reduced levels of physical function (Graves et al., 2009). Thus, it was surprising that treatment control was not significantly related to participation in lifestyle physical activity in this study. It was anticipated that participants who were committed to treatment (anticipated belief and perceived responsiveness to expert intervention) would be more likely to associate controllability of their pain with treatment and report increased lifestyle physical activity, but this relationship was not substantiated. This could be the result of differences in pain perception between persistent stable chronic pain in conditions, such as rheumatoid arthritis, and the varied symptoms associated with neuropathic pain experienced by adults in this study. Research on participants recruited during a different timeline in their chronic pain experience, or participants not seeking interventional anesthesia pain management procedures, could yield significantly different results. It may be that conditions such as RA have established diagnostic criteria, and persons with RA generally accept having the chronic pain condition as unavoidable and therefore easier to accept. Persons in this study were young adults with pain resulting from injury, trauma or pathology to the spine. The aforementioned conditions typically are unexpected, not age-related, familial or genetic in origin. There is an abrupt interruption in lifestyle physical activity rather than a progressive deterioration. The abrupt onset and prolonged duration of pain may obscure illness representations in a way that makes this a unique chronic pain population.

Pain Catastrophizing and Lifestyle Physical Activity

Pain catastrophizing is characterized as a maladaptive or negative affective response (Sullivan et al., 1995) that is theoretically defined as an emotional response to a painful experience associated with irrational anticipation of negative outcomes regardless of pain intensity, frequency or causality and a tendency to (a) increase attention and focus on pain-related thoughts, (b) exaggerate the threat value of the painful stimuli, and (c) adopt a helpless orientation towards coping with painful situations (Keefe, Rumble, Scipio, Giordano & Perri, 2004; Sullivan et al., 1995; Sullivan, Rogers, & Kirsch, 2001). Leventhal, Leventhal and Cameron (2005) proposed that, when confronted with a chronic illness, such as persistent, chronic and neuropathic pain, people are likely to have affective (emotional) reactions to the pain that directly influence health behaviors, such as level of participation in lifestyle physical activities. Sullivan et al. (2005), demonstrated that pain catastrophizing among persons with diagnosed neuropathy contributed to 13% of the variance in self-reports of disability in activities in daily living. Van Vlieger et al. (2006) found that catastrophic thinking about pain among community dwellers recruited from a pain clinic accounted for 8% of the variance in pain disability. Thus, it was hypothesized that pain catastrophizing, an affective reaction to pain, would be inversely associated with level of participation in physical activity in persons with persistent chronic and neuropathic pain. However, this relationship was not supported in this study, although it approached significance ($r = .164$, $p = .079$). The magnitude of the correlation coefficient suggests that the effect of pain catastrophizing on physical activity may be small. Thus, the lack of significance in this relationship may be due to the sample size of 115 in this study that was based on a power estimate for detection of a moderate effect size ($f^2 = .15$) with eight predictor variables and a significance level of .05 (Cohen,

1988) derived from a review of the literature (Piva et al., 2009; Scharloo et al., 1998; Spain et al., 2007; Stafford et al., 2009; Stuifbergen et al., 2006; Sullivan et al., 2005; Van Vlieger et al., 2006). A larger sample size might have yielded that statistical power required to detect a small, but significant, effect between pain catastrophizing and physical activity variables in this study. However, the review of the literature did demonstrate that little is known of the extent to which an individual's interpretation of their pain experience and their emotional reactions to the pain may affect their actual level of participation in lifestyle physical activities.

Another consideration was the conceptualization of lifestyle physical activity using the physical component summary (PCS-12 subscale) of the SF-12v2 health survey. The PCS-12 covers lifestyle physical activity elements that are based on recall within a 4 week timeframe. For patients receiving interventional anesthesia pain management procedures at the onset of their 4 week recall, there may have been distortions in reporting based on the peak effects of steroid injections or nerve blocks on reduced pain and subsequent improvement in physical function during the survey administration.

Work activity (i.e., employment) was not included as a "lifestyle physical activity" for the purpose of this study. However, the study by Boot et al. (2008) revealed that participants who remained employed had more positively oriented illness representations compared to persons who were fully work disabled. Those who were work disabled had greater than 2.8 times the likelihood of reporting a medical health status of progressive deterioration compared to persons who were employed. Boot et al. (2008) also identified work disabled participants as being five times more likely to report negative illness consequences compared to participants who were employed, even when

differences in medical health status between employed and disabled persons were controlled for. Employment was also significantly and negatively related to pain catastrophizing ($p < .05$), that is, participants who were unemployed demonstrated higher levels of catastrophic thinking about their pain. Similar findings were also demonstrated for other affective reactions, including depression ($p < .05$) and anxiety ($p < .05$) among unemployed persons.

Additionally, pain catastrophizing, represented as an affective reaction in this study, was significantly related to absenteeism from work in the study population. There were no studies found in the literature review that directly examined the relationship between employment, absenteeism and pain catastrophizing. Since both work disability due to pain and absenteeism from work in employed persons with chronic illnesses is an important workforce issue, future research should examine the extent to which persons with chronic and persistent neuropathic pain report work absences and are work disabled. In addition, intervention strategies aimed at reducing catastrophic responses to pain are needed. Moreover, future research should give consideration to the re-conceptualization of lifestyle physical function using a disability index specific to persons with injury to the spine, such as *The Functional Rating Index*, a 20-item scoring index which measures perception of function and pain of the spinal musculoskeletal system, or the *Modified Oswestry Pain Questionnaire*, a commonly used outcome measure for low back pain (Longo, Loppini, Denaro, Maffulli, & Denaro, 2010). Use of the PCS-12 subscale of the SF-12v2 health survey may yet be an appropriate measure of lifestyle physical activity in persons with chronic pain originating from causes other than insult or injury to the spine. Lastly, nearly all participants had missing items on their submitted survey instrument.

Future data collection that incorporates in person or telephone directed methodology should improve the accuracy of results by avoiding missing items and the need for statistical imputation.

Illness Representations and Pain Catastrophizing

The CSM also postulates that negative representations of pain evoke negative emotional responses (Leventhal et al., 2011). Thus, it was hypothesized that negative pain representations would be positively related to pain catastrophizing in persons with persistent chronic and neuropathic pain. Not surprisingly, all dimensions of illness representations, that is illness identity (number and type of symptoms), illness timeline, illness consequences, treatment control, and personal control were significantly related to pain catastrophizing in univariate analysis in the theoretically expected direction. Specifically, correlational analysis revealed that an extremely negative chronic neuropathic (multiple and varied symptoms) pain experience is accompanied by high levels of catastrophizing in persons with persistent chronic and neuropathic pain. Notably, the relationship between illness identity (type of pain symptoms), as measured by the MPQ2, was highly correlated with pain catastrophizing ($r = .797$, $p = .000$). In addition, pain catastrophizing was also highly correlated with the affective reactions of depression and anxiety. These findings lend support to the literature that has revealed catastrophic thinking as one of the most important factors that influences negative outcomes of pain experiences, such as depression, anxiety, and disability (Ellis & D'Eon, 2002; Edwards et al., 2010; Keefe, Brown, Wallston, & Caldwell, 1989; Roth, Geisser, Theeisen, Goodvich, & Dixon, 2005; Roth, Lowery, & Hamill, 2004; Sullivan & D'Eon, 1990; Elfving, Andersson, & Grooten, 2007; Huijnen et al., 2011). Moreover, the effect

of illness representations on pain catastrophizing in this study was moderate to large in univariate analyses (i.e., correlation coefficients ranged from 0.24 to 0.79), suggesting that one's interpretation of their pain has a greater effect on pain catastrophizing in persons with chronic, persistent neuropathic pain than on their level of participation in lifestyle physical activity. In multivariate analyses, pain identity (multiple symptoms expressed as MPQ2 scores), consequence, and personal control representations were independent associated with pain catastrophizing when the effects of other illness representations were controlled for. These findings suggest that modifying illness representations could be a useful strategy for reducing level of pain catastrophizing in these persons.

On the other hand, illness timeline and treatment control did not independently predict pain catastrophizing. This may in part be due to the nature of persistent and neuropathic pain for which most participants had already experienced for two or more years and for which all participants were interventional pain treatments. Future tests of mean differences may demonstrate significance for timeline representations effects on pain catastrophizing between patients with acute and chronic pain and for treatment control in persons who are receiving diverse types of treatments for their pain.

Pain Catastrophizing as Mediator

An additional premise of the CSM is that pain representations and emotional representations interact to influence coping procedures, such as participation in lifestyle physical activity. If pain catastrophizing were an antecedent to illness representations and had a mediating effect on life style physical activity then nursing interventions aimed at the reduction or control of pain catastrophizing could be investigated as a means to

improve participation in lifestyle physical activity in this population. Thus, it was hypothesized that pain catastrophizing would mediate the relationship between illness representations and level of participation in lifestyle physical activity in persons with persistent chronic and neuropathic pain. The role of pain catastrophizing as mediator was not supported in this study since it was not significantly related to physical activity in univariate analysis, and the magnitude of the univariate relationship was small. Moreover, the significant relationships between illness representation dimensions and physical activity were not strong in univariate analysis; that is, the magnitude of the correlation coefficients between illness representation variable scores and PCS-12 scores were small and ranged from 0.08 to 0.28. According to Baron and Kenny (1985), a mediator may be operating if the relationships between the independent and dependent variable and between the mediator and dependent variable are strong. Thus, while theoretically plausible that emotional representations mediate the relationship between illness representations and health behaviors, such as engagement in lifestyle physical activity, the magnitude of the relationships among illness representations, pain catastrophizing, and physical activity in this study suggested that pain catastrophizing was likely not an operant mechanism in the interrelationships among these variables.

**Adequacy of the CSM for Explaining Interrelationships among Illness
Representations, Pain Catastrophizing, and Lifestyle Physical Activity in Persons
with Persistent Chronic and Neuropathic Pain**

Relatively little work has been done in examining the theorized interrelationships among illness representations, emotional representations, and coping procedures in persons with persistent chronic and neuropathic pain. Significant theorized relationships

were found between several illness representation dimensions and coping procedures (participation in lifestyle physical activity) and between illness representations and emotional representations (pain catastrophizing) in this study. However, the theorized relationship between emotional representations and coping procedures (life style physical activity) were not supported. The findings do support the notion that, “social-biological systems are complex; the enormous number of possible interactions among their many parts pose a challenge to theoretical ingenuity and methodological skills”, and insignificant findings for some of the hypotheses in this study were to be expected according to Leventhal and researchers (2010, p. 58). Reductions in physical activity in persons with chronic pain can have multiple causes, and since little work has been done to examine the CSM theorized interactions explaining self-regulation behaviors and health outcomes in the study population, more research is sorely needed in this area.

CHAPTER 6: SUMMARY, CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

Summary

Utilizing the theoretical framework of the Common Sense model of self-regulation (Leventhal et al., 2005; Leventhal et al., 2011), this study examined relationships between illness representations (identity, timeline, consequences, and control/cure), pain catastrophizing (as an affective reaction) and lifestyle physical activity. The following hypotheses were examined in adults aged 21 through 64 who experienced persistent chronic and neuropathic pain:

1. Negative pain representations are inversely related to level of participation in physical activity in persons with persistent chronic and neuropathic pain.
2. Pain catastrophizing (i.e., emotional representation) are inversely associated with level of participation in physical activity in persons with persistent chronic and neuropathic pain.
3. Negative pain representations are positively related to pain catastrophizing (i.e., emotional representation) in persons with persistent chronic and neuropathic pain.
4. Pain representations independently predict level of participation in lifestyle physical activity in persons with persistent chronic and neuropathic pain.
5. Negative pain representations independently predict pain catastrophizing in persons with persistent chronic and neuropathic pain.
6. When controlling for the effects of anxiety, depression, and pain representations on level of participation in physical activity, pain catastrophizing independently

predicts low levels of participation in physical activity in persons with persistent chronic neuropathic pain.

7. Pain catastrophizing mediates the relationship between illness representations and level of participation in lifestyle physical activity in persons with persistent chronic neuropathic pain.

The study consisted of 115 participants who met the following inclusion criteria:

(1) scheduled anesthesia pain management procedure for treatment of chronic and neuropathic pain; (2) community-dwelling adults aged 21 through 64; (3) persistent, chronic and neuropathic pain of at least 3 months duration for which treatment was actively being sought; and (4) the ability to read, write and understand English. The mean age of the sample population was 48 ($SD=.938$) years. The sample was 67% female and 33% male. The majority of participants were white/Caucasian (58%). There was a range of diversity among the participants, including 1% Pacific Islander, 29% African American/Black, 10% Latino/Hispanic and 2% identified as other. Most (51%) of the participants worked outside of the home and most had some level of social support (86%). Most participants reported having chronic pain for greater than 2 years (51%) and having missed work due to their chronic pain condition (64%). Of those who reported not working (49%), 33% identified that they were not working due to their pain.

Participants were recruited from their respective outpatient ambulatory care center on the date they were scheduled for an interventional anesthesia pain management procedure. Data were collected using self-report surveys provided to recipients using the modified Taylor Design Method (Dillman et al., 2009). The following instruments were used: Instruments used in the analysis, included (1) a demographic questionnaire

developed by the principle investigator (PI) that included participants' age, gender, marital status, social support, employment, ethnicity, education, absenteeism, duration of pain, medications taken for pain and history of comorbid health conditions; (2) the Brief Illness Perception Questionnaire (BIPQ) (Broadbent et al., 2006); (3) The Short-Form McGill Pain Questionnaire-2 (SF-MPQ-2) (Breivik et al., 2008); (4) the Pain Catastrophizing Scale (PCS) (Sullivan et al., 1995); and (5) the Physical Component Summary scale of the SF-12v2 Health Survey (Ware et al., 1996).

It was the intent of this study to measure variables in terms of correlation and trends with the likelihood of predictability. Hypotheses 1 through 3 were tested using Pearson product-moment correlation coefficients. Inferential statistics revealed significant relationships between 1) two illness representations (illness identity and illness consequences) and lifestyle physical activity; and 2) all dimensions of illness representations and pain catastrophizing. Findings also revealed no significant relationship between pain catastrophizing and lifestyle physical activity. Significantly correlated variables for hypotheses 4 and 5 were subjected to further tests using hierarchical multiple regression analysis. Regression analysis revealed a significant and independent effect of illness consequence representations on lifestyle physical activity and of illness identity (number of symptoms), illness consequence, and personal control representations on pain catastrophizing. Hypotheses 6 and 7 were not tested because the assumptions of the tests were not met.

In summary, several illness representation dimensions are significantly related to pain catastrophizing and to lifestyle physical activity. The relationship between pain catastrophizing and lifestyle physical activity in this study was not supported.

Limitations

Statistical procedures do not imply reality, exactness, or total truth. It is the practice of social science research to isolate and test a variable that is not (or at least minimally) influenced by other variables. Such conditions are rare outside of the creation of an artificial environment. This study was limited by its cross-sectional design and dependence on power analyses based on a paucity of literature regarding the relationship between pain catastrophizing and life style physical activity. The cross-sectional design does not establish a sequence of events, allow for longitudinal analysis of change over time, and does not yield incidence (Hulley, Cummings, Browner, Grady, & Newman, 2007). Recruitment for this study was limited to patients scheduled for an interventional anesthesia pain management procedure which represents respondent skew towards a positive treatment control representation. Generalizability of the sample to other populations is limited due to respondent self-selection bias for participation. Those who agreed to participate in the study may not be representative of the population in general who experience persistent, chronic and neuropathic pain. The study was also limited to those who could read and write in English.

Conclusions

The main findings of this study partially support, as theorized, the relationships between illness representations and physical activity. Only two illness representations (illness identity and illness consequences) were significantly related to physical activity in the study sample. On the other hand, four illness representations were not related to physical activity in this study, and ancillary examinations of interactive effects of sample demographic characteristics and illness representation did not explain these insignificant relationships. However, the negative findings may have occurred because of insufficient

statistical power to detect small effects of these illness representation variables on physical activity. Moreover, persons in this study were young adults with pain resulting from injury, trauma or pathology to the spine, and the use of a disability index specific to persons with injury to the spine as a measure of lifestyle physical activity might have yielded different results.

The theorized relationship between illness representations and pain catastrophizing was supported. Notably, the effects of illness representation variables on pain catastrophizing was moderate to large, suggesting that illness representations may be more important for catastrophic thinking in persons with chronic and persistent neuropathic pain than for their level of participation in lifestyle physical activity. In addition, ancillary analyses revealed that illness representations were independently associated with anxiety and depression in persons with chronic and persistent neuropathic pain.

Lastly, hypothesis testing also revealed that the theorized relationship between pain catastrophizing and physical activity was not supported, though this relationship approached significance in bivariate analysis. Importantly, pain catastrophizing was inversely related to employment and directly related to absenteeism from work. These findings suggest that pain catastrophizing in younger persons with persistent, chronic and neuropathic pain may have a bigger effect on their engagement in “work activity” rather than “lifestyle” physical activities.

Implications for Nursing

The Common Sense Model of Self-regulation posits that the interrelationships among illness representations, emotional reactions, and physical activity are complex.

This study further supports findings from the empirical literature that illness representations are important correlates of the strategies that one adopts to cope with the illness. Understanding that negative illness representations are associated with lower levels of functioning in persons with chronic pain provides opportunities for the implementation of nursing strategies and interventions that are designed to reduce negative affective reactions and provide cognitive strategies that serve to modify negative illness representation such as, 1) lessening one's focus on negative interpretations of the pain experience (i.e., number and type of symptoms and perceived negative consequences of pain), and 2) supporting or bolstering one's personal control over pain (e.g., use of non-pharmacological interventions). Interventions that improve coping strategies and cognitive restructuring around the chronic pain experience may also reduce an individual's time off from work and loss of productivity. In addition, significant relationship between pain representations and affective reactions also support the need for nursing assessment that includes routine screening for depression and anxiety in patients with chronic pain.

Recommendations

Recommendations for future research based on the findings from this study include:

1. Study replication with a change in data collection procedures. Because of the high volume of returned surveys with missing data in the sample population, data collection should be done on 1) a face-to-face basis to assess for completion of the survey, or 2) through the use of electronic or telephone surveys that require completion of an item before progression to the next item

2. Study replication across multiple recruitment sites. A replication of the research across multiple outpatient surgical sites to improve generalizability. Replication of the study across primary care practice sites to reduce limitation provided by the scheduled treatment effect.
3. Re-examination of theorized relationships in a larger sample. Use of a larger sample of participants to increase statistical power and the probability of discovering significant associations for small but significant effects between affective reactions and lifestyle physical activity.
4. Re-examination of relationships among theory concepts that are operationalized differently. Use of objective measurements of physical functioning and subjective assessments of disability designed to assess physical function in persons with pain originating from injury or insult to the spine.
5. Inclusion of Outcomes of Coping Procedures. Use of outcome measures of lifestyle physical activity, such as overall physical functioning, work participation and engagement, absenteeism from work, and quality of life in studies that are guided by the CSM in the study population.
6. Comparison studies. Research that compares adult and elderly populations to assess for differences in relationships between illness representations and affective reactions on lifestyle physical activity and pain catastrophizing regarding age-related in musculoskeletal influences.
7. Intervention studies. Research designed to test strategies that 1) modify negative illness representation; 2) reduce negative affective reactions (pain catastrophizing, depression, anxiety); 3) improve participation in lifestyle physical activity and

employment; and 4) reduce work absenteeism in persons with persistent chronic and neuropathic pain.

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APPENDIX

Table A1.

Summary of studies that examined relationships between illness representations and physical functioning

Author/Yr.	Chronic illness population	Study design	Sample characteristics	Relevant variables and measures	Relevant findings
Boot, Heijmans, Van der Gulden, & Rijken (2008)	Various chronic physical diseases	Cross-sectional Correlational Comparative	<u>Sample size</u> n = 522 (363 employed; 189 fully work disabled) <u>Gender</u> -Female (n = 281): 51% employed; 61% disabled -Male (n = 168): 49% employed; 39% disabled <u>Age</u> Mean = 44 employed group Mean = 52 disabled group <u>Race/ethnicity</u> Not reported	<u>IV</u> Illness identity, timeline, consequences, control/cure representations <u>Measure:</u> IPQ-R <u>DV</u> Employment status (employed, fully work disabled) <u>Covariate</u> -Medical health status/score on 4 disease characteristics -Self-reported health status -Self-report of pain	-Participants in employed group had more positively oriented illness representations compared to fully disabled group. -In the full (adjusted) logistic regression model, persons who were fully work disabled were over 5 times more likely to report negative consequences from their illness compared to persons who were employed (OR = 5.34 (2.31-12.34, p<.001) compared to employed person. -Persons who were fully work disabled were over 2.8 times more likely to report a medical health status of progressive deterioration compared to persons who were employed (OR = 2.80 (1.68, 4.69,

Author/Yr.	Chronic illness population	Study design	Sample characteristics	Relevant variables and measures	Relevant findings
					p<.001). The OR remains the same for this effect in the full model but is no longer significant.
Foster et al. (2008)	Non-specific low back pain	Longitudinal, prospective cohort	<u>Sample size</u> -Baseline: n =1591 -6 month f/u: n = 810 <u>Gender</u> 58% Female <u>Age</u> Mean = 44 <u>Race/ethnicity</u> Not reported	<u>IV</u> Illness identity, timeline, consequences, control/cure representations <u>Measure:</u> IPQ-R <u>DV</u> Self-reported disability due to low back pain <u>Measure:</u> Roland and Morris Disability Questionnaire <u>Covariates</u> Age, gender, pain duration	-Logistic regression (adjusted models controlling for demographic variables and pain duration) revealed that those persons at baseline who believed that their pain would last well into the future (RR = 1.84, 95% CI = 1.4, 2.5), has serious consequences (RR = 1.38, 95% CI = 1.0, 1.9), or who held weaker beliefs about the controllability of their back pain (OR =1.49, 95% CI = 1.1, 2.0) were more likely to have higher levels of disability compared to persons who held positive illness beliefs at baseline. *No p-values were reported for logistic regression findings. Covariates controlled for, but relationship between these variables and functioning not

Author/Yr.	Chronic illness population	Study design	Sample characteristics	Relevant variables and measures	Relevant findings reported.
Graves, Scott, Lempp, & Weinman (2009)	Rheumatoid arthritis	Cross sectional Correlational	<u>Sample size</u> n = 125 <u>Gender</u> 73% female <u>Age</u> Mean = 60 <u>Race/ethnicity</u> 68% White (British), 12% White (other); 12% Black (Caribbean, African, British); 6% Indian; 1% Asian other	<u>IV</u> Illness identity, timeline, consequences, control/cure representations <u>Measure:</u> IPQ-R <u>DV</u> Physical, role, social functioning <u>Measure:</u> SF36 Disability in rheumatological disease <u>Measure:</u> Health Assessment Questionnaire <u>Covariate</u> Disease activity in 28 joints <u>Measure:</u> Disease activity score	-Univariate correlational analysis revealed that consequence representations ($r = -.22$, $p < .05$) associated with physical function (i.e., strongly held beliefs that RA had negative consequences were associated with lower levels of physical, social, and role functioning. Personal control ($r = .20$, $p < .05$), and treatment control ($r = .25$, $p < .01$) representations also associated with physical function. Linear univariate regression analysis revealed significant associations between illness identity ($\beta = -.78$, $p = .01$) and treatment control ($\beta = .86$, $p < .01$) representations and physical function. Multivariate analysis revealed significant independent associations between only illness identity

Author/Yr.	Chronic illness population	Study design	Sample characteristics	Relevant variables and measures	Relevant findings
					representation and physical function (beta $-.75$, $p = .02$).
					Disease activity scores were significantly associated with physical function in univariate analyses ($r = -.38$, $p < .01$) and remained significantly related to physical function multivariate regression analysis (beta $.16$, $p < .01$).
Hagger & Orbell (2003)	Multiple chronic illness conditions across studies	Meta-analysis	Empirical studies guided by the CSM	<p><u>IV</u> Illness identity, timeline, consequences, control/cure representations</p> <p><u>DV</u> Physical, role, and social functioning</p>	<p>-Average corrected correlations (rc) reported.</p> <p>-Across studies, illness identity representations significantly related to physical functioning (PF) (rc $-.28$, $p < .05$), role functioning (RF) (rc $-.56$, $p < .05$), and social functioning (SF) (rc $-.48$, $p < .05$).</p> <p>-Timeline representations significantly related to role functioning (rc $-.11$, $p < .05$) and social functioning (rc $-.15$, $p < .05$). Illness</p>

Author/Yr.	Chronic illness population	Study design	Sample characteristics	Relevant variables and measures	Relevant findings
					consequences significantly related to PF (rc = .18, $p < .05$), RF (rc = -.43, $p < .05$), and SF (rc = -.49, $p < .05$).
					-Control/cure significantly related to SF (rc = .13, $p < .05$).
Hobro, Weinman & Hankins (2004)	Pain related to chronic illnesses, accidents, and unknown causes	Cross-sectional Comparative	<u>Sample size</u> n = 130 <u>Gender</u> 63% female <u>Age</u> Mean = 53 <u>Race/ethnicity</u> Not reported	<u>IV</u> Illness identity, timeline, consequences, control/cure representations <u>Measure:</u> IPQ-R <u>DV</u> Physical, role, and social functioning <u>Measure:</u> SF-36 <u>Covariate</u> Pain severity <u>Measure:</u> McGill Pain Questionnaire	-Adaptors reported more positive illness timeline (t = -5.46, $p < .001$), consequence (t = -5.43, $p < .001$), personal control representations (t = 4.07, $p < .001$) compared to non-adaptors, whose illness representations were more negative. -Adaptors reported higher levels of PF (t = 2.08, $p = .006$) and SF (t = 2.11, $p = .038$) compared to non-adaptors. -Adaptors reported lower pain severity (t = -4.15, $p < .001$) compared to non-adaptors.
Moss-Morris et al. (2007)	Chronic pain patients who completed pain management	Longitudinal	<u>Sample size</u> Total = 76 n = 64 (baseline) At end of pain	<u>IV</u> Illness identity, timeline, consequences, control	-At baseline, univariate analysis revealed illness timeline (r = -.32, $p < .01$),

Author/Yr.	Chronic illness population	Study design	Sample characteristics	Relevant variables and measures	Relevant findings
	program		program n = 58 (6-month follow up) management <u>Age</u> Mean = 42 <u>Gender</u> 65% female <u>Race/ethnicity</u> 82% white/European 8% Maori 10% other	representations <u>Measure</u> : IPQ-R <u>DV</u> Physical, role, and social functioning <u>Measure</u> : SF36	consequence ($r = -.47$, $p < .001$), and control ($r = .36$, $p < .01$) representations significantly related to physical functioning. -At 6 months, decreases in consequence representations significantly predicts improvement in physical functioning ($\beta = -.29$, $p < .01$) in the adjusted model.
Scharloo et al. (1998)	Rheumatoid arthritis (RA) COPD Psoriasis	Cross sectional Correlational	<u>Sample size</u> RA: n = 84 COPD: n = 80 Psoriasis: n = 80 <u>Gender</u> RA: 63 F, 21 M COPD: 22 F, 58 M; Psoriasis: 33 F, 47 M <u>Gender</u> RA: 75% F COPD: 29% F Psoriasis: 41% F <u>Age</u> RA: Mean = 52 COPD: Mean = 64 Psoriasis: Mean = 48 <u>Race/ethnicity</u> Not reported	<u>IV</u> Illness identity, timeline, consequences, control representations <u>Measure</u> : IPQ <u>DV</u> Physical, social, role functioning <u>Measure</u> : SF20 <u>Covariate</u> Illness duration <u>Measure</u> : # of yrs Disease severity <u>Measure(s)</u> : COPD – FEV Psoriasis – % of skin affected RA – joint erosion,	In multivariate regression analysis: -Illness identity representations an independent predictor of (1) physical functioning in persons with psoriasis ($\beta = -.61$, $p < .001$) and persons with RA ($\beta = -.33$, $p < .01$); (2) role functioning in persons with psoriasis ($\beta = -.65$, $p < .001$) and COPD ($\beta = -.39$, $p < .001$); and (3) social functioning in persons with psoriasis ($\beta = -.33$, $p < .05$) and COPD ($\beta = -.44$,

Author/Yr.	Chronic illness population	Study design	Sample characteristics	Relevant variables and measures	Relevant findings
				presence/absence rheumatoid factor, use of antirheumatic drugs	<p>p<.01).</p> <p>-Timeline representations an independent predictor of social functioning in persons with psoriasis (beta = -.31, p<.01).</p> <p>-Control/cure an independent predictor of social functioning in persons with RA (beta -.24, p<.001).</p> <p>*Of note, alpha reliability low on consequence scale for persons with psoriasis and control/cure scale for persons with RA and these variables not entered in regression equations for these groups.</p> <p>Disease severity was a significant covariate of functioning across diagnostic groups.</p>
Scharloo et al. (2000)	Psoriasis	Longitudinal Baseline and one-yr. follow up measures	<p><u>Sample size</u> n= 69</p> <p><u>Gender</u> 45% female</p> <p><u>Age</u> Mean = 48</p> <p><u>Race/ethnicity</u></p>	<p><u>IV</u> Illness identity, timeline, consequences, control representations</p> <p><u>Measure:</u> IPQ</p>	<p>-Baseline illness identity representations explained 3% of the variance in physical functioning at time 2.</p>

Author/Yr.	Chronic illness population	Study design	Sample characteristics	Relevant variables and measures	Relevant findings
			Not reported	<u>DV</u> Physical, social, role functioning <u>Measure:</u> SF 20 <u>Covariate</u> Illness duration <u>Measure:</u> /# of years Disease severity <u>Measure:</u> % of skin affected	-Baseline identity representations explained 12% of variance in social functioning at time 2. -In multivariate analysis, baseline illness duration accounted for 6% of variance in PF at time 2 and 8% of variance in social functioning at time 2. That is, shorter illness duration was independently associated with better functioning at time 2. *Of note, no betas or significance levels were reported in this study.
Spain, Tubridy, Kilpatrick, Adams, & Holmes (2007)	Multiple Sclerosis	Cross-sectional Correlational	<u>Sample size</u> n = 687 <u>Gender</u> 79% female <u>Age</u> Mean = 47 <u>Race/ethnicity</u> Not reported	<u>IV</u> Illness identity, timeline, consequences, control/cure representations <u>Measure:</u> IPQ <u>DV</u> Physical functioning <u>Measure:</u> SF 36 <u>Covariates</u> Depression and anxiety <u>Measure:</u>	In multivariate analyses, Illness identity (beta -.18, $p < .01$) and illness consequence (beta -.10, $p < .05$) representations independently predicted physical function. Pain (beta -.26, $p < .01$), depression (beta -.17, $p < .01$), and anxiety (beta .25, $p < .01$) also independently predicted physical

Author/Yr.	Chronic illness population	Study design	Sample characteristics	Relevant variables and measures	Relevant findings
				Hospital Anxiety and Depression Scale (HAD)	function with IR variables in the model.
				Pain <u>Measure:</u> Pain VAS	
Stuifbergen Phillips, Voelmeck, & Browder (2006)	Fibromy- algia	Cross- sectional Correlational	<u>Sample size</u> n = 91 <u>Gender</u> 100% female <u>Age</u> Mean = 54 <u>Race/ethnicity</u> 85% White Racial mix of remaining 15% not reported	<u>IV</u> Illness identity, timeline, consequences, control representations <u>Measure:</u> IPQ-R <u>DV</u> Physical functioning <u>Measure:</u> SF-36	In multivariate analysis -Personal control representations independently predict physical functioning (beta .33, p.038), i.e., more positively held beliefs that one has personal control over illness associated with higher levels of PF.

Table A2.

Summary of studies that examined relationships between illness representations and emotional representations (affective reactions)

Author/Yr.	Chronic illness population	Study design	Sample characteristics	Relevant variables and measures	Relevant findings
Grace et al. (2005)	Coronary artery disease	Prospective study	<p><u>Sample size</u></p> <p>n = 661</p> <p><u>Gender</u></p> <p>24% female</p> <p><u>Age</u></p> <p>Mean = 61</p> <p><u>Race/ethnicity</u></p> <p>Not reported</p>	<p><u>IV</u></p> <p>Illness identity, timeline, consequences, control/cure, emotional representations</p> <p><u>Measure: IPQ-R</u></p> <p><u>Emotional representations</u></p> <p>Depressive symptomatology</p> <p><u>Measure:</u></p> <p>Hospital Anxiety and Depression Scale (HADS)</p>	<p>No gender differences in depressive symptoms</p> <p>-In multivariate analysis, for men ($F = 7.68$, $p < .001$), timeline (chronic) ($p < .05$), greater consequences ($p < .001$), and lower cure/control ($p < .05$) representations were associated with greater depressive symptomatology.</p> <p>-In multivariate analysis, for women ($F = 5.49$, $p < .001$), chronic timeline representations ($p < .01$) were associated with greater depressive symptomatology.</p> <p>Findings suggest the important role that illness representations play in negative</p>

Author/Yr.	Chronic illness population	Study design	Sample characteristics	Relevant variables and measures	Relevant findings
					emotional reactions to illness.
Hagger & Orbell (2003)	Multiple chronic illness conditions across studies	Meta-analysis	Empirical studies guided by the CSM	<p><u>IV</u> Illness identity, timeline, consequences, control/cure representations <u>Measure:</u> IPQ</p> <p><u>Emotional representation</u> Psychological distress</p>	-Corrected partial correlation across studies revealed that the control/cure dimension was significantly and negatively related to psychological distress ($r = .17$, $p < .05$), indicating that persons who believe that their illness is not controllable or curable experienced greater psychological distress.
Hobro, Weinman & Hankins (2004)	Pain related to chronic illnesses, accidents, and unknown causes	Cross-sectional Comparative	<p><u>Sample size</u> $n = 130$</p> <p><u>Gender</u> 63% female</p> <p><u>Age</u> Mean = 53</p> <p><u>Race/ethnicity</u> Not reported</p>	<p><u>IV</u> Illness identity, timeline, consequences, control/cure representations <u>Measure:</u> IPQ-R</p> <p><u>Emotional representations</u> Depression, anxiety <u>Measure:</u> Hospital Anxiety and Depression Scale (HADS)/</p>	-Significant differences in emotional representations were demonstrated between clusters (adaptors vs. non-adaptors) ($t = -5.082$, $p = 0.001$) on emotional representations, depressive symptomology and symptoms of anxiety.

Author/Yr.	Chronic illness population	Study design	Sample characteristics	Relevant variables and measures	Relevant findings
					-Adaptors who demonstrated short timeline beliefs, less serious pain consequences, and strongly-held beliefs in personal and treatment control over pain were less emotionally affected by their illness ($t = -5.082$, $p < .0001$), had lower levels of depressive symptoms ($t = -3.159$, $p = .002$) and had less anxiety symptoms ($t = -2.044$, $p = .045$) than the non-adaptors.
Moss-Morris et al. (2007)	Persons with chronic pain (unspecified)	Longitudinal	<u>Sample size</u> $n = 76$ <u>Age</u> Mean = 42 <u>Gender</u> 65% female <u>Race/ethnicity</u> 85% white	<u>IV</u> Illness identity, timeline, consequences, control/Illness representations <u>Measure:</u> IPQ-R <u>Emotional representations</u> Pain catastrophizing <u>Measure:</u> Pain catastrophizing scale (PCS)	-At baseline, univariate analysis revealed significant associations between illness identity ($r = .31$, $p < .05$), timeline ($r = .27$, $p < .05$), control ($r = -.41$, $p < .01$) and pain catastrophizing. -Multivariate associations between these variables not examined.

Author/Yr.	Chronic illness population	Study design	Sample characteristics	Relevant variables and measures	Relevant findings
Stafford, Berk, & Jackson (2009)	Coronary artery disease	Prospective, longitudinal (3 months and 9 months after hospital discharge)	<u>Sample size</u> n = 193 at baseline <u>Gender</u> 19% female <u>Age</u> mean = 64 <u>Race/ethnicity</u> Not reported	<u>IV</u> Illness identity, timeline, consequences, control/cure representations <u>Measure:</u> IPQ-R <u>Emotional representations</u> Depressive symptoms <u>Measure:</u> 7-item depression subscale of Hospital Anxiety and Depression Scale (HADS)	-Multivariate analysis reveal beliefs that CAD had serious illness consequences (beta = 0.18, $p < 0.01$) and little personal control over the illness (beta = -.22, $p < .001$) were independent predictors of depressive affect at baseline. Independent association of personal control no longer significant ($p = .07$) 9 months after hospital discharge
Stuifbergen Phillips, Voelmeck, & Browder (2006)	Fibromyalgia Fibromyalgia	Cross-Cross-sectional Correlational	<u>Sample size</u> n = 91 <u>Gender</u> 100% females <u>Age</u> Mean = 54 <u>Race/ethnicity</u> 85% White Racial mix of remaining 15% not reported	<u>IV</u> Illness identity, timeline, consequences, control/Illness representations <u>Measure:</u> IPQ-R <u>Emotional representation</u> Self-report of extent to which one is emotionally affected by the illness <u>Measure:</u> IPQ-R	-Multiple illness-related symptoms (illness identity) ($r = .45$, $p < 0.01$), perceived increased severity of illness consequences ($r = 0.54$, $p < 0.01$), and beliefs that FMS was not controllable or curable ($r = -0.30$, $p < 0.01$) were significantly associated with participants'

Author/Yr.	Chronic illness population	Study design	Sample characteristics	Relevant variables and measures	Relevant findings
					reports of being emotionally affected by the illness.
					*Of note is the independent effects of illness representation dimensions on emotional representations were not explored.
Van Wilgen, Van Ittersum, Kaptein, & Van Wijhe (2008)	Fibromyalgia (FM)	Prospective at baseline (T1) and 3 weeks (T2)	<p><u>Sample size</u></p> <p>n = 51</p> <p><u>Gender</u></p> <p>92% female</p> <p><u>Age</u></p> <p>Mean = 44</p> <p><u>Race/ethnicity</u></p> <p>Not reported</p>	<p><u>IV</u></p> <p>IPQ-R/ Illness identity, timeline, consequences, control/cure representations</p> <p><u>Measure:</u> IPQ-R</p> <p><u>Emotional representations</u></p> <p>Pain catastrophizing</p> <p><u>Measure:</u> Pain Catastrophizing Scale</p> <p>Anxiety</p> <p><u>Measure:</u></p> <p>Fibromyalgia Impact Questionnaire (FIQ)</p>	<p>In univariate analysis, timeline (cyclic) representation was significantly associated with catastrophizing ($r = -0.41, p = 0.01$).</p> <p>Beliefs that FM had severe consequences was significantly associated with anxiety symptoms ($r = 0.45, p = 0.01$). That is, beliefs that FM has serious consequences are associated with high levels of anxiety.</p>

Table A3.

Summary of studies that examined relationships between emotional representations (affective reactions) and life style physical activity

Author/Yr.	Chronic illness population	Study design	Sample characteristics	Relevant variables and measures	Relevant findings
Foster et al. (2008)	Non-specific low back pain	Longitudinal, prospective cohort	<u>Sample size</u> -Baseline: n = 1591 -6 month f/u: n = 810 <u>Gender</u> 58% Female <u>Age</u> Mean = 44 <u>Race/ethnicity</u> Not reported	<u>Emotional representation</u> Self-report of extent to which one is emotionally affected by the illness <u>Measure:</u> IPQ-R <u>DV</u> Level of disability from low back pain <u>Measure:</u> Roland and Morris Disability Questionnaire/s self-reported disability due to low back pain <u>Covariates</u> Age, gender, duration of current episode of pain	Compared to patients who reported little to no emotional reactions to their illness, patients who reported they were severely affected emotionally by their illness reactions had a 30% increased risk for disability due to low back pain [$OR = 1.34$, (95% CI = 1.0-1.8), $p < 0.05$]. At 6 months the difference between emotional representations between those who perceived good outcomes versus those who perceived greater disability was significant ($p < .00001$).
Motl, & McAuley (2009)	Multiple Sclerosis	Cross-sectional Correlational	<u>Sample size</u> n = 292 <u>Gender</u> 84% female <u>Age</u> Mean = 48 <u>Race/ethnicity</u> 93% Caucasian	<u>Emotional representation</u> Depressive symptoms <u>Measure:</u> Hospital Anxiety and Depression	Univariate analysis revealed a statistically significant association existed between depressive symptoms and

Author/Yr.	Chronic illness population	Study design	Sample characteristics	Relevant variables and measures	Relevant findings
				Scale (HADS) DV Actual physical activity behavior Measure: ActiGraph accelerometer Self-report of usual physical activity behavior Measure: Godin Leisure-Time Exercise Questionnaire (GLTEQ)	actual physical activity behavior ($r = -0.16, p < 0.05$) and self-reported participation in physical activity ($r = -0.18, p < .05$). That is, higher levels of depressive symptoms were associated with lower levels of physical activity.
Piva, & colleagues (2009)	Patella-femoral pain syndrome (PFPS)	Cross-sectional. Correlational	Sample size n = 74 adults Gender 39% female Age Mean = 29 Race/ethnicity White 50% Black 8% Hispanic 8 % Asian 3% Native American 1% Other 4%	Emotional representation s Fear about work and physical activity Measure: Fear-Avoidance Beliefs Questionnaire Anxiety Measure: Beck Anxiety Index DV Physical function Measure: KOS-ADLS Knee Outcome Survey–Activity of Daily Living Scale	Multivariate analysis in the full adjusted model revealed that anxiety (beta $-.28, p = .01$) fear-avoidance for work (beta $-.23, p = .03$), and fear-avoidance for physical activity (beta $-.27, p < .05$) independently predicted physical function. That is, high levels of anxiety and fear-avoidance beliefs for work and physical activity were independently predicted low levels of physical activity.

Author/Yr.	Chronic illness population	Study design	Sample characteristics	Relevant variables and measures	Relevant findings
Scopaz & colleagues (2009)	Osteoarthritis of the knee	Cross-sectional, correlational	<u>Sample size</u> n = 182 <u>Gender</u> 67% female <u>Age</u> Mean = 64 <u>Race/ethnicity</u> Not reported	<u>Emotional representation</u> <u>s</u> Anxiety <u>Measure:</u> Beck Anxiety Inventory Depressive symptoms <u>Measure:</u> Center for Epidemiological Studies Depression Scale Fear-avoidance beliefs <u>Measure:</u> Fear Avoidance Belief Questionnaire-Physical Activity (FABQ-PA) Scale <u>DV</u> Self-reported limitations in activities of daily living <u>Measure:</u> Lower Extremity Function Scale (LEFS)	Correlational analysis revealed that higher anxiety was significantly associated with lower levels of participation in activities of daily living ($r = -0.433, p < 0.01$). Similarly, higher levels of depression was significantly associated with lower level of participation in activities of daily living ($r = -0.272, p < 0.01$). Lastly, fear avoidance beliefs were also significantly associated with reductions in level of participation in activities of daily living ($r = -0.263, p < 0.01$). Findings support relationship between emotional representations (higher fear-avoidance beliefs) and reduced physical function (worse self-reported function).

Author/Yr.	Chronic illness population	Study design	Sample characteristics	Relevant variables and measures	Relevant findings
Sullivan, Lynch, & Clark (2005)	Neuropathic pain	Cross-sectional, correla-tional	<u>Sample size</u> n = 80 <i>diabetic neuropathy (n = 19)</i> <i>Post herpetic neuralgia (n = 12)</i> <i>Post-surgical or post-traumatic neuropathy (n = 49)</i> <u>Gender</u> 49% female <u>Age</u> Mean = 52 <u>Race/ethnicity</u> Not reported	<u>Emotional representation</u> <u>s</u> Pain catastrophizing <u>Measure:</u> Pain Catastrophizing Scale <u>DV</u> Self-reports of disability in activities of daily living <u>Measure:</u> Pain Disability Index	In the full logistic regression model, the combined PCS dimensions of catastrophizing (i.e., rumination (beta = .33, $p < .01$), magnification (beta = .22, $p < .05$) and helplessness (beta = .42, $p < .01$) accounted for 13% of the total variance in self-rated physical disability [F change (3,73) = 4.0, $p < 0.01$]. *Of note, no individual subscale contributed significant unique variance to the prediction of self-rated disability.
Van Vlieger, Crombez, & Eccleston (2006)	chronic pain of nonspecific origin	Cross-sectional correla-tional	<u>Sample size</u> n = 185 adults n = 123 <i>(community-dwelling volunteers)</i> n = 63 <i>(recruited from a tertiary chronic pain center)</i> <u>Gender</u>	<u>Emotional representation</u> Worry <u>Measure:</u> Worry Domains Questionnaire (WDQ) Pain catastrophizing <u>Measure:</u> Pain catastrophizing scale (PCS)	Worry ($r = 0.52$, $p < 0.01$) and catastrophic thinking ($r = 0.44$, $p < 0.01$) were significantly related to reduced lifestyle physical activity. Regression analyses

Author/Yr.	Chronic illness population	Study design	Sample characteristics	Relevant variables and measures	Relevant findings
			63% female <u>Age</u> Mean = 54 <u>Race/ethnicity</u> Not reported	<u>DV</u> Degree to which pain interferes with participation in activities of daily living <u>Measure: Pain Disability Index</u>	demonstrated catastrophizing as a significant predictor of disability ($\beta = 0.24, p < 0.005$). Catastrophic thinking about pain independently predicted reductions in lifestyle physical activity, that is, it accounted for 8% of the variance ($\Delta R^2 = 0.08, p < .005$) in pain disability.

VITA

Aleesa Mae Mobley (nee Fitzgerald) was born on July 21, 1956 in Camden, New Jersey and is a United States citizen. She graduated from Williamstown High School, Williamstown, NJ in 1974.

EDUCATION

Year	Degree	Institution	Content
1976	AAS	Gloucester County College	Nursing
1992	BA	Rutgers University, Camden, NJ	Psychology
1994	BS	Rutgers University, Camden, NJ	Nursing
1996	MS	Rutgers University, Newark, NJ	Nursing
2000-2007	*	Walden University, Baltimore, MD	Adult Education /Leadership
2014	PhD	Rutgers University, Newark, NJ	Nursing

PROFESSIONAL EXPERIENCE

2008	Gloucester County College-Senior adjunct faculty, nursing: clinical instructor
09/2009 present	Adult Nurse Practitioner. Comprehensive Pain Management, Cherry Hill, NJ
10/2013 to present	Adjunct Faculty - Rowan University, Glassboro, NJ
	Fall 2013 <i>Nursing Informatics</i> [online]
	Fall 2013 Online graduate course <u>design and development</u> : <i>Integrated Information Technology</i>
	Spring 2014 <i>Integrated Information Technology</i> [online]

PUBLICATIONS

- Mobley, A. (2009). Slowing the progression of chronic kidney disease. *Journal for Nurse Practitioners*, 5(3), 188-194.
- Mobley, A. (2008). A trichomoniasis primer. *Journal for Nurse Practitioners*, 4(6), 456-458.

MANUSCRIPT REVIEWS

- Manuscript referee: (March, 2013). Transmission dynamics of trichomoniasis in bisexuals. *World Journal of Modeling and Simulation*.
- Manuscript referee: (July 2012). Contextual and internal factors that can influence the development of vocational guidance and career planning in Italia students. *Educational Research Journal*.

BOARDS/ COMMITTEE MEMBERSHIPS

2009-2011	President, NJSNA Region 5
2011-2013	NJ Department of Education, Career and College Readiness Task Force, Health Education Cluster Chair
2011-2013	Immediate Past President/Treasurer, NJSNA Region 5
2013- present	STTI Eta Mu Chapter Corresponding Secretary-Newsletter Editor
2013-present	Treasurer, NJSNA Region 5

PROFESSIONAL ORGANIZATIONS

National League for Nursing
 American College of Nurse Practitioners
 ANA/New Jersey State Nurses Association
 Sigma Theta Tau, the International Honor Society of Nursing