# INDIVIDUAL DIFFERENCES, MOOD AND COPING:

# A PROCESS ANALYSIS OF DAILY CHRONIC PAIN

by

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## Abstract

This study addresses recent calls in the literature to explore both general trends and individual differences in the process of coping and associated health outcomes as they unfold across time (Parker & Endler, 1996; Tennen & Affleck, 1996; Tennen, Affleck, Armeli & Carney, 2000). Twice daily for one week, 71 individuals coping with RA pain reported on their pain severity, coping efforts, and negative mood via a structured diary. Each of the Big Five personality dimensions (i.e., neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness) and disease status information were measured via questionnaire. Using these two sources of data (i.e., time variant and time invariant data) both idiographic and nomothetic patterns in the associations among daily negative mood, coping and pain were examined. Temporal associations among these variables within the unfolding of a single day were tested via Hierarchical Linear Modeling (HLM; Bryk & Raudenbush, 1992), a statistical technique recommended for use with multi-level data collected across time. First, the tested models examined the temporal associations between mood and pain within days. Second, the moderating role of coping efforts, personality and disease status was examined. Third, the moderating role of personality and disease status in both coping use and coping effectiveness was explored. The findings from this study suggest fluctuations in negative mood and ways of coping have an impact upon how subjective pain experience unfolds within the course of a single day. The findings also suggest that these temporal associations are at times moderated by both contextual and person factors.

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# Introduction

A substantial body of empirical literature has accumulated that examines components of stress and coping processes. To date research has revealed these processes are often complex, with health outcomes influenced both directly and indirectly by a vast array of biological and psychosocial factors. Cognitive and behavioural coping efforts are key variables affecting stress and health processes. Empirical evidence indicates that both the use and effectiveness of specific ways of coping can vary substantially across different stressful situations or contexts (for reviews, see Aldwin, 1994; Gottlieb, 1997; Snyder, 1999; Zeidner & Endler, 1996). Given this, researchers should examine the nature of the stress and coping process in the context of a relatively homogeneous stressor.

## *Chronic Pain*

One such context is coping with chronic pain. Banks & Kerns (1996) argue that chronic pain is a unique symptom in comparison to other types of health complaints due to pain's high physical and psychological aversiveness, ability to disrupt cognitive and behavioural processes, and ability to deplete physical, emotional, behavioural, and mental resources. Unlike acute pain (which is time limited), chronic pain extends over time (with or without pain-free periods). Chronic pain may or may not be associated with readily identifiable organic pathology.

Chronic pain is associated with a multitude of secondary stressors and threats to well-being including sleep disruption, mood disturbance, unemployment or underemployment, financial burdens, tension and disruption to interpersonal relationships, reductions in leisure and social activities, and difficulty or inability to engage in basic tasks of daily living such as housework, personal grooming/hygiene, or yard work (e.g., Stenstrom, Lindell, Swanberg, Nordemar, & Harms-Ringdahl,1992; Taal, Seydel, Rasker, & Wiegman, 1993). These secondary problems simply compound the stress associated with chronic pain and make further demands upon coping resources.

Canadian population surveys suggest approximately 14% (3.5 million) Canadians age 12 and older suffer from arthritis/rheumatism; and 14% (3.5 million) suffer from back problems, making these chronic pain conditions second only to non-food allergies in regards to health problems (Health Canada, 1999a, 1999b). Given that chronic pain conditions are the most common chronic health problems among those aged 65 and older (Health Canada, 1999a, 1999b), the need to further our understanding of chronic pain will intensify as an increasingly larger segment of the population ages.

*Biopsychosocial models of pain*

During the last 50 years, researchers and clinicians have made significant advances in our understanding and conceptualization of pain by examining empirically derived biopsychosocial models of pain (e.g., Melzack & Wall, 1965; 1996; Melzack, 1999; Wall & Melzack, 1999; for a historical review, see Gamsa, 1994). Empirical evidence to date supports the inclusion of psychosocial variables such as cognitive appraisals and coping strategies (along with more traditional biological, physiological, or medical variables) when predicting pain and related variables (for reviews see Jensen, Turner, Romano, & Karoly, 1991; Boothby, Thorn, Stroud, & Jensen, 1999). For example, higher levels of psychological distress are often associated with higher levels of pain (for a review, see Craig, 1999). However the nature of the temporal relations among biopsychosocial variables remains controversial. The majority of existing research has been cross-sectional in design and findings have often been mixed. As a result there have been calls in the literature for researchers to 1) utilize process models (i.e., those that allow examination of temporal associations among key variables) when studying stress and coping in the context of chronic pain and 2) examine individual differences in the magnitude and direction of these associations (Tennen et al., 2000). Increased understanding of both within and between person differences in these daily processes is critical if we are to better understand chronic pain conditions.

In response to such calls, there has emerged a line of research that utilizes non-aggregated repeated measures data across a variety of stressors in such a way that temporal issues can be

addressed (e.g., Affleck et al., 1999; Almeida & Kessler, 1998). The limited research to date examining such models within the context of chronic pain has identified significant temporal associations between psychosocial variables such as mood and pain (see below for a review of this research). However there is a need to extend this approach to examining the role of additional psychosocial variables such as coping efforts. Current stress and coping theory views coping as a process that unfolds over time, and one that can vary both between and within persons from moment to moment (e.g., Tennen et al., 2000). In order to capture both between and within person differences in these dynamic health related processes, it is critical for researchers to examine stress and coping variables across micro-units of time (e.g., repeated measures across hours and days). Process designs utilizing repeated measures within or across relatively small periods of time provide a more appropriate lens through which to evaluate modern stress and coping theory. Although repeated measure studies using larger periods of time have been informative (e.g., panel studies with monthly or yearly repeated measurements), such designs do not allow researchers to examine the specific stress and coping processes that determine between person and within person variability in daily adjustment over time. By examining process variables across smaller units of time there is less chance for intervening events to occur in between reporting periods that may confound the pattern of findings. Process designs also have increased potential to inform clinical practice by identifying the daily biopsychosocial processes that are associated with pain experience. These processes can then be targeted as a component of treatment or symptom management.

Despite calls in the literature (e.g., Affleck et al., 1999), to my knowledge no study has examined ways of coping and the pain-mood nexus (i.e., the associations and interactions between mood and pain) in one model when predicting pain outcomes within the temporal frame of a single day. The unfolding of the coping process within a single day is arguably a psychologically meaningful unit of time for individuals with chronic pain. It is not uncommon for people coping with chronic problems to approach the coping process "one day at a time" and many are actively

encouraged to do so by health professionals, family or friends. I am also unaware of any research that has examined the role of personality differences in the magnitude and direction of the within day associations among mood, coping and pain. For example, some individuals may be more likely to utilize or derive benefits from the use of a specific coping strategy within the course of a day than others.

*General Purpose of the current study*

The purpose of the current study is three-fold. First, the proposed models will allow exploration of the temporal associations between negative mood and pain within days (i.e., the mood-pain nexus). Second, the temporal associations between coping and pain will be examined within days. Third, individual differences in personality will be examined as moderators of the temporal mood and pain associations, daily coping use and daily coping effectiveness. Before describing the study methodology and hypotheses, a review of the literature to date regarding mood, pain, coping and personality follows below.

*Negative mood and pain*

Reviews of the literature generally suggest elevated levels of negative affect and distress among individuals coping with chronic pain (Banks & Kerns, 1996; Craig, 1999; Robinson & Riley, 1999; Romano & Turner, 1985). A range of negative emotions including frustration, depression, anger, fear, and anxiety are frequently experienced by people coping with a variety of chronic pain conditions (e.g., Wade, Price, Hamer, Schwartz, & Hart, 1990). Some studies have found that higher levels of chronic pain are associated with higher levels of anxious mood (e.g., Linton & Gotestam, 1985; Gaskin, Greene, Robinson & Geisser, 1992; McCracken, Zayfert, & Gross, 1992), depressed mood (e.g., Gaskin et al 1992; Kerns, Rosenberg & Jacob, 1994; Linton & Gotestam, 1985; Smith & Christensen, 1996) and angry/hostile mood (e.g., Gaskin et al., 1992; Kerns et al., 1994). However other studies have failed to find significant associations between subjective pain severity and depressed or anxious mood (e.g., Kuch, Cox, Evans, Watson & Bubela, 1993).

Empirical evidence suggests that various subtypes of negative mood (e.g., anger, sadness, anxiety) are highly related and load on a higher order factor best described as general negative affect or mood (e.g., Watson and Tellegen, 1985). As a result, specific negative mood indices such as depression, anxiety and anger are often combined into a composite negative mood index (for a review of these issues see Robinson & Riley, 1999). This composite approach avoids some of the statistical limitations of models that include highly correlated variables with shared variance (e.g., problems interpreting findings due to multi-colinearity among predictors). Studies utilizing composite negative mood indices typically find that higher levels of distress or negative mood are associated with higher levels of pain intensity (e.g., Smith & Christensen, 1996; Zautra et al., 1995a).

*Temporal associations in the mood-pain nexus.*

The causal implications of the temporal associations between negative mood and pain have been the subject of much debate (e.g., Romano & Turner, 1985). Review of the literature suggests that a) pain can result in negative emotion, b) negative emotion or moods can aggravate pre-existing pain, and/or c) negative emotion and pain are simply concurrent with each other (Craig, 1999; Gamsa, 1994; Robinson & Riley, 1999). The more recent neuromatrix theory of pain (Melzack, 1999) incorporates complex stress and affect pathways via which negative mood could presumably lead to exacerbation of pain symptoms. To date there is no strong evidence in support of older psychosomatic views of chronic pain which presumed pathological psychosocial processes (e.g., affective or personality disturbance) led to the onset of chronic pain conditions for which no organic causes could be readily identified.

Despite much debate and speculation, the temporal associations between negative mood, pain and related variables have remained obscured due to the dominance of cross-sectional and/or retrospective designs (which preclude examination of causal or temporal associations). In recent years a small but growing number of researchers have begun to examine process models of mood and pain across time in a way that allows temporal issues to be addressed. Most research to date has

examined long-term temporal associations from pain to subsequent mood. Findings have been mixed and suggest the temporal associations from pain to subsequent mood may weaken as the period of examined time lengthens. Higher levels of pain predicted higher levels of subsequent depression 6 months later (e.g., Brown, 1990) and 24 months later (Nicassio & Wallston, 1992), but not 5 years later (e.g., Leino & Magni, 1993).

The studies examining the temporal associations from mood to subsequent pain have also been mixed. Higher levels of depressed mood have predicted higher chronic pain 5 years later (e.g., Leino & Magni, 1993). Higher depressed mood and higher state or trait anxiety have all been associated with the development of chronic pain across a 1 year period (Dworkin, Hartstein, Rosner, Walther, Sweeney, & Brand, 1992). In contrast, Brown (1990) found no evidence that depression predicted pain 6 months later. Higher levels of distress have predicted higher levels of pain one month later, but pain has failed to predict negative distress one month later (Zautra, Marbach, Raphael, Dohrenwend, Lennon & Kenny, 1995b). Researchers have also examined the mood-pain relations within smaller units of time such as across days. Utilizing repeated daily measures of mood and pain, higher pain has been associated with less positive and/or more negative mood across days (e.g., Affleck, Tennen, Urrows, & Higgins, 1991; Affleck, Tennen, Urrows, & Higgins, 1992a; Affleck, Urrows, Tennen, & Higgins, 1992b; Keefe, Affleck, Lefebvre, Starr, Caldwell, & Tennen, 1997). In a notable exception, one daily diary study found no overall main effect for pain on mood across days (i.e., pain did not predict positive or negative mood the next day; Affleck et al., 1999). The temporal effects of mood upon subsequent pain were not examined in this study. In another process study, increases in depressed mood (but not anxious or angry mood) predicted increases in pain the following day, and pain also predicted increased depressed, anxious and angry mood the following day (Feldman, Downey & Schaffer-Neitz, 1999). Additional prospective research across a variety of temporal units (e.g., days, weeks, months, years) is needed to further our understanding of the magnitude and direction of the mood-pain nexus across time.

*Summary.* Elevated levels of negative mood (e.g., depressed, anxious, hostile) are often experienced by individuals with chronic pain. Although higher levels of negative mood and distress have been associated with higher levels of pain reports, the temporal associations between mood and pain remain controversial due to limited research examining process or prospective models. Limited research to date has found some evidence for bi-directional associations between negative mood and pain. However, findings have been mixed and very few researchers have examined micro-units of time such as within or across days.

*Health Outcomes and ways of coping*

Robinson and Riley (1999) note the bi-directional associations between mood and pain may be mediated via other biological or psychosocial variables. One important set of potential mediators of the mood-pain nexus includes cognitive and behavioural coping efforts. Furthermore, coping strategies are often directly associated with health outcomes (see below for a detailed review). A substantial body of research examining the ways in which individuals cope with stress has accumulated (for reviews, see Aldwin, 1994; DeLongis & Newth, 1998; Gottlieb, 1997; Snyder, 1999; Zeidner & Endler, 1996) and provides support for transactional/process models of stress and coping (e.g., DeLongis, Folkman, & Lazarus, 1988; Lazarus & Folkman, 1984; Lazarus & DeLongis, 1983; Folkman & Lazarus, 1988).

*Transactional model of stress and coping*

According to transactional coping theory, individuals engage in primary appraisals (of the degree of threat, harm, or loss posed by stressors), secondary appraisals (of one's potential resources and ability to cope with stressors) and various ways of coping (see DeLongis & Newth, 1998, for a review). Stress and coping variables are presumed to have dynamic and potentially bi-directional associations. It is also assumed that the temporal associations among variables can be moderated by individual differences (e.g., personality traits) or contextual factors (e.g., type or severity of stressor).

The role of individual differences in mood, coping use and coping effectiveness will be returned to shortly. First, the general trends in the coping literature will be reviewed.

*Coping: General findings*

Empirical evidence suggests coping efforts are related to important outcomes such as psychological and physical well-being across a variety of situations and stressors (for reviews, see Aldwin, 1994; DeLongis & Newth, 1998). The use of coping strategies that promote less negative construals of the problem (e.g., positive reappraisal, downward social comparison) tend to be associated with more adaptive outcomes such as positive psychosocial adjustment or positive affect (e.g., Affleck, Tennen, Pfieffer, & Fifield, 1988b; Folkman & Lazarus, 1988). Likewise, the use of coping that promotes active attempts to change the situation (e.g., seeking more information, formulating a plan) are generally related to more positive outcomes such as satisfactory resolution of a stressful encounter (e.g., Folkman, Lazarus, Dunkel-Schetter, DeLongis, & Gruen, 1986a). In comparison, the use of coping strategies that prevent or interfere with constructive action or positive reframing (e.g., catastrophizing, confronting, wishful thinking) tends to result in more negative outcomes such as increased levels of distress or psychological symptoms (e.g., Folkman & Lazarus, 1988; Folkman, Lazarus, Gruen, & DeLongis, 1986b; McCrae & Costa, 1986). Therefore, empirical evidence to date suggests there are both adaptive and maladaptive ways of coping when faced with a variety of stressors.

As previously mentioned the patterns of findings for coping variables are often moderated by contextual factors. Situational factors account for cross-situational variability in the types of coping strategies individuals use to manage stress (for reviews, see Aldwin, 1994; Eckenrode, 1991; Lazarus & Folkman, 1984; Mattlin, Wethington & Kessler, 1990; Wethington & Kessler, 1991). Despite limited empirical attention, there is also evidence that contextual factors account for cross-situational variability in the effectiveness of coping strategies (Aldwin, 1994; Lazarus, 1993; Mattlin et al., 1990). That is, most coping strategies can not be globally labelled as "maladaptive" vs. "adaptive"

for all individuals across all situations or types of stressors. Instead, the impact and effectiveness of any one strategy seems to depend upon the context or situation in which the individual encounters and copes with the stressor. To illustrate, it may be maladaptive for an individual to engage in distraction (e.g., watching television) when coping with an approaching deadline for an unfinished project. However, it may be highly adaptive for the same individual to use the same form of distraction when coping with temporary pain following dental surgery. In order to capture this contextual variability, coping and outcome must be assessed independently of the other (Lazarus, 1993). In addition individuals should be asked to report on their coping efforts in relation to a specific stressor at a specific point in time rather than their general tendencies. In this way, the fluctuating context-dependent relations between coping and outcomes may be identified and compared across contexts. In keeping with this recommendation, a more detailed review of coping within the context of chronic pain follows.

*Coping and chronic pain*

Research findings to date suggest that organic disease variables alone are insufficient in predicting health outcomes among individuals coping with chronic pain. Instead, the most powerful models include psychosocial factors such as cognitive or behavioural ways of coping and mood. Examination of how coping efforts relate to adjustment is important given that some individuals have to cope with their chronic pain without some of the available medical interventions. Medications sometimes only reduce rather than eliminate symptoms, and can be associated with serious or intolerable side effects for some individuals (e.g., gastrointestinal bleeding). Previous research indicates that ways of coping are significantly related to important outcome variables within the context of chronic pain such as functional ability, pain severity, and psychological well-being (for reviews, see Boothy et al., 1999; DeGood, 2000; Jensen et al., 1991; Zautra & Manne, 1992). However, identifying general trends in the relations between specific ways of coping and chronic pain outcomes has been limited by methodological and/or conceptual variability across studies (e.g.,

heterogeneous coping inventories, variance in factor structures identified using the same inventories with different samples, and diverse conceptualizations of core coping constructs; for reviews of these issues, see DeGood, 2000; Jensen et al., 1991; Zautra & Manne, 1992).

Much of the earlier coping and chronic pain research also utilized coping composite scores that aggregated specific ways of coping into more general categories (e.g., "passive" vs. "active", "avoidance" vs. "approach"). It has been argued that composite coping scales are of limited theoretical and clinical value as they provide little information about the specific cognitive or behavioural processes that are primarily responsible for significant associations with outcomes (Boothby et al., 1999). To illustrate, Jensen, Turner & Romano (1992) found that the use of the composite coping scales did not increase the ability to predict outcomes (relative to individual coping scales), failed to identify the specific cognitive or behavioural responses that accounted for significant associations, and failed to identify significant interactions between ways of coping and contextual moderators (e.g., pain intensity or pain duration). Therefore the following review will focus upon studies that examined associations of pain outcomes with specific ways of coping. In general, research indicates there are both maladaptive and adaptive ways of coping when faced with chronic pain (for reviews see Boothby et al, 1999; DeGood, 2000; Jensen et al., 1991; Zautra & Manne, 1992).

*Distancing.*

While attentional variables have been significantly associated with pain in experimental studies (Artnz, 1991; Arntz, Dreeson & Merckelbach, 1991) the effects of redirecting attention as a way of coping with chronic pain remains controversial. Several ways of coping include the deliberate redirection of attention away from pain such as distancing, distracting, and ignoring pain. Some studies have failed to find significant associations between diverting attention and pain, disability, functional status, psychological distress or mood (e.g., Affleck et al., 1999; Dozois et al., 1996; Grant, Long & Willms, 2002; Van Lankveld, Van't Pad Bosch, Van De Putte, Naring & Van

Der Staak, 1994). Some researchers have found the effectiveness of distraction varies according to contextual variables such as pain intensity at time of coping. To illustrate, Affleck et al. (1992b) found that use of distraction was associated with more positive mood, but only for individuals coping with lower levels of pain. For individuals coping with more intense pain the use of this strategy was associated with less positive mood. Ignoring pain symptoms has been associated with lower pain and lower depression (e.g., Watkins, Shifren, Park, & Morrell, 1999).

*Cognitive reframing.*

There is empirical evidence suggesting that certain forms of coping may be adaptive under circumstances in which the individual has little or no control over a stressor (e.g., Mattlin et al., 1990). Chronic pain is stressor over which an individual has limited control. For many individuals no clear diagnosis or etiology is established, there are no current "cures" for many chronic pain conditions, and many individuals do not respond positively to conventional medical treatment (Arnett et al., 1988; Grennan & Jayson, 1989; Parker et al., 1988a; Rodnan & Schumacher, 1983). In the context of chronic pain, engaging in positive appraisals as a way of coping appears to be adaptive. Greater use of positive reappraisal, downward social comparison, comforting cognitions, positive self-statements and rational thinking have been related to more positive outcomes such as lower pain, lower levels of distress, more positive mood and less functional disability (e.g., Affleck, Tennen, Urrows, Higgins & Abeles, 2000; Affleck, Tennen, Pfieffer, Fifield, & Rowe, 1987; Affleck et al., 1988b; Beckham, Keefe, Caldwell, & Roodman, 1991; Parker et al., 1988b; Smith, Wallston, Dwyer & Dowdy, 1997; Van Lankveld et al., 1994; Watkins et al., 1999).

*Emotional Expression.*

Emotional expression (sharing one's pain related distress with others) has also been examined as a way of coping but findings have been mixed. Some studies have failed to find significant associations between emotional expression and mood or pain outcomes (e.g., Parker et al., 1988b). Others have found higher use of emotional expression to be associated with decreases in

positive affect across a six month time period (Revenson & Felton, 1989). Higher use of emotional expression has failed to predict next day positive mood but has been significantly associated with higher next day negative mood (e.g., Affleck et al., 1999). Some researchers have failed to find a significant association between emotional expression and pain (e.g., Affleck et al., 1999). Other research findings suggest it may be the lack of emotional expression as a way of coping that is associated with adjustment in the face of chronic pain. To illustrate, the tendency to internalize angry feelings (i.e., lack of emotional expression) has been associated with higher pain intensity ratings, while aggressive or appropriate expressions of anger were not significantly associated with pain (Kerns et al., 1994). These types of findings suggest that emotional expression vs. emotional suppression when experiencing negative mood may have implications for chronic pain outcomes.

*Active problem solving.*

When coping with stressors an individual also has the option of attempting to create a new plan of action to direct future coping efforts. Research has demonstrated that in general, the use of active problem solving results in more adaptive health outcomes (for a review see Aldwin, 1994). For example, in studies examining normative daily stressors higher use of active problem solving has been associated with positive health outcomes such as lower negative emotion and more positive emotion (e.g., Folkman & Lazarus, 1988). However it should not be assumed that active problem solving is always adaptive. According to transactional models of stress and coping, the impact of any given coping strategy will depend upon a variety of person and contextual factors. Therefore it should not be surprising that several studies have failed to find significant associations between active problem solving and psychological or physical health outcomes (e.g., Folkman et al., 1986b).

The use of problem focused coping strategies in the face of uncontrollable stressors may actually be detrimental to health outcomes (Aldwin, 1994). Perceptions of uncontrollability have been associated with lower levels of active problem solving (e.g., taking direct action) among non-pain samples (e.g., David & Suls, 1999). The effectiveness of active problem solving may also vary

across stressors according to contextual factors such as degree of controllability. Chronic pain is a stressor characterized by at least some degree of uncontrollability for many sufferers (e.g., the occurrence of future pain may be unpreventable). The associations between active problem solving and outcomes in the context of uncontrollable stressors such as chronic pain may vary substantially from the associations in the context of controllable stressors.

The limited findings to date regarding active problem solving and chronic pain have been mixed. For example, some researchers have found higher levels of information seeking are associated with higher levels of positive mood and lower levels of negative mood (e.g., Felton & Revenson, 1984; Revenson & Felton, 1989) while other researchers have failed to find any significant associations between information seeking and psychological well-being (e.g., Parker et al., 1988b), functional disability (e.g., Parker et al., 1988b) or negative mood (Felton & Revenson, 1984; Revenson & Felton, 1989). Active problem solving such as creative solution seeking (e.g., finding new ways of getting things done in the face of chronic pain) has failed to show significant associations with disease activity, quality of life, depressed mood or cheerful mood (Van Lankveld et al., 1994). It should be noted that most of the research examining the role of problem-focused coping has examined mood or distress outcomes. As a result, little is known about the role of active problem solving in pain outcomes over time.

*Temporal processes in the context of chronic pain*

There have been calls in the literature to examine theory driven models of emotion and pain that include the moderating influence of coping and how these relate to health outcome processes (Robinson & Riley, 1999). Little is known about the temporal associations between ways of coping and health outcomes in the context of chronic pain. As a result, the conditions under which coping efforts or mood states precede changes in subsequent health symptoms such as pain remains unclear. For example, do coping efforts and levels of negative mood have an impact upon subsequent levels of pain? How quickly do any apparent effects of coping or negative mood on subsequent pain occur

(within hours, across days, etc.)? Lack of research examining these types of empirical questions has limited theory and understanding, as health and illness are processes that unfold over time (Larsen & Kasimatis, 1991). There have been calls for researchers to utilize temporal designs when examining the coping processes such as those involving chronic pain (e.g., Tennen et al., 2000).

To the best of the my knowledge, only two studies to date have examined both nomothetic (general or average) and idiographic (person specific) trends in the temporal associations among mood, pain and coping (Affleck et al., 1999; Grant et al., 2002). In a daily diary study, Grant and colleagues (2002) found that higher use of catastrophizing and praying/hoping were significantly associated with higher pain within days, while distraction, ignoring pain and reinterpreting pain were not significant predictors of pain. In their daily diary study, Affleck and colleagues (1999) found that redefinition of pain and venting emotions predicted increases in next day negative mood, but ways of coping were not generally associated with next day pain (i.e., nomothetic trends). However, for individuals with Rheumatoid Arthritis, higher use of emotional support seeking was followed by a day of higher pain; whereas for individuals with Osteoarthritis, higher use of emotional support seeking was followed by a day of less pain (i.e., idiographic trends for coping effectiveness according to disease type).

*Summary.* Individuals coping with chronic pain report engaging in a variety of ways of coping. Specific cognitive and behavioural ways of coping appear to vary in their associations with chronic pain outcomes. The use of cognitive reframing or positive reappraisal appears to be an adaptive way of coping in that higher use is often associated with lower levels of pain. However, the effects of other forms of coping such as active problem solving, emotional expression or attempts to redirect attention remain controversial due to mixed findings. Firm conclusions about the effectiveness of specific ways of coping in the context of chronic pain are further limited by the underutilization of pain outcomes (relative to mood or distress as outcomes), and the limited research examining the temporal associations among coping and chronic pain outcomes.

*Person factors and chronic pain*

The lack of attention to person factors relative to situational or contextual factors has been a substantial hurdle in advancing transactional/process models of coping. Despite the pervasive impact of "situationalism" upon theory and research, the contribution of person factors (i.e., qualities specific to each individual) has always remained central to this theoretically driven approach (e.g., Lazarus & Folkman, 1984). In addition to contextual variables, person factors are assumed to contribute to variance in all components of the coping process, including cognitive appraisals, coping use and coping effectiveness (Lazarus, 1990). Identifying stable person factors that predict appraisals and coping may increase our understanding of adjustment given that both appraisals and coping are themselves significant predictors of outcomes (e.g., Folkman et al., 1986a; Folkman et al., 1986b). In summary, both theory and research to date warrant the inclusion of stable individual difference variables in current coping models.

A growing body of research has examined the role of empirically derived personality traits or individual difference variables (e.g., neuroticism, optimism, perfectionism, etc.), particularly in regards to their role in health processes. Larson and Kasimatis (1991) note that personality could be associated with health and illness via multiple pathways (e.g., occurrence of symptoms, duration of symptoms, recovery from health problems, and associations between mood and health symptoms). Furthering our understanding of the role of personality in adjustment to illness or disease is particularly important given that the etiology and cure for many diseases or illnesses associated with chronic pain have yet to be identified (e.g., Rheumatoid Arthritis). To illustrate, identifying significant associations between personality, coping, mood and pain may enable pain management plans to be individually tailored according to an individual's profile, thereby maximizing well-being and minimizing illness.

As a result there have been multiple calls to examine how individual differences such as personality moderate various components of health/illness processes, stress and coping processes and

outcomes over time (e.g., Costa & McCrae, 1990; Horowitz, 1990; Larsen & Kasimatis, 1991; Moos & Swindle, 1990). Preliminary evidence suggests that stable person factors such as personality are significantly related to appraisals, coping efforts, and health outcomes within a variety of stressful contexts (e.g., Bolger, 1990; Bolger & Zuckerman, 1995; Deary et al., 1996; O'Brien & DeLongis, 1996; Scheier & Carver, 1987; Terry, 1994). Evidence suggests that specific contexts pull for the manifestation of specific personality traits (Shoda, Mischel, & Wright, 1994). That is, the characteristic patterns of thoughts, emotions and behaviours that reflect any given personality trait may manifest in some contexts but not others. The role of personality in the specific context of chronic pain has a substantial but controversial history. Over the last century, the role of personality in pain experience has been examined from psychodynamic, trait and biopsychosocial perspectives (for a review, see Weisberg & Keefe, 1999). During the earlier part of the past century it was often believed that individuals who suffered from chronic pain had a "pain prone personality" that led to the development of their pain condition and subsequent maladjustment (especially if medical professionals were unable to identify organic causes for the pain). This conceptualization frequently stigmatized the pain patient and often stemmed from the false assumption that pain was either organic or psychosomatic in origin (myths that have largely been debunked by lack of empirical support).

Much of earlier personality and pain research utilized profiles derived from the Minnesota Multiphasic Personality Inventory (MMPI; Graham, 1993), and failed to find evidence of one distinct "chronic pain profile" in regards to personality (Weisberg & Keefe, 1999). The associations between personality and pain related variables remain unresolved and controversial, especially given mixed findings and lack of prospective studies (Weisberg & Keefe, 1999). More recent examination of the role of personality focuses upon ways in which personality traits may be associated with between person variability in vulnerability to, progression of and adaption to conditions associated with chronic pain. Empirically derived personality traits are viewed as broad markers of specific and

pervasive patterns of cognition, emotion and behaviour. The associations between personality and health outcomes are presumed to be influenced by these characteristic patterns in thought, emotion, and behaviour, especially those pertaining to mood, stress and coping processes.

The context of chronic pain provides an ideal context within which to examine the role of personality in the process of stress and coping. There appear to be significant individual differences in health processes and outcomes in the context of chronic pain. For example, Robinson & Riley (1999) found evidence in their review of the literature that suggests subgroups of pain patients may have varied associations between pain and specific aspects of negative emotion. Further research is needed to determine whether personality traits account for this type of between person variance in chronic pain processes and outcomes. Unfortunately, the role of personality in regards to daily processes and outcomes across time has received scant empirical attention (Cimbolic Gunthert, Cohen, & Armeli, 1999). Little is known about the role of personality in 1) pain or mood outcomes, 2) the temporal associations between pain and mood, 3) coping strategy use, and 4) coping strategy effectiveness (i.e., temporal associations with pain, mood or other health outcomes). For example, do personality differences predict differences in pain or mood levels over time? Does mood have implications for subsequent pain experience for some individuals but not others according to their personality traits? Do individuals vary in their choice of coping strategies according to their personality traits? Does the impact of coping upon health outcomes over time (e.g., pain) vary according to personality?

*The big five*

A promising avenue for the examination of personality is the common factors often referred to as "the big five". There is a general consensus among personality researchers that five core traits represent the basic underlying dimensions of personality (Costa & McCrae, 1998; Deary & Mathews, 1993; see Block, 1995 for an exception). Neuroticism (N), Extraversion (E), Openness to

experience (O), Agreeableness (A), and Conscientiousness (C) are considered to reflect these five fundamental dimensions of personality and are reviewed in more detail below.

Although researchers tend to agree on the conceptualization of both N and E, there have been heterogeneous definitions and measurements of O, A, and C (Bergeman et al., 1993). However, multiple analyses utilizing a variety of five factor measures (e.g., descriptive sentences, adjective scales) across a variety of samples (e.g., men and women, children and adults) have yielded similar factor structures representing these five underlying dimensions of personality (e.g., Costa & McCrae, 1989; 1992; Digman & Inouye, 1986; Trapnell & Wiggins, 1990). Furthermore the five factor structure has been found across diverse languages and cultures including North American, German, Portuguese, Hebrew, Chinese, Korean, and Japanese samples (e.g., McCrae & Costa, 1997). Rather than being an exhaustive set of personality traits, the five-factor model is seen as a higher order level of personality measurement, under which a broad rubric of sub-traits can be subsumed and incorporated (for a historical review, see Hogan, Johnson & Briggs, 1997). There have been calls in the literature to examine the role of each of the five factors of personality in predicting health outcomes over time (e.g., Smith & Williams, 1992).

*Neuroticism.*

Neuroticism (N) refers to the tendency to experience emotional distress. Closely related constructs include trait negative affectivity (NA)(e.g. Watson & Clark, 1984).[1] Individuals high on N can be described as being more prone to feeling anxious, fearful, tense, and depressed. Of the limited studies assessing the role of the big five personality dimensions in the coping process, this trait has received the most empirical attention. A review of the literature reveals that higher levels of N have been associated with a wide range of psychosocial variables including mood, ways of coping, and occurrence of psychosocial stressors. Higher levels of N tend to be associated with maladaptive health outcomes. For example, higher levels of N have been associated with higher levels of negative mood, interpersonal stressors, negative appraisals, and maladaptive coping choices

(Cimbolic Gunthert et al., 1999). In the same study, the associations between appraisals, coping and negative distress was moderated by neuroticism, with higher N individuals showing greater emotional reactivity to negative appraisals (e.g., undesirability of event, coping efficacy) and maladaptive ways of coping (e.g., catharsis, self-blame, hostile reaction).

David and Suls (1999) argue that individuals higher on N should use higher levels of emotion focused coping than individuals lower on N, as higher N individuals are more likely to perceive stressors as threatening than challenging. Research has shown higher levels of N (or trait anxiety/negative affect) are associated with 1) higher levels of coping that tend to be associated with negative outcomes such as escape-avoidance, catastrophizing, self-blame, denial, mental or behavioural disengagement, emotional expression, using alcohol/drugs, distraction, self-blame, wishful thinking, escape avoidance (e.g., Affleck et al., 1992a; Bolger, 1990; Carver, Scheier, & Weintraub, 1989; Crombez, Vlaeyen, Heuts & Lysens, 1999; Deary et al., 1996; Hooker, Frazier & Monahan, 1994; Jelinek & Morf, 1995; O'Brien & DeLongis, 1996; Smith, Pope, Rhodewalt, & Poulton, 1989; Vollrath, Torgersen, & Alnaes, 1995), 2) lower use of coping that tends to be associated with adaptive outcomes such as humor or positive reappraisal (e.g., Carver et al., 1989; Vollrath et al., 1995), and 3) lower use of active coping or planning (e.g., Carver et al., 1989; Deary et al., 1996; Hooker et al., 1994; Jelinek & Morf, 1995; O'Brien & DeLongis, 1996; Smith et al., 1989; Vollrath et al., 1995). In a notable exception, Bolger and Zuckerman (1995) found that higher N was associated with greater use of problem solving within the context of interpersonal stressors.

The associations between N and psychosocial variables are often robust. The associations between higher levels of N and ways of coping remain significant even after controlling for the other Big Five traits, gender, socio-economic status, or situational factors (e.g., Hooker et al., 1994; O'Brien & DeLongis, 1996). Daily diary studies utilizing multi-level analyses have also found higher levels of N associated with higher levels of some forms of coping (e.g., interpersonal withdrawal, escape avoidance, self-blame, catharsis, and relaxation) but not others (e.g., distraction,

distancing, acceptance, planful problem solving)(e.g., David & Suls, 1999; Lee-Baggley, DeLongis, Preece, & Campbell, 2002). David and Suls (1999) found that differences between higher vs. lower N were most apparent in the context of stressors appraised as less severe in comparison to the context of more severe stressors. Levels of N moderated the associations between perceived severity of stressor and coping use. Individuals higher on N reported higher use of distraction and relaxation than individuals lower on N in response to less severe problems. These types of findings suggest the associations between N and coping variables may be context dependent and/or context specific. As a result, researchers may be most likely to find significant and meaningful associations between personality traits and coping if they examine these variables within specific and relatively homogeneous contexts.

In regards to the context of pain, N has been associated with some variables and not others. N does not seem to be significantly associated with sensory pain reports. For example, in an experimental study involving a cold pressor task, Miro & Raich (1992) found that N was not significantly associated with pain intensity or pain aversiveness. Other experimental studies of pain have also failed to find significant associations between N and the sensory-intensive aspects of pain (e.g., Harkins, Price, & Braith, 1989). However, the associations between N and pain may vary depending upon whether the study concerns 1) acute vs. chronic pain samples, or 2) the induction of pain in chronic pain samples vs. pain free samples.

In studies of chronic pain patients, various indices of N and trait negative affectivity have failed to predict a variety of pain outcomes including pain disability, pain ratings, and subjective pain increases during a behavioural test, (e.g., Crombez et al., 1999; Gaskin et al, 1992; Harkins et al., 1989;Wade, Dougherty, Hart, Rafii, & Price, 1992b). Higher N has been associated with higher pain unpleasantness and negative emotions reflecting pain suffering (Wade et al., 1992b) and higher levels of affective disturbance in response to either experimental or chronic pain (Harkins et al., 1989). N has also been associated with coping responses to pain. In an experimental study of pain,

individuals higher on N were less likely than individuals lower on N to report using any coping strategies to control the pain during the pain induction (e.g., Miro & Raich, 1992). Taken together, these findings suggest that levels of N are not directly associated with pain outcomes (e.g., perceived pain severity) but levels of N do seem to be associated with the affective components of coping with chronic pain (e.g., pain related distress).

*Extraversion.*

Extraversion (E) refers to the degree to which an individual seeks the company of others and their tendency to experience positive affect. Individuals high on E can be described as dominant, gregarious, outgoing, fun-seeking and warm (Watson & Clark, 1997). Some studies have indicated that individuals higher on E are more likely to engage in problem-focused coping such as active planning or seeking instrumental support than are those individuals low on E (e.g., Deary et al., 1996; Hooker et al., 1994; Vollrath et al., 1995). In contrast, other studies have failed to reveal a significant association between E and problem-focused coping (e.g., Amirkhan, Risinger, & Swickert, 1995; Jelinek & Morf, 1995; O'Brien & DeLongis, 1996). Likewise, some researchers have found higher E associated with higher levels of emotion focused coping such as escape avoidance, distraction and social diversion (e.g., Deary et al., 1996; Jelinek & Morf, 1995) while others have found higher E associated with lower levels of emotion-focused coping such as escape-avoidance, self-blame, and wishful thinking (e.g., Amirkhan et al., 1995; Hooker et al., 1994; O'Brien & DeLongis, 1996).

Most of the research examining the associations between E, coping, and outcome variables has been cross-sectional in nature, thus precluding analyses that allow one to address causal issues. However, daily diary studies utilizing multi-level analyses have found that higher levels of E are associated with higher use of some forms coping (e.g., redefinition of problem, catharsis, use of religion, self-blame, compromise) but not others (e.g., distraction, acceptance, escape avoidance, problem solving)(e.g., David & Suls, 1999; Lee-Baggley et al., 2002). As with N, some of the

associations between E and coping (e.g., lower self-blame, avoidance, and wishful thinking) appear to be robust, even after controlling for the other big five traits, gender, and socio-economic status (e.g., Hooker et al., 1994).

Research examining the role of E and chronic pain has been mixed. In an experimental study involving a cold pressor task, Miro & Raich (1992) found that higher levels of E were not significantly associated with pain intensity, pain aversiveness, or coping strategies employed during the pain induction. In another chronic pain study, higher levels of E failed to predict pain intensity ratings but did predict higher levels of pain suffering, even after controlling for pain intensity (Wade et al., 1992b). Interestingly, follow-up analyses in the same study indicated that highly assertive individuals (a sub-facet of high E) may engage in more emotion expression (e.g., voicing their suffering) but these individuals do not have elevated levels of disruptions or secondary gain. Levels of E have also failed to differentiate clinical subgroups of chronic pain patients clustered according to distinctive personality profiles using four common MMPI profiles found in chronic pain samples (conversion V, hypochondriasis, emotionally overwhelmed, and denier/controlled coping; Wade, Dougherty, Hart, & Cook, 1992a). As with N, it appears that E is associated with some components of pain experience but not others.

*Openness to Experience.*

Openness to Experience (O) reflects the degree to which an individual is creative, imaginative, and open to diverse experiences. Individuals high on O have been described as intellectual, open-minded, and curious. There has been a call in the literature to examine the stress-moderating effects of O within health research (e.g., Smith & Williams, 1992). Limited research has examined the role of this trait in regards to psychosocial variables, and the findings of these studies have been mixed.

Some researchers have found no significant associations between O and coping strategies that tend to be associated with maladaptive health outcomes such as wishful thinking, self-blame,

escape avoidance, distraction, distancing (e.g., Deary et al., 1996; Hooker et al., 1994). In comparison, others have found individuals higher on O to be less likely to engage in escape-avoidance (e.g., O'Brien & DeLongis, 1996). Some researchers have found significant associations between higher levels of O and positive reappraisal (e.g., Jelinek & Morf, 1995; O'Brien & DeLongis, 1996). Some researchers have failed to find a significant associations between O and active problem solving (e.g., Deary et al., 1996; Jelinek & Morf, 1995; Hooker et al., 1994).

Within these mixed findings it remains unclear whether any significant associations between O and outcomes are robust in relation to other biopsychosocial variables. For example, in multiple regression analyses, the associations between O and ways of coping were no longer significant after controlling for the other big five traits, gender, and socio-economic status (e.g., Hooker et al., 1994). However there is not enough research to date in order to reach firm conclusions regarding the role of this trait in health processes. David & Suls (1999) review evidence suggesting O had few notable associations with coping responses as the majority of research has utilized simple correlations or aggregated repeated measures data. They argue that these older approaches to data analysis may have obscured the complex associations between this trait and coping that are only apparent with more sophisticated methodology. Diary studies utilizing multi-level analyses have found that higher levels of O were significantly associated with lower use of some forms of coping (e.g., distraction, distancing) but not with other forms of coping (e.g., positive reappraisal, acceptance; problem solving; e.g., Lee-Baggley et al., 2002; David & Suls, 1999). Levels of O failed to differentiate clinical subgroups of chronic pain patients clustered according to distinctive MMPI personality profiles (Wade et al., 1992a). In summary very little is known yet about the role of this trait in stress, coping and health processes.

*Agreeableness.*

Agreeableness (A) reflects the degree to which an individual seeks to avoid antagonism or conflict. Individuals high on A can be described as caring, easygoing, and cooperative. As with O,

very few studies have investigated the relation of this trait to psychosocial variables within the context of health outcomes. While some researchers have found no significant relations between A and ways of coping such as positive reappraisal, escape avoidance or distancing (e.g., Deary et al., 1996; Jelinek & Morf, 1995), others have found individuals higher on A to be less likely to engage in confrontive coping (O'Brien & DeLongis, 1996) self-blame, wishful thinking, or escape avoidance (e.g., Hooker et al., 1994). It is unclear whether these associations between A and coping variables are robust, as significant associations have failed to remain significant after controlling for the influence of the other big five traits, gender, and socioeconomic status (e.g., Hooker et al., 1994). Researchers have also failed to find significant associations between A and active problem solving (e.g., Deary et al., 1996; Hooker et al., 1994; Jelinek & Morf, 1995). Very few studies have allowed researchers to examine the role of A in coping over time. Notable exceptions include one diary study that found no significant associations between A and ways of coping (e.g., David & Suls, 1999) and one diary study that found higher levels of A were associated with lower levels of self-blame (e.g., Lee-Baggley et al., 2002). Little is known about the role of A in coping with chronic pain. Levels of A failed to differentiate clinical subgroups of chronic pain patients clustered according to distinctive personality profiles (Wade et al., 1992a). The author is unaware of any other research that has examined the role of this trait within the pain experience.

*Conscientiousness.*

Conscientiousness (C) reflects the extent to which an individual tends to be organized and reliable. Individuals high on C have been described as disciplined, tidy, diligent and responsible. Again, few researchers have explored the empirical relations between this trait and the ways in which individuals cope. Some studies have found higher C associated with greater use of active problem solving (e.g., Deary et al., 1996; Hooker et al., 1994; Jelinek & Morf, 1995) whereas other researchers have failed to find a significant association between C and use or effectiveness of problem focused coping (e.g. David & Suls, 1999; O'Brien & DeLongis, 1996). Higher levels of C

have also been associated with lower use of escape-avoidance, accepting responsibility, wishful thinking, and self-blame (e.g., Hooker et al., 1994; O'Brien & DeLongis, 1996). Researchers have failed to find significant associations between C and positive reappraisal, escape avoidance, or distancing (e.g., Deary et al., 1996; Jelinek & Morf, 1995).

In daily diary studies, higher levels of C have been associated with lower use of religious coping and higher use of compromise, but C has not been significantly associated with other forms of coping such as positive reappraisal, distraction, distancing, or acceptance (e.g., David & Suls, 1999; Lee-Baggley, 2002). Conclusions about the role of this trait are further restrained by evidence that the associations between C and outcomes may not be robust. One study found the associations between C and coping were no longer significant after controlling for the other big five traits, gender, and socio-economic status (Hooker et al., 1994). Little is known about the role of C in coping with chronic pain. Levels of C failed to differentiate clinical subgroups of chronic pain patients clustered according to distinctive personality profiles (Wade et al., 1992a).

*Summary.* Evidence to date suggests that the big five personality traits (most notably N and E) are associated with various components of stress and coping processes including mood and coping efforts. While there is no empirical support for the notion of a "pain-prone personality", limited research has examined the role of the big five personality traits in coping processes within the context of chronic pain. Furthermore, very little is known about the role of these traits in the unfolding of mood, coping and pain processes over time.

*The current study*

The purpose of the current study is to examine the role of personality in mood, stress and coping processes over time in the context of chronic pain. The study addresses calls for time series data that allows examination of the ways in which personality and contextual factors interact in regards to health outcomes over time (e.g., Larsen & Kasimatis, 1991; Smith & Williams, 1992). Daily coping, negative mood and pain will be examined in conjunction with the moderating role of

personality traits and disease status. Specific hypotheses are outlined below after a description of the methodology in the current study.

# Method

*Methodological issues in the study of the coping process*

In order to expand on prior research, several methodological issues were addressed in the current study. Methodological concerns particular to stress and coping research continue to evolve in accordance with progressions in design and analysis tools. A review of these issues and potential solutions is important for current researchers seeking to address unresolved questions regarding health processes.

First, prior stress and coping research has often focused upon the process of coping among individuals dealing with extreme events such as breast cancer or other life-threatening illnesses (e.g., Wood, Taylor, & Lichtman, 1985), earthquakes and other natural disasters (e.g., Lehman & Taylor, 1988), or the death of a loved one (e.g., Nolen-Hoeksema, Parker, & Larson, 1994). As Parker and Endler (1996) argue, the impact of person factors upon coping may be reduced when facing very extreme stressors. Contextual factors under extreme circumstances may override dispositional coping tendencies or demand responses that are less variable among individuals. This suggests that person variables may be more likely to predict coping in response to less extreme stressors in the context of normative day by day functioning in comparison to extreme non-normative stressors.

Second, many researchers examining stress and coping models have utilized designs and/or statistical tools that limit the types of relations among variables that can be explored. To illustrate, much of the stress and coping research reviewed above examined simple correlations within cross-sectional designs. As Epstein (1983) notes, person variables assess dispositional trends which may not become apparent using one time-point measures of dependent variables. That is, dispositional tendencies may only become apparent over several similar situations as they occur over time. Therefore, Epstein argues that multiple time-points are often necessary to create an appropriate test of the relation between dispositional variables and dependent measures. Cross-sectional designs also limit the ability of researchers to explore the process of coping as it occurs over time, and therefore

preclude the exploration of the temporal relations among variables (Lazarus & DeLongis, 1983). These designs do not allow researchers to explore the constantly changing interplay between the person and the environment that are central to transactional/process models of stress and coping. Therefore, it is important that stress and coping researchers make use of developments in research designs and statistical tools that allow for examination of these processes.

In order to address issues of process and causality, multiple time points of data are necessary (DeLongis, Hemphill, & Lehman, 1992). It has been noted that predictive value, reporting accuracy, and statistical power are strengthened when utilizing a daily stress and coping paradigm (Cimbolic Gunthert et al., 1999). Unfortunately, most of the existing time series, repeated measures or longitudinal research has relied upon aggregational analyses. Although aggregation analyses may be more likely to identify dispositional trends (Epstein, 1983), such analyses do not allow exploration of the temporal relations between variables (DeLongis et al., 1992). In addition, it has been noted that the aggregation of variables can result in misleading results via overestimations of the magnitude of relations between variables, or identification of relations that vary from those revealed in non-aggregated data (Bryk and Raudenbush, 1992; Epstein, 1983). However, until recently, few pragmatic statistical tools existed that would allow researchers to make the most of non-aggregated time series data.

*Hierarchical linear modeling*

Current developments in statistical tools make it possible to address several of these key methodological and conceptual issues faced by stress and coping researchers. Before such developments, researchers were frequently able to explore only one of the sources of variability in the ways in which individuals cope: (a) intraindividual (i.e., within person) variability in the degree to which individuals vary their coping from timepoint to timepoint, or (b) interindividual (i.e., between person) variability in coping from one individual to another. To date there have been few studies that have simultaneously examined both within and between person variability in the coping

process and health outcomes despite calls in the literature for such an approach (Parker & Endler, 1996; Tennen & Affleck, 1996). Historically, the most obvious reason for this deficiency has been lack of statistical tools suitable for simultaneously examining intraindividual and interindividual patterns among variables. Hierarchical Linear Modeling (HLM; Bryk & Raudenbush, 1992), is a multi-level modeling statistical technique recommended for use with data collected across time that allows simultaneous exploration of these two sources of variability.

*The present study: An idiographic-nomothetic approach*

The present study utilized multi-level analyses of time series data in order to explore both within and between variation in the coping process and health outcomes within the context of chronic pain. Specifically, the relations among time variant variables such as coping efforts, negative mood, and pain were explored in conjunction with their relations to time invariant variables such as personality traits. The multi-level analyses also allowed for the control of other confounding variables (e.g., disease status or demographic variables), and therefore made possible a more elegant examination of the coping process.

Participants were asked to indicate how they coped with one particular stressor: chronic pain. As Stewart and Knight (1991) note, the relations between coping strategies and health outcomes among patients with chronic yet variable diseases such as Rheumatoid Arthritis may be different than the relations found among patients with chronic and stable diseases/conditions (e.g., some forms of chronic back pain). It has also been argued that the effects of personality are more likely to be detected when examining the role of traits among individuals coping with the same type of stressor (Hooker et al., 1994). It has been suggested that negative mood may aggravate pain only under certain conditions, and that likewise pain may only result in aggravated negative mood under certain conditions (Bank & Kerns, 1996). Therefore, to maximise the ability to detect specific relationships between negative mood, coping and pain, the current sample was restricted to

individuals diagnosed with Rheumatoid Arthritis. Participants reported specifically on coping with Rheumatoid Arthritis related pain within the context of their normal everyday lives.

Rheumatoid Arthritis (RA) is a chronic autoimmune disease that results in a variety of distressing and debilitating symptoms including pain, stiffness, joint inflammation, fatigue, and mood changes (Grennan & Jayson, 1989; Rodnan & Schumacher, 1983). RA sufferers also typically experience a wide range of related daily stressors or hassles including: difficulties performing household chores, impaired ability to work or hold a job, financial loss, difficulties engaging in leisure or social activities, interpersonal tensions resulting from added burdens for friends and family members, and prejudice (Affleck et al., 1988a; Affleck et al., 1988b; Anderson, Bradley, Young, McDaniel, & Wise, 1985; Blalock, McEvoy Devellis, Holt, & Hahn, 1993; Eberhardt, Larsson, & Nived, 1993; Lefebvre, 1996; Moldofsky, 1981; Parker et al., 1988b; Stenstrom et al., 1992; Taal et al., 1993). Evidence also suggests that RA pain, related symptoms and functional disability vary substantially both across time and between individuals due to fluctuating cycles of RA symptoms and varying levels of disease progression (Affleck et al., 1991; Grennan & Jayson, 1989). The within- and between-person variability in RA symptoms and its consequences provides a rich context in which to investigate the idiographic-nomothetic approach to coping with chronic pain (e.g., Tennen & Affleck, 1996; Keefe et al., 1997).

Participants reported upon their degree of pain severity, negative mood and coping efforts at multiple time points. Participants also provided information regarding demographic and disease variables, and completed a five-factor personality inventory (Trapnell, 1989; Trapnell & Wiggins, 1990) (see below for more detailed description of study variables and measures). Using both time invariant variables (i.e., personality traits, demographic variables, disease status variables) and time variant variables (i.e., pain severity, negative mood, ways of coping), several interrelated sets of issues were addressed within the current study. First, what are the relations between mood and pain over time? Second, what are the relations of specific ways of coping to pain over time? Third, do the

associations between mood, coping and pain over time vary between individuals? If so, what person factors account for this variability? For example, do the associations between pain and mood over time vary according to personality traits or disease status? Does the use or effectiveness of coping strategies over time vary according to personality traits or disease status? Addressing these questions may have theoretical and clinical implications for how we understand and manage chronic pain conditions such as Rheumatoid Arthritis.

*Sample and procedures*

The study utilizes data collected as one component of a larger daily diary research program examining psychosocial processes in the context of chronic pain. The following is a description of the methodology and information about the variables pertinent to the current study.

*Participant recruitment.*

Respondents (R's) were recruited via the British Columbia Rheumatoid Arthritis Registry and the Provincial Department of Vital Statistics. Three hundred and twenty-seven potentially eligible individuals were identified and 230 met the following criteria: (1) diagnosed with RA as defined by the American Rheumatism Association criteria (Arnett et al., 1988), (2) non-hospitalized and had utilized outpatient services during the previous three years, (3) did not meet criteria for major co-morbidity (e.g., life-threatening illness, major heart disease, stroke complications), (4) had clearance from their primary physician, (5) lived within the Greater Vancouver Region and (6) spoke English. Of these 230 eligible R's, 200 gave consent via mail to be reached by telephone. One hundred and forty-nine individuals agreed via telephone to participate in the current study and were mailed study materials.

In total, 126 study material packages were returned (although 12 of these were left uncompleted by the R's). We were able to contact 25 of the R's who had not returned the study materials in order to establish reasons for their withdrawal. Reasons for withdrawal included unexpected illness (RA-related or other types of illness), leaving town, and reluctance to complete

study materials twice daily. Of the 114 R's who had completed and returned their study materials, 17 had completed less than 50% of the 14 timepoints within the structured diary and were dropped from the analyses due to insufficient data. An additional 23 R's indicated they had absolutely no RA related pain to cope with during the course of the study. Given the focus of the current analyses (i.e., the daily process of coping with RA pain), these individuals were excluded from the current analyses. Similarly, 3 R's who indicated they had done nothing at all over the course of the study to cope with their RA pain were also excluded from the current analyses.

Analyses indicated that dropped R's were not significantly different from the final sample in educational status, $t$ (92) = -.27, $p$ = n.s., years since diagnosis of RA, $t$ (93) = -.68, $p$ = n.s., or age, $t$ (81) = .29, $p$ = n.s.. Furthermore, dropped R's were not significantly different from the final sample in levels of Extraversion, $t$ (78) = -.68, $p$ = n.s., Openness to Experience, $t$ (78) = -.41, $p$ = n.s., Agreeableness, $t$ (81) = -.41, $p$ = n.s., or Conscientiousness , $t$ (80) = .23, $p$ = n.s.. However, the final sample reported more frequent morning stiffness, $t$ (92) = -3.12, $p < .01$, longer lasting morning stiffness, $t$ (92) = -4.46, $p < .001$, more frequent general pain, $t$ (93) = -4.25, $p < .001$, greater difficulties in daily living activities, $t$ (93) = -3.67, $p < .001$, and lower levels of Neuroticism , $t$ (78) = 1.97, $p$ = .05, in comparison to those dropped from the current analyses. These findings suggest that some of the R's who were omitted from the current analyses may have been experiencing lower levels of general disease activity or general distress, and were potentially less motivated to participate in a study regarding coping with RA. The final sample included 71 individuals with RA.

*Sample characteristics.*

The R's ranged from 24 to 76 years in age, with a mean age of 55.31 years ($SD$ = 13.30). Seventy-six percent of the R's were women and 69% were currently married. Three percent reported grade school as the highest level of education obtained, 59% high school, and 38% college or university. Regarding work status, 29% were currently working outside the home, 38% were retired, 15% were on sick-leave, 7% were unemployed, 10% worked in the home only, and 1 person had

been laid off. Time since diagnosis of RA ranged from less than one year to 41 years, with a mean of 10.99 years since disease diagnosis (SD = 9.89). The current sample qualifies as a "chronic pain" sample according to the International Association for the Study of Pain (IASP, 1986) as all participants had experienced pain duration of at least three months. Additional information regarding the health status of the R's is reviewed in the results section below.

*Measures: Questionnaire data*

*Demographic and disease information.*

First, R's completed a questionnaire in order to provide background information including age, sex, education level, marital status, work status, general health status, year of RA diagnosis, pain frequency, morning stiffness frequency, morning stiffness duration, and treatment status. Functional disability was assessed via difficulties performing 8 daily activities (e.g., dressing oneself, getting in and out of bed, walking) on a four point scale ranging from 0 (without any difficulty) to 3 (unable to do). These items were drawn from the Modified Stanford Health Asessment Questionnaire (Pincus, Summey, Soraci, Wallston, & Hummon, 1983) which is a short-form of the Difficulty in Mobility Subscale of the Standford Health Assessment Questionnaire (HAQ; Fries, Spitz, & Kraines, 1980).

*Personality.*

Second, R's also completed an adjective self-report measure of personality before beginning the diary phase of the study. Each of the Big Five factors of personality was measured by means of six trait adjectives found in previous studies to be prototypical markers of the factors (e.g., Goldberg, 1992; Trapnell & Wiggins, 1990). The scales reflecting each of the five factors were constructed as follows: Neuroticism (N) - worrying, fretful, anxious, relaxed (reversed), calm (reversed), at ease (reversed); Extraversion (E) - outgoing, vocal, lively, shy (reversed), quiet (reversed), unauthoritative (reversed); Openness to Experience (O) - intellectual, questioning, abstract thinking, unsearching (reversed), unphilosophical (reversed), uninquisitive (reversed); Agreeableness (A) -

caring, tender-hearted, gentle-hearted, unsympathetic (reversed) cold hearted (reversed), unkind (reversed); Conscientiousness (C) - organized, efficient, systematic, untidy (reversed), undisciplined (reversed), irresponsible (reversed) (Trapnell, 1989). Participants indicated the degree to which each of these 30 adjectives were descriptive of themselves on a seven point scale ranging from 1(not true) to 7 (very true). The composition of each of the five personality factors and the psychometric properties of these five scales are reported in Table 1. The alphas ranged from .61 (agreeableness) to .76 (neuroticism) indicating acceptable reliabilities.

*Measures: Diary data*

R's completed a structured diary twice a day for one-week resulting in 14 time-points of data. The diary was completed at or after lunch, and again before going to bed each day. Given the cyclic nature of chronic pain, it is important to obtain repeated measures of pain and related variables at the same time each day in order to avoid confounding results with time of the day (Bradley, 1993). At each timepoint, R's would report their coping since the last entry in the diary. R's were encouraged to seal the diaries after each completion using stickers provided by the researchers. In this way, the period of cued recall was limited to no more than half a day. This is important given the need to minimize retrospective contamination in coping research (DeLongis et al., 1992).

*Pain severity.*

R's indicated severity of pain on a 10 cm visual analogue scale (VAS) with possible scores ranging from 0 mm (no pain) to 100 mm (severe pain) (Huskisson, 1974). Subjective measures of pain do have limitations (for a review, see Craig 1992). For example, it has been suggested that while visual analogue scales reflect the evaluative dimensions of pain, they may also overlap with the affective dimensions of pain, and do not address the sensory qualities of pain (for a detailed review of the multi-dimensional assessment of pain, see Melzack & Katz, 1999). However, despite their problems, VAS measures of pain continue to be the most common method of assessing subjective pain severity in use among pain researchers, and their use in the current study will

Table 1

Personality Factor Scales and Internal Reliability Estimates

| Scale |
|---|
| NEUROTICISM (alpha = .76) |
| Worrying |
| Fretful |
| Relaxed |
| At ease |
| Anxious |
| Calm |
| EXTRAVERSION (alpha = .68) |
| Outgoing |
| Quiet |
| Unauthoratative |
| Vocal |
| Lively |
| shy |
| OPENNESS TO EXPERIENCE (alpha = .70) |
| Unphilisophical |
| Uninquisitive |
| Intellectual |
| Unsearching |
| Questioning |
| Abstract thinking |
| AGREEABLENESS (alpha = .65) |
| Cold hearted |
| Caring |
| Tenderhearted |
| Unkind |
| Gentle hearted |
| Unsympathetic |
| CONSCIENTIOUSNESS (alpha = .61) |
| Organized |
| Undisciplined |
| Irresponsible |
| Efficient |
| Untidy |
| Systematic |

facilitate comparisons with previous studies. Acceptable reliabilities have been found using VAS measures of pain (e.g., test-retest reliabilities of approximately .90)(Bradley, 1993; Huskission, 1983). Bradley (1993) argues in his review of pain measurement in arthritis that VAS measures are also superior to frequently used categorical measures of pain for a variety of reasons. First, VAS measures provide a larger range of possible responses and thereby avoid forcing artificial choices between pain severity levels. Second, VAS measures provide suitable interval scale data for conducting parametric statistical analyses unlike categorical ratings. Therefore, within the current model, subjective pain severity via a VAS was selected as the health outcome dependent variable.

*Mood states.*

There is evidence that sadness, fear/anxiety, and anger are three main emotions accounting for the empirically derived affective component of pain (Fernandez & Milburn, 1994). Three subscales assessing depressed, anxious, and hostile mood were drawn from the Affects Balance Scale (ABS; Derogatis, 1975) for use in the current study. Previous researchers have reported good internal consistency for the ABS subscales with reliability alpha coefficients ranging from .78 to .92 (Northouse & Swain, 1987). R's indicated the degree to which 15 descriptors (e.g., nervous, resentful, sad, etc) reflected how they felt during a given time period on a scale ranging from 0 (never) to 4 (always). Each of the three negative mood subscales were computed as the average of five items. Higher scores on all of these scales indicate a higher level of the particular mood state. There is also evidence that negative emotions are multivariate with each component intercorrelating with others (Robinson & Riley, 1999). Therefore a composite negative mood scale based on all three subtypes of negative mood (depressed, anxious and hostile) was also calculated with alphas at each of the time points ranging from .93 to .96.

*Coping strategies.*

Coping was assessed with a brief Ways of Coping inventory derived from the Revised Ways of Coping (WOC-R; Folkman & Lazarus, 1985). When studying the process of coping, it is

important that the included coping items are relevant to the specific stressor (Stone, Greenberg, Kennedy-Moore, & Newman, 1991). That is, the coping inventory must include the appropriate range of cognitive and behavioural strategies that are actually used by individuals coping with any given stressor. Therefore, the three highest loading items that were relevant to coping with chronic pain were drawn from each of the following WOC-R subscales: planful-problem solving, confrontation, distancing, self-control, escape-avoidance, accepting responsibility, positive reappraisal and seeking social support. In addition, based upon previous literature suggesting the important role of downward social comparison in promoting adjustment when coping with illness (e.g., Affleck et al., 1987; Affleck et al., 1988b; Tennen & Affleck, 1997; Wood, et al., 1985), three items assessing this specific form of coping were also included.

In total, 27 coping items reflecting nine distinct forms of coping were assessed in the current coping measure. R's indicated the degree to which they had utilized each strategy specifically to cope with RA pain on a three point scale labeled 0 (not at all), 1 (some) and 2 (a lot). Due to low endorsement by R's in the current sample, items reflecting escape avoidance (e.g., ate, drank, or smoked to feel better) and accepting responsibility (e.g., realized I had brought the problem upon myself) were dropped from the current analyses. Items reflecting escape avoidance or accepting responsibility as ways of coping with pain were endorsed in less than 18% and 11% of all timepoints respectively. This indicates that within the current sample, most individuals used these strategies as a way of coping with pain on very few occasions if at all, thus precluding any meaningful analysis. One additional seeking social support item was also dropped due to low endorsement (sought professional help was endorsed in fewer than 8% of all timepoints). Factor analysis of the remaining 20 coping items was conducted as part of a prior study within a larger program of research (Newth, 1997). This earlier study also included preliminary analyses of the coping factors and their associations with pain outcomes in order to determine their utility for inclusion in the multi-level model being tested in the current study (see the hypotheses specified below regarding coping

effectiveness for more information). A Maximum Likelihood extraction and oblique rotation was used. Oblique rotation is most appropriate for coping data given evidence that 1) people often engage in multiple ways of both problem- and emotion-focused coping when facing a single stressor, and 2) the use of one specific form of coping does not necessarily preclude the use of another (e.g., Folkman et al., 1986a, 1986b; Newman, Fitzpatrick, Lamb, & Shipley, 1990). Based upon the initial factor analysis, two items that failed to load higher than .30 on any factor were dropped. In total, 18 items were retained in the final factor analyses.

The final factor analysis (Newth, 1997) yielded four factors based upon the 18 coping items reviewed above. The construction of the coping scales according to the factor analysis and the psychometric properties of these four scales are reported in Table 2. Item loadings for each of the factors ranged from .45 to .77, with no item loading higher than .20 on an alternative factor. The reliability estimates for each coping scale were calculated at each of the 14 timepoints. The average alphas across all 14 timepoints for the four coping scales ranged from .72 to .80, indicating moderately high levels of scale reliability across the course of the study. Both item loadings and alphas are comparable with empirically derived coping scales previously reported in the literature (e.g., Carver et al., 1989; Folkman et al., 1986a, 1986b).

*Cognitive reframing* (Factor 1) represents efforts to perceive one's current situation positively. Items reflect both positive reappraisal and downward social comparison. Therefore, this scale includes strategies that enable the individual to see themselves as better off than others (e.g., "Realized how, in some ways, I'm more fortunate than others") in addition to efforts to see positive elements within one's current situation (e.g., "Changed or grew as a person in a good way").

*Stoic distancing* (Factor 2) represents attempts to avoid acknowledging, dwelling upon, or expressing the extent of the pain and its associated distress. This scale includes elements of distancing oneself and others from the pain or pain-related distress as a means of coping (e.g., "Went on as if nothing had happened" or "Tried to keep pain to myself").

Table 2

Coping Scales, Item Loadings and Internal Reliability Estimates

| Scale | Factor Loading[a] |
|---|---|
| Scale 1: COGNITIVE REFRAMING (alpha[b] =.78 [.63 to .86]; n = 65[c] [61 to 68]) | |
| Reminded myself how much worse things could be. | .73 |
| I thought about someone I know who is in a worse situation. | .73 |
| Realized how, in some ways, I'm more fortunate than others. | .72 |
| Rediscovered what is important in life. | .55 |
| Changed or grew as a person in a good way. | .45 |
| Scale 2: STOIC DISTANCING (alpha = .80 [.77 to .86]; n = 66 [63 to 69]) | |
| Kept others from knowing how bad it was. | .77 |
| Tried to keep my pain to myself. | .77 |
| Didn't let it get to me; refused to think about it too much. | .55 |
| Went on as if nothing had happened. | .55 |
| Made light of the situation; refused to be upset. | .54 |
| Tried to keep my pain from interfering with other things too much. | .50 |
| Scale 3: EMOTIONAL EXPRESSION (alpha = .72 [.62 to .82]; n = 67 [60 to 69]) | |
| Talked to someone about how I was feeling. | .73 |
| Expressed anger. | .61 |
| I let my feelings out somehow. | .58 |
| Accepted sympathy and understanding from someone. | .55 |
| Scale 4: ACTIVE PROBLEM SOLVING (alpha = .79 [.59 to .87]; n = 65 [62 to 68]) | |
| Made a plan of action and followed it. | .77 |
| Concentrated on what I had to do - the next step. | .72 |
| I knew what I had to do so increased my efforts to make things work. | .53 |

[a] No coping item loads higher than .20 on the alternative factors (i.e., coping scales).

[b] The alphas for the coping scales were calculated at each of the 14 timepoints. A mean alpha for each coping scale was then computed from these 14 alpha estimates and is the value reported here. This was done in order to avoid the potentially misleading relations between variables that can occur when one aggregates data across time prior to statistical procedures such as factor analysis. The range of alphas obtained for the 14 timepoints is reported in brackets.

[c] Alpha estimates for each timepoint include only those participants with complete data for the particular coping scale in question. The average n is reported, with the range of the n's for the 14 timepoints reported in brackets.

*Emotional expression* (Factor 3) represents efforts to express the pain-related distress within an interpersonal context. This scale includes items reflecting both the expression of pain-related emotions (e.g., "Expressed anger") as well as efforts to obtain social support for such feelings (e.g., "Accepted sympathy and understanding from someone").

*Active problem-solving* (Factor 4) represents increased efforts to engage oneself cognitively and behaviorally in order to directly impact the source of stress as a means of coping. Items on this scale reflect effortful and attentive attempts to develop and execute of a course of action that will directly impact the stressor (i.e. the pain) and its effects (e.g., "I knew what I had to do so increased my efforts to make things work").

In summary, the time variant variables (i.e., repeated measures collected over time) included coping strategies, negative mood, and pain severity. The time invariant variables (i.e., individual differences assessed once at the beginning of the one week study) included disease status information, demographics and each of the big five personality traits (N, E, O, A , C).

*The Statistical Model*

As previously described, HLM was utilized in order to examine a multi-level model that incorporates both time variant and time invariant information into one comprehensive process model. In order to examine the temporal relations among variables all of the diary data were divided into morning (AM) timepoints and evening (PM) timepoints. AM variables were then examined as predictors of PM variables which allowed causal issues among key variables within the unfolding of a single day to be examined. The following is a general overview of the models and specific hypotheses tested via HLM and are outlined here in a similar manner to the format utilized by Affleck, Tennen and colleagues (1999). See Appendix 1 for a detailed overview of HLM model procedures and detailed equation specifications.

*The mood-pain nexus.*

The first set of analyses examined the associations between morning mood and evening pain, controlling for morning pain.

Hypothesis 1a: Morning pain severity will be positively associated with evening pain within days, even after controlling for morning negative mood.

Hypothesis 1b: Morning negative mood will be positively associated with evening pain within days, even after controlling for morning pain.

Exploratory analyses were conducted in order to test whether the associations between morning negative mood and evening pain varied as a function of morning pain. In order to address each of these empirical questions, evening pain ($EP_{ij}$) was modeled as a function of one's average evening pain across all diary days ($\beta_{0j}$), morning pain ($\beta_{1j}$; to capture residualized change in pain within days), morning mood ($\beta_{2j}$), morning mood by morning pain ($\beta_{3j}$) and that evening's deviation from the pain average ($\varepsilon_{ij}$):

$$EP_{ij} = \beta_{0j} + \beta_{1j}(\text{AM PAIN}) + \beta_{2j}(\text{AM MOOD}) + \beta_{3j}(\text{AM PAIN by AM MOOD}) + \varepsilon_{ij}$$

*Coping Effectiveness.*

Preliminary analyses as part of a larger program of research indicated that ways of coping were significantly associated with pain outcomes in the current sample (Newth, 1997). The current study extends these findings by determining whether the significant positive effects of cognitive reframing and distancing, and the significant negative effects of active problem solving 1) remain significant after controlling for personality effects, 2) remain significant after controlling for mood, pain and their interaction, and 3) are modified by specific personality traits. See below for specification of models and hypotheses regarding personality variables.

*Individual differences in pain.*

Hypothesis 2a: There will be significant between person variability in evening pain severity within days, even after controlling for morning pain and morning negative mood.

Exploratory analyses examining the role of the five personality traits and disease status factors in accounting for this variability were conducted. For the first set of level 2 analyses, the level 1 evening pain severity intercept ($\beta_{0j}$) for any person (i) was tested as a function of the average intercept (mean pain) across persons ($\phi_{00}$), all five personality factors and their respective regression coefficients (e.g., $\phi_{01}$, $\phi_{02}$, $\phi_{03}$, $\phi_{04}$, $\phi_{05}$) and a random component ($\upsilon_{0j}$):

$\beta_{0j} = \phi_{00} + \phi_{01}(N_i) + \phi_{02}(E_i) + \phi_{03}(O_i) + \phi_{04}(A_i) + \phi_{05}(C_i) + \upsilon_{0j}$

For the second set of level 2 analyses, the level 1 evening pain severity intercept ($\beta_{0j}$) for any person (i) was tested as a function of the average intercept (mean pain) across persons ($\phi_{00}$), disease status variables and their respective regression coefficients (e.g., $\phi_{01}$, $\phi_{02}$, $\phi_{03}$, $\phi_{04}$, $\phi_{05}$) and a random component ($\upsilon_{0j}$):

$\beta_{0j} = \phi_{00} + \phi_{01}$ (Years since diagnosis$_i$) + $\phi_{02}$ (General pain frequency$_i$) + $\phi_{03}$ (General morning stiffness frequency$_i$) + $\phi_{04}$ (General morning stiffness duration$_i$) + $\phi_{05}$ (General functional disability$_i$) + $\upsilon_{0j}$

*Individual differences in the mood-pain nexus and coping effectiveness.*

A multivariate contrast was conducted to determine whether any of the big five personality factors accounted for significant variability in the slope for morning mood to evening pain and the slopes for each of the morning coping strategies to evening pain as a set. HLM models including personality factors modeled directly on the mood or specific coping slopes were only tested for those personality factors that reached significance in the multivariate contrasts.

The level 1 morning mood slope ($\beta_{2j}$) for any person (i) was tested as a function of the average morning mood slope across persons ($\phi_{00}$), significant personality factor(s), and their respective regression coefficients (e.g., $\phi_{01}$, $\phi_{02}$, $\phi_{03}$, $\phi_{04}$, or $\phi_{05}$). The following is an example of a personality factor modeled onto the mood to pain slope (i.e,, a cross-level interaction between personality and the effects of morning mood on evening pain):

$\beta_{2j}$ (morning negative mood slope) = $\phi_{20} + \phi_{21}$ (Neuroticism$_i$)

The level 1 coping slopes ($\beta_{4j}$, morning cognitive reframing; $\beta_{5j}$,morning stoic distancing; $\beta_{6j}$, morning emotional expression; $\beta_{7j}$, morning active problem solving) for any person (i) were each tested as a function of the average morning coping slope across persons ($\phi_{40}$, $\phi_{50}$, $\phi_{60}$, or $\phi_{70}$,), significant personality factors, and their respective regression coefficients (e.g., $\phi_{01}$, $\phi_{02}$, $\phi_{03}$, $\phi_{04}$, or $\phi_{05}$). The following is an example of a single personality factor modeled onto a coping to pain slope (i.e., a cross-level interaction between personality and the effects of morning coping on evening pain):

$\beta_{4j}$ (morning cognitive reframing slope) = $\phi_{40} + \phi_{41}$ (Extraversion$_i$)

*Individual differences in coping use.*

Hypothesis 3: There will be significant between person variability in the use of each of the coping strategies, even after controlling for morning pain and morning negative mood.

In order to examine the role of personality in the use of coping strategies each level 1 coping use intercept ($\beta_{0j}$) for any person (i) was tested as a function of the average intercept (mean coping use) across persons ($\phi_{00}$), morning pain ($\beta_{1j}$), morning mood ($\beta_{2j}$), that day's deviation from average coping use ($\varepsilon_{ij}$), each of the five personality factors and their respective regression coefficients (e.g., $\phi_{01}$, $\phi_{02}$, $\phi_{03}$, $\phi_{04}$, $\phi_{05}$) and a random component ($\upsilon_{0j}$). The two levels of these multivariate analyses were specified for each coping strategy as follows:

1) Morning cognitive reframing use$_{ij}$ = $\beta_{0j} + \beta_{1j}$ (AM PAIN) + $\beta_{2j}$ (AM MOOD) + $\varepsilon_{ij}$

and

$\beta_{0j} = \phi_{00} + \phi_{01}$ ($N_i$) + $\phi_{02}$ ($E_i$) + $\phi_{03}$ ($O_i$)+ $\phi_{04}$ ($A_i$)+ $\phi_{05}$ ($C_i$)+$\upsilon_{0j}$

2) Morning stoic distancing use$_{ij}$ = $\beta_{0j} + \beta_{1j}$ (AM PAIN) + $\beta_{2j}$ (AM MOOD) + $\varepsilon_{ij}$

and

$\beta_{0j} = \phi_{00} + \phi_{01}$ ($N_i$) + $\phi_{02}$ ($E_i$) + $\phi_{03}$ ($O_i$)+ $\phi_{04}$ ($A_i$)+ $\phi_{05}$ ($C_i$)+$\upsilon_{0j}$

3) Morning emotional expression $use_{ij} = \beta_{0j} + \beta_{1j}(\text{AM PAIN}) + \beta_{2j}(\text{AM MOOD}) + \varepsilon_{ij}$

and

$\beta_{0j} = \phi_{00} + \phi_{01}(N_i) + \phi_{02}(E_i) + \phi_{03}(O_i) + \phi_{04}(A_i) + \phi_{05}(C_i) + \upsilon_{0j}$

4) Morning active problem solving $use_{ij} = \beta_{0j} + \beta_{1j}(\text{AM PAIN}) + \beta_{2j}(\text{AM MOOD}) + \varepsilon_{ij}$

and

$\beta_{0j} = \phi_{00} + \phi_{01}(N_i) + \phi_{02}(E_i) + \phi_{03}(O_i) + \phi_{04}(A_i) + \phi_{05}(C_i) + \upsilon_{0j}$

# Results

The results are presented in three main sections. Both time invariant variables (obtained from the questionnaire) and aggregated time variant variables (obtained from the 7 morning and 7 evening structured diary time points) were examined. First, descriptive statistics including means, ranges and standard deviations of key variables are reported. Second, bivariate relations among these same variables are presented. Third, multi-level models and analyses are reported. Multi-level relations were examined in the current study using Hierarchical Linear Modelling (HLM: Bryk & Raudenbush, 1992). Consistent with common usage of multi-level models and analyses, time variant data are referred to as "level 1" variables (e.g., coping, mood, and pain), whereas time invariant data (e.g., personality traits, years since diagnosis at time of the study, general disease status variables) are referred to as "level 2" variables.

## *Descriptives*

The means and standard deviations for age, disease status variables and personality are presented in Table 3.

### *Disease Status.*

Examination of the level 2 variables from the questionnaire indicated notable variability between R's in regards to several dimensions of disease status. First, R's were asked how often they had felt pain from arthritis during the past month on a 5-point scale ranging from "never" to "all of the time". Responses indicated that 25.4% of the sample reported pain from RA "some of the time", 11.3% "about half the time", 40.8% "most of the time", and 22.5% "all of the time". Second, R's were asked how often they got morning stiffness on a 6-point scale ranging from "never" to "all of the time". Responses indicated that 19.7% of R's experienced morning stiffness "all of the time", 26.8% "most of the time", 15.5% "more often than not", 21.1% "occasionally", 7% "rarely", and 9.9% "never". R's were also asked how long their morning stiffness usually lasted each day on a 5-

Table 3

Means and Standard Deviations for Level 2 (Time Invariant) Variables

| **Variables** | **Range** | **M** | *SD* |
|---|---|---|---|
| Age | 24-76 | 55.31 | 13.30 |
| Years since diagnosis | <1 – 41 | 10.99 | 9.89 |
| General functional disability | 0-3 | .79 | .55 |
| Pain frequency (prior month)[a] | 1-4 | 2.59 | 1.13 |
| Morning stiffness severity (prior month) | 0-5 | 3.01 | 1.57 |
| Morning stiffness duration (prior month) | 0-4 | 1.96 | 1.21 |
| Neuroticism | 1.00 – 6.50 | 3.63 | 1.07 |
| Extraversion | 1.50 – 6.67 | 4.20 | 1.06 |
| Openness to experience | 2.33 – 6.83 | 4.87 | 1.00 |
| Agreeableness | 2.75 – 7.00 | 5.88 | .96 |
| Conscientiousness | 2.20 – 7.00 | 5.48 | .95 |

Note. N=71, except for Age where N = 65 due to missing data.
[a] prior month = retrospective rating for month prior to study

point scale ranging from "no lasting stiffness" to "more than four hours of morning stiffness". Reports of morning stiffness duration spanned this entire range with a mean duration of approximately 1 hour. Third, R's were asked to report the degree to which they experience difficulties completing eight common daily activities (e.g., dressing, getting out of bed, doing chores, and climbing stairs) on a 4 point scale ranging from "no difficulty" (0) to "unable to do" (3). R's' reports of disability spanned this entire range (M = .79, SD = .55). When asked if they had any other medical conditions, ailments, or impairment other than rheumatoid arthritis, 42.3% of R's reported comorbid medical conditions (e.g., cataracts, high blood pressure) that did not meet exclusionary criteria for major co-morbidity. Prescription medications for RA related symptoms (e.g., anti-inflammatories, gold therapy, and corticosteroids) were used by 90.1 percent of R's during the previous month.

*Personality.*

The means for the five factors of personality were as follows: Neuroticism (M = 3.63, SD = 1.07), Extraversion (M = 4.20, SD = 1.06), Openness to Experience (M = 4.87, SD = 1.00), Agreeableness (M = 5.88, SD = 0.96), Conscientiousness (M = 5.48, SD = 0.95).

*Diary Variables: Coping, negative mood, and pain.*

The means and standard deviations for the level 1 variables (morning pain, morning mood, morning coping and evening pain) are presented in Table 4. "AM" variables refer to diary reports for the morning period, while "PM" variables refer to daily reports for the afternoon and evening period. Average morning and evening pain severity were 40.20 and 40.23 respectively on a scale ranging from 0 to 100. Average morning negative mood was .63 on a scale ranging from 0 to 4. Average morning coping use ranged from 1.29 (emotional expression) to 1.74 (stoic distancing) on 3 point scale from 0 to 2.

Table 4

Means and Standard Deviations for Level 1 (Time Variant) Variables[a]

| **Variables** | **M** | *SD* |
|---|---|---|
| AM Pain Severity | 40.20 | 19.82 |
| PM Pain Severity | 40.23 | 19.55 |
| AM Negative Mood | .63 | .64 |
| AM Cognitive Reframing | 1.43 | .43 |
| AM Stoic Distancing | 1.74 | .44 |
| AM Emotional Expression | 1.29 | .30 |
| AM Active Problem Solving | 1.55 | .51 |

Note. N=71, except for the four coping scales where N=69 due to missing data.
[a] Daily measures have been aggregated for each participant over all time-points.

Bivariates

The correlations among the level 1 (time variant) variables and level 2 (time invariant) variables are presented in Tables 5 through 9. Preliminary analyses indicated that hostile mood, anxious mood, and depressed mood were highly positively correlated (depressed mood and anxious mood, $r = .85$, $p<.001$; depressed mood and hostile mood, $r = .90$, $p <.001$; anxious mood and hostile mood, $r = .88$, $p<.001$; $N=71$). This high level of shared variance can be problematic for multi-level modeling (e.g., potential for multi-colinearity) and data reduction is highly recommended when attempting to model large numbers of associated variables (Kreft & De Leeuw, 1998). As a result, the depressed, anxious and hostile mood indices were combined into a global negative mood measure.

Table 5 includes the correlations among level 2 disease variables. The patterns of correlations indicates that general disease activity variables (i.e., pain frequency, morning stiffness frequency, morning stiffness duration) were significantly positively associated with general functional disability. Years since diagnosis was not significantly associated with any of these disease status/activity variables.

Table 6 indicates the correlations between aggregated level 1 variables (morning negative mood, morning coping strategies, morning pain severity, evening pain severity) and level 2 disease status variables. Years since diagnosis were not significantly associated with any of the aggregated level 1 variables (morning negative mood, morning coping, morning pain or evening pain). Aggregated morning negative mood was significantly positively associated with general pain frequency and general morning stiffness duration. Aggregated morning pain severity, aggregated evening pain severity and aggregated morning emotional expression were all significantly positively associated with all of the disease variables (e.g., general morning stiffness), except for years since diagnosis.

TABLE 5

Correlations among disease status variables

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Years Since Diagnosis | - | | | | |
| General Functional Disability | .06 | - | | | |
| Pain Frequency (prior month)[a] | -.17 | .47*** | - | | |
| AM stiffness severity (prior month) | -.06 | .40** | .45*** | - | |
| AM stiffness duration (prior month) | -.16 | .31* | .49*** | .59*** | - |

Note. *p<.05; ** p<.01, ***p<.001. N=71.
[a] prior month = retrospective rating for month prior to study.

Table 6
Correlations among aggregated daily variables [a] and disease status variables

| | Years Since Diagnosis | General Functional Disability | Pain Frequency | Morning Stiffness Severity | Morning Stiffness Duration |
|---|---|---|---|---|---|
| AM PAIN SEVERITY | .01 | .46*** | .49*** | .43*** | .40** |
| PM PAIN SEVERITY | .12 | .45*** | .47*** | .40*** | .33** |
| AM NEGATIVE MOOD | -.11 | .20 | .24* | .20 | .42*** |
| AM COGNITIVE REFRAMING | .03 | .23 | .14 | .03 | .10 |
| AM STOIC DISTANCING | .07 | .12 | .10 | .25* | .13 |
| AM EMOTIONAL EXPRESSION | -.15 | .27* | .39** | .26* | .44*** |
| AM ACTIVE PROBLEM SOLVING | .07 | .11 | .13 | .20 | .20 |

Note. *p<.05, ** p<.01, ***p<.001. N=71, except for correlations with coping strategies (N = 69) due to missing data.
[a] Daily variables were aggregated for each participant across all timepoints.

Table 7 indicates the bivariate associations among the level 1 variables (mood, coping and pain). Aggregated morning pain severity and morning negative mood were significantly positively associated with the aggregated use of morning cognitive reframing, emotional expression and active problem solving, but not with stoic distancing. Aggregated evening pain severity was also significantly positively associated with aggregated morning emotional expression and active problem solving. Aggregated morning active problem solving was significantly positively associated with aggregated morning cognitive reframing, stoic distancing and emotional expression. Aggregated morning emotional expression was also significantly positively associated with aggregated morning cognitive reframing.

Table 8 indicates the correlations among the level 1 aggregated mood, pain and coping variables with each of the level 2 personality traits and age. Examination of this table suggests that age was significantly negatively related to the aggregated use of stoic distancing. Neuroticism was significantly positively associated with aggregated morning negative mood and morning emotional expression. Extraversion was significantly positively associated with aggregated morning stoic distancing, emotional expression and active problem solving. Conscientiousness was significantly negatively associated with aggregated morning negative mood. Openness to experience and Agreeableness were not significantly associated with any of the aggregated level 1 pain, mood or coping variables.

Table 9 contains the correlations among personality, age and disease status. Openness to experience was significantly positively associated with both Extraversion and Agreeableness. Agreeableness was also significantly positively associated with Conscientiousness. Neuroticism was significantly negatively associated with years since diagnosis. Extraversion was significantly positively associated with general morning stiffness duration. Age was not significantly associated with any of the big five personality traits or disease status variables.

Table 7

Correlations among aggregated daily variables [a]

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| 1. AM pain severity | .94[b] | | | | | | |
| 2. PM pain severity | .87*** | .94 | | | | | |
| 3. AM negative mood | .45*** | .41*** | .96 | | | | |
| 4. AM cognitive reframing | .27* | .17 | .50*** | .94 | | | |
| 5. AM stoic distancing | .09 | .06 | .17 | .22 | .94 | | |
| 6. AM emotional expression | .38** | .32** | .60*** | .47*** | .21 | .87 | |
| 7. AM active problem solving | .32** | .40** | .51*** | .50*** | .42*** | .45*** | .95 |

Note. *p<.05, ** p<.01, ***p<.001. N=71, except for correlations with coping strategies (N = 69) due to missing data.

[a] Daily variables were aggregated for each participant across all timepoints.

[b] Numbers on the diagonal reflect daily stabilities (i.e., alpha reliability estimates for each of the aggregated daily variables)

Table 8

Correlations among aggregated daily variables [a], personality and age

| | N[b] | E | O | A | C | Age |
|---|---|---|---|---|---|---|
| 1. AM pain severity | .16 | .22 | .05 | -.06 | -.06 | .14 |
| 2. PM pain severity | .20 | .15 | .09 | -.07 | -.06 | .09 |
| 3. AM negative mood | .44*** | .17 | -.01 | -.20 | -.41*** | -.22 |
| 4. AM cognitive reframing | .07 | .21 | -.19 | -.01 | -.23 | .01 |
| 5. AM stoic distancing | -.06 | .24* | .08 | .09 | .12 | -.40** |
| 6. AM emotional expression | .35** | .33** | .11 | .06 | -.10 | -.17 |
| 7. AM active problem solving | .12 | .49*** | .14 | .04 | -.14 | -.21 |

Note. *p<.05, ** p<.01, ***p<.001.
N=71, except for correlations with Age and/or correlations with coping strategies (N = 63 to 69) due to missing data.
[a] Daily variables were aggregated for each participant across all timepoints.
[b] N = Neuroticism, E = Extraversion, O = Openness to experience, A = Agreeableness, C = Conscientiousness

Table 9

Correlations among personality, age and disease status variables

| | | N[a] | E | O | A | C | Age |
|---|---|---|---|---|---|---|---|
| 1. | Neuroticism | - | | | | | |
| 2. | Extraversion | -.15 | - | | | | |
| 3. | Openness | -.21 | .38** | - | | | |
| 4. | Agreeableness | -.13 | .15 | .28* | - | | |
| 5. | Conscientiousness | -.09 | .15 | .17 | .46** | - | |
| 6. | Age | -.06 | -.06 | -.09 | -.11 | -.05 | - |
| 7. | Years since diagnosis | -.26* | -.17 | -.03 | -.23 | -.11 | .08 |
| 8. | General Functional Disability | -.03 | -.03 | .09 | .04 | .00 | .00 |
| 9. | Pain frequency (prior month)[b] | .11 | .09 | .15 | .18 | .08 | -.09 |
| 10. | AM stiffness severity (prior month) | -.01 | .19 | .17 | -.01 | .08 | .03 |
| 11. | AM stiffness duration (prior month) | .16 | .28* | .10 | .05 | .03 | -.17 |

Note. *p<.05, ** p<.01, ***p<.001.
Note. N=71, except for correlations with age (N = 65) due to missing data.
[a] N = Neuroticism, E = Extraversion, O = Openness to experience, A = Agreeableness, C = Conscientiousness
[b] prior month = retrospective ratings for month prior to study

*Hierarchical linear models: Overview*

Hierarchical linear modelling (HLM) was used to analyse the data in which repeated measures data from the diary were nested within persons. Level 1 of the nested data includes the time variant data (repeated measures of coping, mood and pain from the structured diary). The level 1 variables were also divided into morning time points and evening time points. Level 2 of the nested data includes the time invariant data (personality and disease status). For the current analyses, evening pain severity was the dependent variable and the preceding same day morning values of coping efforts and negative mood were the predictor variables. Additional variables were also entered as controls (e.g., morning pain severity or disease status variables) or covariates (e.g., personality traits) where appropriate due to significant associations.

*Null model*

The first step in fitting a multi-level model is the "null model" (i.e., estimates degree of within and between person variability in the outcome variable prior to modelling the predictors or control variables). To proceed with modelling predictor variables there must be a significant level of variability in the dependent variable. A chi-square test, $\chi^2(70, \underline{N}=71) = 862.87$, $\underline{p} < .001$, indicated that significant between-person variability existed among the intercepts ($\beta_{0j}$'s) in evening pain. That is, R's varied significantly from one another in their average evening pain severity (each R's average pain severity is based upon seven days of data collection). The null model also includes calculation of a "reliability estimate" which indicates whether reliable random variance lies between individuals, with smaller values on a scale ranging from 0 to 1.0 indicating less reliable variance among the intercepts than higher values (Bryk & Raudenbush, 1992). The reliability estimate (evening pain = .91) indicated that highly reliable variance existed between R's in average levels of pain severity across the course of the study.[2] Finally, HLM analyses assume homogeneity of level 1 variance across individuals (i.e., assumes that individuals are not statistically different from one another in their within-person variance in pain). A chi-square test, $\chi^2(67, \underline{N}=71) = 60.99$, $\underline{p} > .50$, revealed that

heterogeneity of level 1 variance did not exist in the current data. Taken together these statistics suggest that proceeding with multi-level modeling is appropriate in the current study.

*Level 1 model: The mood-pain nexus*

The first purpose of the multi-level analyses was to explore the temporal mood-pain nexus (i.e., between and within person differences in the temporal associations between negative mood and pain severity within days). Of particular interest was the degree to which negative mood is associated with subsequent pain within the same day, even after controlling for initial pain severity. The tested mood-pain model examined these temporal associations by modeling morning negative mood on evening pain severity with the inclusion of morning pain severity as a control variable. Results for the mood-pain nexus model are presented in Table 10. First, as hypothesized morning pain severity was positively associated with same day evening pain severity ($\beta = .57$, $t(440)=10.82$, $p<.001$). Second, as hypothesized morning negative mood was positively associated with evening pain severity within the same day, even after controlling for morning pain severity ($\beta = .10$, $t(440)=2.01$, $p<.05$). Finally, exploratory analyses revealed a significant interaction between morning pain and morning negative mood in predicting evening pain severity ($\beta = -.08$, $t(440)= -1.98$, $p<.05$), even after controlling for the significant main effects of both morning pain and morning negative mood.

The interaction between morning pain and morning mood was plotted according to the recommendations of Aiken and West (1991) with values corresponding to the mean, the mean minus one standard deviation (low) and the mean plus one standard deviation (high) for the predictor variables. Significance of the simple slopes can not be calculated as the appropriate error term for determining significance has yet to be identified (Fabes & Eisenberg, 1997). As demonstrated in

Table 10

Hierarchical Linear Model (HLM) Analyses: Relations of morning mood and morning pain to evening pain severity

| EFFECT[a] | β | SE |
|---|---|---|
| AM[b] pain severity | .57 *** | .05 |
| AM negative mood | .10* | .05 |
| AM negative mood by AM pain severity | -.08* | .04 |

Note. *p<.05, **p<.01, ***p<.001 (N = 71)
[a] All variables have been standardized.
[b] AM = morning time period.

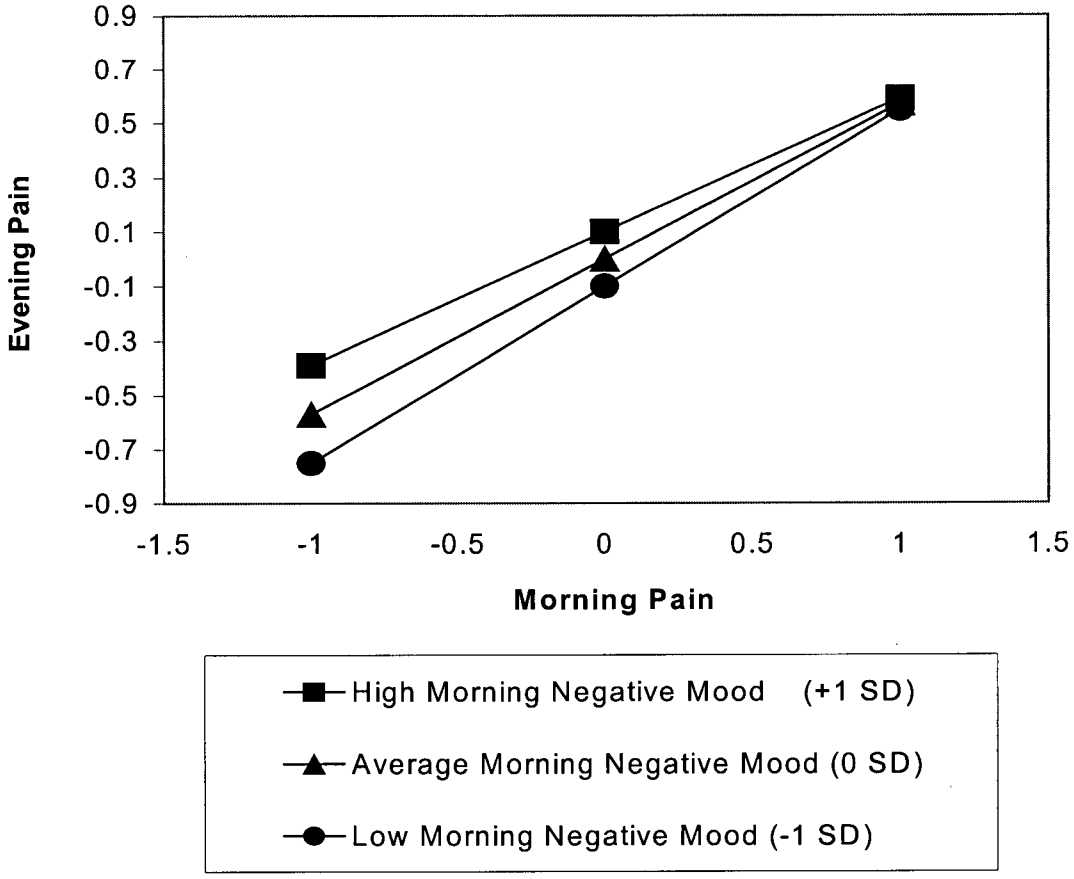
Figure 1 negative mood moderated the relationship of morning pain to evening pain such that the positive associations between morning pain and evening pain were strongest under conditions of low negative mood.[3]

*Multi-Level Model: Mood, pain, individual differences and coping effectiveness*

Before proceeding with fitting the final multi-level model an exploratory analysis was conducted via HLM in order to determine which level 2 variables (i.e., demographics, disease status and personality) should be retained as controls or covariates. General functional disability was positively associated with evening pain severity ($\beta = .16$, $t(69)=3.26$, $p<.01$) and therefore was maintained as a control variable modeled directly onto the evening pain intercept in the multi-level model analyses. The remaining disease status variables (i.e., years since diagnosis, general morning stiffness, general morning stiffness duration and general pain frequency), age, and gender were not significantly associated with evening pain severity and were therefore dropped from the evening pain intercept in subsequent models. Likewise, none of the personality traits were significantly associated with evening pain severity and therefore the direct effects of personality on evening pain were also dropped from the evening pain intercept in subsequent models.[4]

The purpose of the final multi-level analyses was to examine 1) whether the mood-pain nexus remains significant even after controlling for coping and personality, and 2) individual differences in the temporal associations between coping, mood and pain due to personality. Given that level 1 and 2 variance are often interrelated (Snijders & Bosker, 1999) the model was fitted at both levels prior to interpretation of the effects. The final multi-level model that contains all level 1 predictors (mood, pain, coping), level 2 predictors (personality), and control variables (significant disease status variables) is presented in Table 11. In accordance with current recommendations, only significant main effects and interaction terms were maintained in the final model to maximize stability and reliability of the final estimated effects (Kreft & De Leeuw, 1998). The final HLM equation was specified as follows:

**Figure 1.**
**The Relationship between Morning Negative Mood and Morning Pain to Evening Pain**




Note: Each variable has been standardized around its grand sample mean.
Morning Pain: 0 (no pain) to 100 (severe pain); M = 40.20, *SD* = 19.82
Evening Pain: 0 (no pain) to 100 (severe pain); M = 40.23, *SD* = 19.55
Morning Negative Mood: 0 (never) to 4 (always); M = .63, *SD* = .64

$Y_{ij}$(PM PAIN) = $\beta_{0j}$ + $\beta_{1j}$(AM Pain) + $\beta_{2j}$(AM Negative Mood) + + $\beta_{3j}$(AM Cognitive Reframing)+ $\beta_{4j}$(AM Stoic Distancing) + $\beta_{5j}$(AM Emotional Expression) + $\beta_{6j}$(AM Active Problem Solving) +$\beta_{7j}$(AM Negative Mood by AM Pain) $\varepsilon_{ij}$

$\beta_{0j} = \phi_{00} + \phi_{01}$ (Functional Disability Status) +$\upsilon_{0j}$

$\beta_{1j} = \phi_{10}$

$\beta_{2j} = \phi_{20} + \phi_{21}$ (Neuroticism)

$\beta_{3j} = \phi_{30} + \phi_{31}$ (Extraversion)

$\beta_{4j} = \phi_{40}$

$\beta_{5j} = \phi_{50} + \phi_{51}$ (Extraversion)

$\beta_{6j} = \phi_{60}$

First, as expected, the multi-level model indicated that morning pain severity was significantly positively associated with evening pain severity ($\beta$= .54, $t$(432)=12.15, $p$<.001). The main effect for morning negative mood on evening pain severity was no longer significant ($\beta$= .03, $t$(432)=.63, $p$>.10) after controlling for coping, individual difference variables, and the significant cross-level interaction between morning negative mood and Neuroticism ($\beta$= .10, $t$(432)=2.15, $p$<.05). This interaction is plotted in Figure 2 and indicates a positive association between morning negative mood and evening pain severity for average to higher levels of N but a negative association between morning negative mood and evening pain for individuals lower on N. Even after controlling for the significant cross-level interaction between morning negative mood and N, the interaction between morning negative mood and morning pain severity remained significant ($\beta$= -.11, $t$(432)=-2.68, $p$<.01).

Several of the morning coping strategies were also significantly associated with evening pain severity even after controlling for all other significant predictors in the model. Morning cognitive

Table 11

Hierarchical Linear Model (HLM) Analyses: Relations of morning mood, morning pain, morning coping and personality traits to evening pain severity

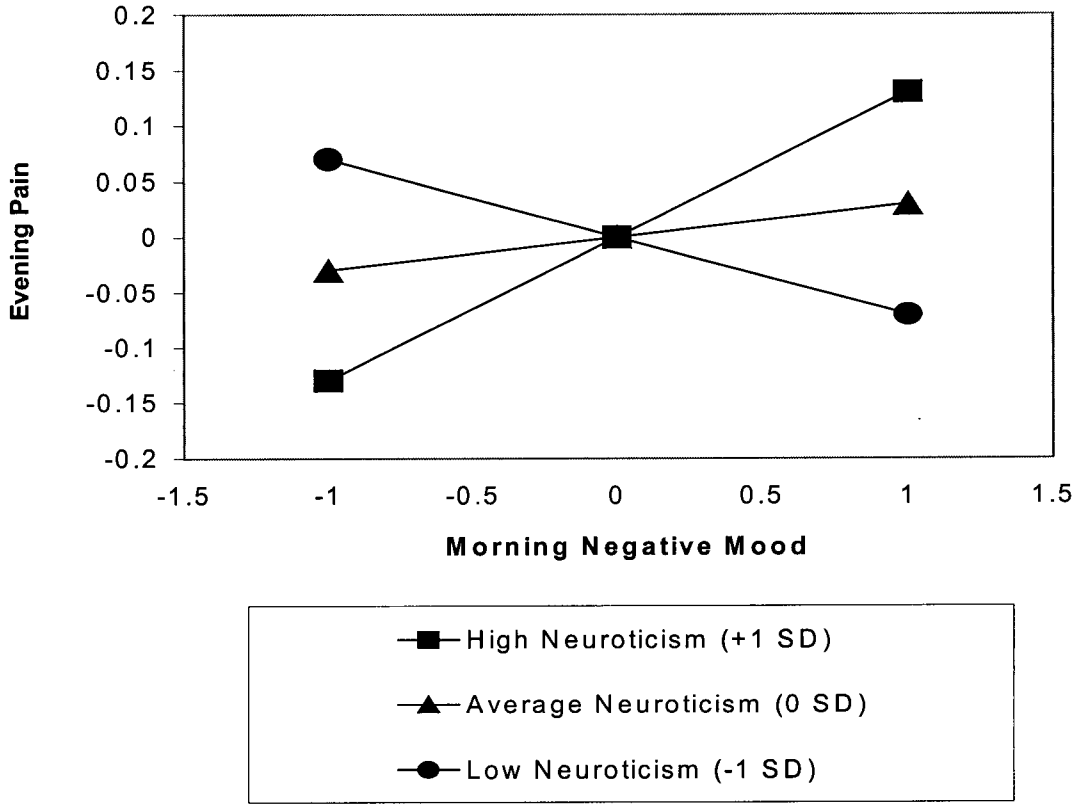
| EFFECT[a] | β | SE |
|---|---|---|
| Functional Disability Status | .15** | .05 |
| AM[b] pain severity | .54*** | .05 |
| AM negative mood | .03 | .05 |
| AM cognitive reframing | -.13** | .05 |
| AM stoic distancing | -.06* | .03 |
| AM emotional expression | .001 | .04 |
| AM active problem solving | .22 *** | .05 |
| AM negative mood by AM pain severity | -.11** | .04 |
| AM negative mood by Neuroticism | .10* | .05 |
| AM cognitive reframing by Extraversion | -.14 ** | .04 |
| AM emotional expression by Extraversion | .08** | .03 |

Note. *p ≤.05, **p<.01, ***p<.001
[a] All variables have been standardized.
[b] AM = morning time period.

reframing was negatively associated with evening pain severity ($\beta$= -.13, $t$(432)= -2.61, $p$<.01). Morning stoic distancing was also negatively associated with evening pain severity ($\beta$= -.06, $t$(432) = -1.96, $p \leq .05$). Morning active problem solving was positively associated with evening pain severity ($\beta$= .22, $t$(432)= 4.87, $p$<.001). Morning emotional expression was not significantly associated with evening pain severity ($\beta$= .001, $t$(432)=.03, $p$>.10). However emotional expression was significantly associated with pain severity, negative mood and several ways of coping at the bivariate level. In addition, as reviewed below, there was a significant personality by emotional expression interaction. Therefore the main effect of emotional expression was maintained in the current analyses.

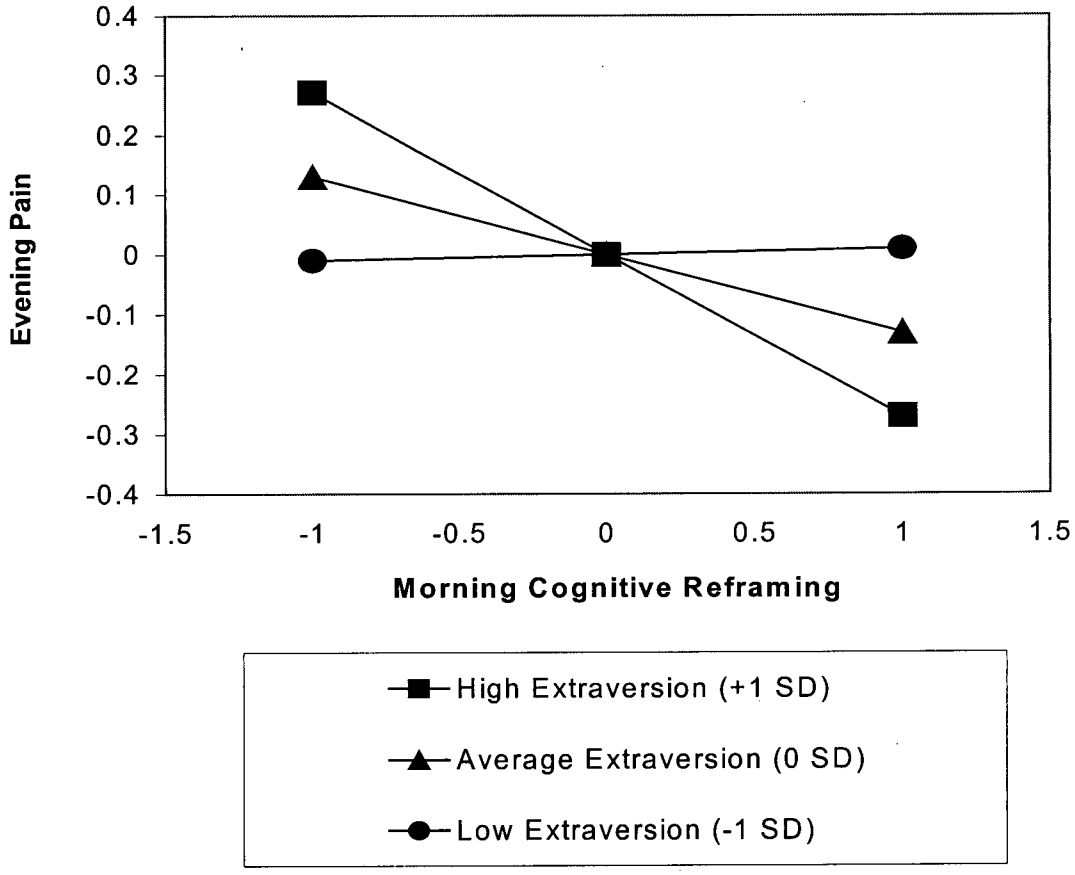
Multivariate contrasts were conducted for each of the five personality factors (N, E, O, A, C) in order to determine the ability of each trait to moderate the associations between the mood or coping variables and evening pain outcomes as a block. Specifically, the ability of E, O, A, and C to account for significant variability in the associations between the five morning predictor variables (cognitive reframing, stoic distancing, emotional expression, active problem solving, negative mood) and evening pain outcomes was examined in four separate multivariate contrasts (one for each trait with all five predictors as a block). The multivariate contrast for N examined the ability of this trait to account for significant variability in the associations between the four coping predictors only and evening pain outcomes (i.e., negative mood was excluded). The significant cross-level interaction between N and negative mood had already been hypothesized and confirmed in prior stages of the multi-level model analyses as reviewed above (i.e., no further analysis of the mood by N associations was required). Chi-sqaure tests indicated no cross-level interactions for N by coping $\chi^2(5, N=71) = 3.74$, $p > .50$, O by coping or mood $\chi^2(6, N=71) = 1.35$, $p > .50$, A by coping or mood $\chi^2(6, N=71) = 9.87$, $p > .10$, or C by coping or mood $\chi^2(6, N=71) = 3.44$, $p > .50$. Therefore no further tests were conducted for these four traits (N, O, A, C) and their interactions with either mood or coping in predicting pain. This approach minimized the number of statistical tests required for examination of

**Figure 2.**
**The Relationship between Morning Negative Mood and Neuroticism to Evening Pain**




Note: Each variable has been standardized around its grand sample mean.
Morning Negative Mood: 0 (never) to 4 (always); M = .63, *SD* = .64
Evening Pain: 0 (no pain) to 100 (severe pain); M = 40.23, *SD* = 19.55
Neuroticism: 1 (low) to 7 (high); M = 3.63, *SD* = 1.07

**Figure 3.**
**The Relationship between Morning Cognitive Reframing and Extraversion to Evening Pain**




Note: Each variable has been standardized around its grand sample mean.
Morning Cognitive Reframing: 0 (not at all) to 2 (a lot); M = 1.43, *SD* = .43
Evening Pain: 0 (no pain) to 100 (severe pain); M = 40.23, *SD* = 19.55
Extraversion: 1(low) to 7 (high); M = 4.20, *SD* = 1.06

cross-level interactions. In contrast, the chi-square statistic for the multivariate contrast examining E as a moderator of mood or coping as a block was significant $\chi^2(6, N=71) = 18.63$, $p < .01$. Follow-up analyses indicated that morning cognitive reframing and E interacted significantly in predicting evening pain severity ($\beta = -.14$, $t(432) = -3.38$, $p < .01$), even after controlling for all other variables in the model. This interaction is plotted in Figure 3. Emotional expression and E also interacted significantly in predicting evening pain severity ($\beta = .08$, $t(432) = 3.02$, $p < .01$) even after controlling for all other variables in the model. This interaction is plotted in Figure 4.

A chi-square test of the between-person variance in evening pain intercepts, $\chi^2(69, N=71) = 191.96$, $p < .001$, revealed that even after controlling for morning pain, morning mood, morning mood by morning pain, morning coping, personality and general functional disability, significant variability in pain severity continued to exist across individuals. The reliability estimate within the final multi-level (evening pain = .65) also indicated between-person variability in pain severity was unlikely to be zero (i.e., the variance was reliable).

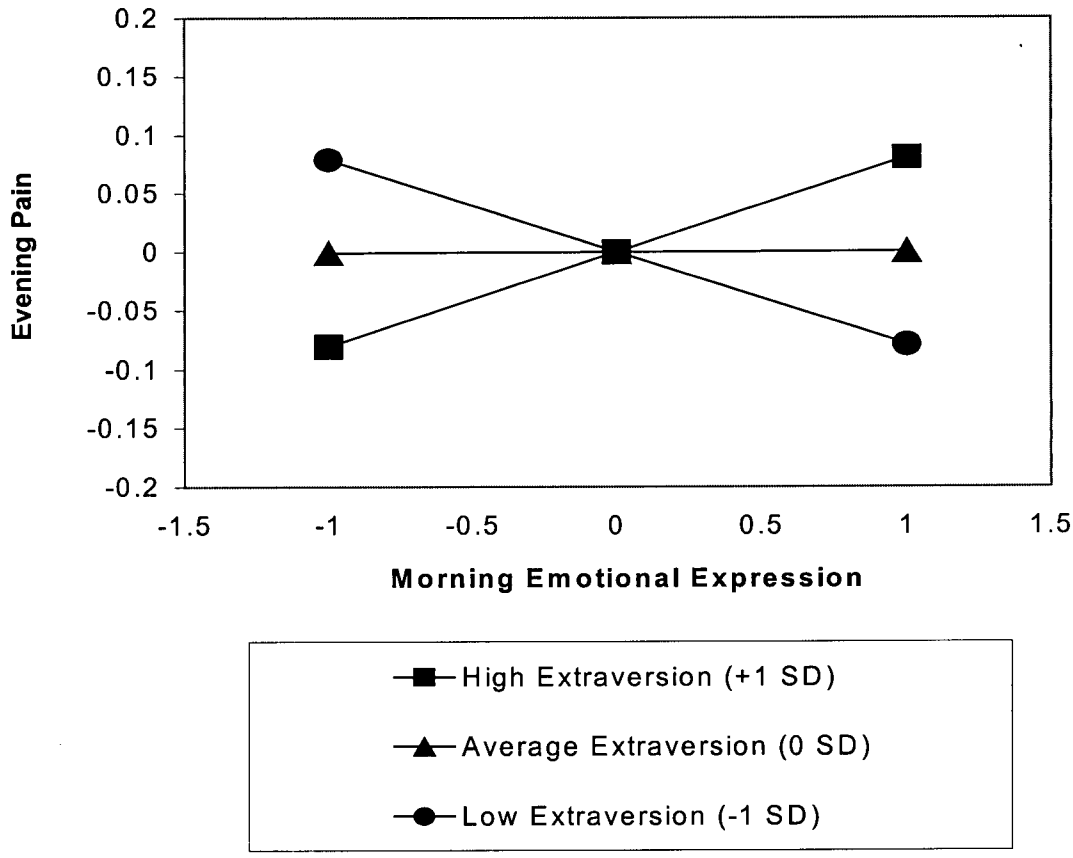
*Multi-Level Model: Mood, pain and individual differences in coping use*

The next stage of multi-level analyses examined predictors of the predictors. That is, the associations of mood, pain, and personality, with the use of each coping strategy were examined. As with the prior analyses any significant demographic or disease status variables were maintained in the model for control purposes and non-significant variables were dropped. The results for each of these four multi-level models (i.e., one for each form of coping) are presented in Table 12.

*Cognitive reframing.*

Of the disease and demographic variables only general functional disability status was positively associated with use of morning cognitive reframing ($\beta = .18$, $t(67) = 2.24$, $p < .05$) and so was maintained in the model as a control variable. Morning pain severity was not significantly associated with use of morning cognitive reframing and so was not included in the model. Morning

**Figure 4.**
**The Relationship between Morning Emotional Expression and Extraversion to Evening Pain**




Note: Each variable has been standardized around its grand sample mean.
Morning Emotional Expression: 0 (not at all) to 2 (a lot); $\underline{M} = 1.29$, $SD = .30$
Evening Pain: 0 (no pain) to 100 (severe pain); $\underline{M} = 40.23$, $SD = 19.55$
Extraversion: 1(low) to 7 (high); $\underline{M} = 4.20$, $SD = 1.06$

Table 12

Hierarchical Linear Model (HLM) Analyses: Relations of morning mood, pain, and personality to morning coping use

| | AM[a] Cognitive Reframing | | AM Stoic Distancing | | AM Emotional Expression | | AM Active Problem Solving | |
|---|---|---|---|---|---|---|---|---|
| EFFECT[b] | β | SE | β | SE | β | SE | β | SE |
| Functional Disability Status | .18* | .08 | ns | | ns | | ns | |
| AM[b] pain severity | ns | | .13* | .06 | ns | | .09# | .05 |
| AM negative mood | .26*** | .07 | .20** | .08 | .43*** | .08 | .22*** | .06 |
| Neuroticism | ns | | ns | | .13* | .07 | ns | |
| Extraversion | .23* | .10 | ns | | .20* | .08 | .35*** | .08 |
| Openness to Experience | -.29** | .09 | ns | | ns | | ns | |
| Agreeableness | ns | | ns | | ns | | ns | |
| Conscientiousness | ns | | .17* | .09 | ns | | ns | |

Note. # $p<.10$, * $p \leq .05$, ** $p<.01$, *** $p<.001$. [a] AM = morning time period. [b] All variables have been standardized.

negative mood was positively associated with use of morning cognitive reframing (β= .26, t(439)= 3.67, p<.001). Extraversion was positively associated with use of morning cognitive reframing (β= .23, t(67)=2.36, p<.05) and Openness to Experience was negatively associated with use of morning cognitive reframing (β= -.29, t(67)=-3.13, p<.01). Neuroticism, Agreeableness and Conscientiousness were not significantly associated with use of morning cognitive reframing and were dropped from the model.

*Stoic distancing.*

None of the demographic or disease variables were significantly associated with use of morning stoic distancing and so were not included in the model. Morning pain severity was positively associated with use of morning stoic distancing (β= .13, t(440)= 2.04, p<.05). Morning negative mood was positively associated with use of morning stoic distancing (β= .20, t(440)= 2.63, p<.01). Conscientiousness was positively associated with use of stoic distancing (β= .17, t(69)=1.97, p<.05). Neuroticism, Extraversion, Openness to Experience, and Agreeableness were not significantly associated with use of morning stoic distancing and were dropped from the model.

*Emotional expression.*

None of the demographic or disease variables were significantly associated with use of morning emotional expression and so were not included in the model. Morning pain severity was not significantly associated with use of morning emotional expression and so was dropped from the model. Morning negative mood was positively associated with use of morning emotional expression (β= .42, t(440)= 5.61, p<.001). Extraversion was positively associated with use of morning emotional expression (β= .20, t(68)=2.59, p<.05). Neuroticism was also positively associated with use of morning emotional expression (β= .13, t(68)=1.96, p=.05). Openness to Experience, Agreeableness and Conscientiousness were not significantly associated with use of morning stoic distancing and were dropped from the model.

*Active problem solving.*

None of the demographic or disease variables were significantly associated with use of morning active problem solving and so were not included in the model. There was a trend for morning pain severity to be positively associated with use of morning active problem solving ($\beta$= .09, $t(440)=1.69$, $p=.09$ therefore this variable was maintained as a control variable in the current model. Morning negative mood was positively associated with use of morning active problem solving ($\beta$= .22, $t(440)= 3.65$, $p<.001$). Extraversion was positively associated with use of morning active problem solving ($\beta$= .36, $t(69)=4.32$, $p<.001$). Neuroticism, Openness to Experience, Agreeableness and Conscientiousness were not significantly associated with use of morning active problem solving and were dropped from the model.

# Discussion

## *General review of findings*

The central purpose of the current study was to examine temporal variations in the process of coping with chronic pain as it unfolds within the timeframe of a single day. Hypotheses regarding general effects, person effects, and contextual effects in the temporal associations among ways of coping, negative mood and subjective pain experience were examined. The role of the big five personality traits in pain experience and between person variability in coping use or coping effectiveness was also examined. Previous studies have examined temporal associations among mood, coping and pain variables (e.g., Affleck et al., 1991; Keefe et al., 1997; Lefebvre et al., 1999) and the role of individual difference variables in these associations (e.g., Affleck et al., 1992a). However there have been calls for further research taking a process approach to data collection and statistical analysis that allows for simultaneous examination of both idiographic and nomothetic trends (Tennen et al., 2000). Overall, the study findings were consistent with the fundamental assumptions of transactional/process models of stress and coping and empirically derived biopsychosocial models of pain. There were significant temporal associations among key psychosocial variables including mood, coping and subjective pain experience within the unfolding of a single day. Furthermore, these associations were at times moderated by contextual effects and person effects, including individual differences in the big five personality traits. As hypothesized, there was a significant mood-pain nexus. However, the magnitude and direction of the temporal mood-pain associations were moderated by the level of pain concurrent with negative mood (contextual factor) and individual differences in neuroticism (person factor). These findings are discussed below.

As hypothesized, ways of coping varied in their associations with pain. Cognitive reframing (attempts to see chronic pain experiences more positively) and stoic distancing (attempts to avoid thinking about or expressing feelings about chronic pain experiences) were both found to be

adaptive. That is, higher reported use of cognitive reframing or stoic distancing was associated with lower pain reports later in the day, even after controlling for morning pain levels, negative mood, other forms of coping, general functional disability, neuroticism, and extraversion. In contrast, higher use of active problem solving (efforts to plan and execute strategies to better manage chronic pain) appeared to be a maladaptive way of coping. That is, higher use of this strategy was associated with higher pain later in day, even after controlling for morning pain levels, negative mood, other forms of coping, general functional disability, neuroticism, and extraversion. There was no main effect of emotional expression on pain. However, the effectiveness of emotional expression and cognitive reframing were significantly moderated by levels of E. There were also significant individual differences in reported use of each of the four ways of coping that were associated with several of the big five personality traits. More detailed discussion of these study findings follows below. First the temporal mood-pain nexus and person or contextual moderators of this association are reviewed. Second, the associations between ways of coping and subsequent pain (i.e., coping effectiveness) are reviewed. Third, the role of personality in the use and effectiveness of coping strategies is reviewed. Finally the implications of the current study for theory, future research and applications will be discussed.

*The mood-pain nexus: Main effects, contextual affect and person effects*

There is generally little debate that negative mood is a frequent concomitant of chronic pain (for reviews see Craig, 1999; Robinson & Riley, 1999). However, there is some controversy regarding the temporal role of emotions in the pain experience. Modern pain theory (derived from a substantial body of multi-disciplinary empirical findings) suggests psychosocial variables, including negative affect, can influence various components of the pathways involved in the perception of pain (e.g., Melzack, 1999). "Aggravational" or causal mood to pain hypotheses have been speculative until recent years due to lack of appropriate research designs and statistical tools. Researchers have found that mood and pain often covary across time (e.g., Affleck et al., 1992a). Feldman and

colleagues (1999) were the first to confirm the prospective temporal associations between negative mood and subsequent pain experience within relatively small units of time (i.e., from one day to the next). Their study demonstrated that depressed mood (but not anxious or angry mood) was associated with higher pain experience the following day. The current study replicated this finding within an even smaller time frame (i.e., within the unfolding of a single day) suggesting that the underlying mechanisms accounting for the temporal mood-pain nexus can occur within a matter of hours.

The current study also extends prior research by identifying contextual and person effects that moderate the mood to pain pathway as the day unfolds. In regards to contextual effects, the positive associations between mood and subsequent pain varied according to initial pain levels. The mood and pain interaction remained significant even after controlling for ways of coping, general functional disability, neuroticism and extraversion. The overall pattern of findings suggests that people experiencing higher levels of pain in the morning are likely to remain in higher pain throughout the day, regardless of their negative mood levels in the morning. Alternatively, when a person experiences lower pain in the morning their level of concurrent negative mood appears to have implications for how much pain they subsequently report. Under conditions of lower morning pain, individuals with higher concurrent negative mood appear more likely (than do individuals who experience lower concurrent negative mood) to report higher levels of pain throughout the day.

Furthermore, the associations between negative mood and pain were found to vary between persons according to their level of neuroticism. Participants higher on neuroticism reported a strong positive association between negative mood and subsequent pain. When negative mood was higher in the morning they tended to report higher evening pain. When negative mood was lower in the morning they tended to report lower evening pain. Likewise, for individuals with scores within a standard deviation of mean neuroticism, the associations between negative mood and subsequent pain were also positive (i.e., mood congruent) although considerably weaker than individuals higher

on N. In comparison, for those individuals lower on neuroticism, there was an unexpected negative association between negative mood and subsequent pain. When negative mood was higher in the morning lower N individuals tended to report lower evening pain. When negative mood was lower in the morning lower N individuals tended to report higher evening pain. Taken together, these findings suggest that there appears to be a subjective amplification of pain associated with negative mood for individuals who are more prone to negative affect. In contrast, there appears to be a subjective attenuation of pain associated with negative mood for individuals who are less prone to negative affect.

The pattern of findings for negative mood, neuroticism and pain is consistent with recent theory and research suggesting that mood/distress can play a causal role in pain experience via shared neurophysiological pathways, gateway mechanisms and/or associated biophysiological stress response systems (for an extensive review see Melzack, 1999). The amplified positive associations between mood and pain for increasingly higher levels of N is also consistent with prior research. Studies have shown that higher N is associated with greater reactivity to stressors (e.g. Bolger & Schilling, 1991; Bolger & Zuckerman, 1995). However, several alternative explanations of the current pattern of findings can not be ruled out and are reviewed below.

First, individuals with chronic pain experiencing a negative mood (and/or those who tend to experience higher levels of chronic distress) may be more prone to engage in maladaptive ways of coping not assessed in the current study. That is, the complex associations between levels of negative mood, neuroticism and levels of subsequent pain may have been mediated by additional cognitive or behavioural responses. For example, higher use of catastrophizing and escape avoidance have both been found to be associated with higher levels of N, state negative mood, pain, and interference due to pain (e.g., Affleck et al., 1992a; Bolger & Zuckerman, 1995; McCracken et al., 1992; O'Brien & DeLongis, 1996; Sullivan, Bishop & Pivak, 1995; Wade et al., 1992; Waddell, Newton, Henderson, Somerville, & Main, 1993). Fear of pain appraisals are also powerful predictors

of chronic pain related outcomes even after controlling for negative mood (e.g., Crombez et al., 1999; McCracken, Faber, & Janeck, 1998; Waddell et al., 1993). Taken together, this prior research suggests that higher use of additional ways of coping (e.g., catastrophizing, escape avoidance; fearful pain appraisals) may have mediated the associations between mood, N and pain found in the current study. For example, individuals with higher N may be more likely to report higher levels of subsequent pain as a result of higher levels of catastrophizing, avoidance or fearful pain appraisals. There have been calls in the literature to examine both fear of pain appraisals and ways of coping in the same model (e.g., Asmundson, Norton, & Norton, 1999). Examination of these types of variables in a process model of chronic pain may help clarify how both state and trait differences in negative mood are associated with variations in pain experience within a matter of hours.

A second alternative explanation for the current pattern of findings among negative mood, neuroticism and pain reports is the possibility of inflated or biased reporting. It has been argued that N is associated with symptom perception as individuals higher on N and/or negative affectivity are more likely to attend to or complain about health symptoms (Watson & Pennebaker, 1989). The current study extends prior research by demonstrating that individuals higher on neuroticism may be particularly vulnerable to increased symptom reports following an episode of higher negative mood. Studies have also shown that higher levels of N are associated with higher levels of subjective but not objective health complaints, suggesting that trait negative affectivity leads to inflated symptom reports (Watson and Pennebaker, 1989). Furthermore, prior research has shown that individuals in a negative mood are more likely to make mood congruent judgments (i.e., make less positive and more negative ratings when judging stimuli) than those not in a negative mood (see Morris, 1989 for a review). Taken together with the current findings, this suggests higher levels of state or trait negative affect may have led to biased (i.e., inflated) pain reports in the current study. This effect may be obscured (or less apparent) under conditions of higher pain when there is less room for pain ratings to be inflated any higher than they already are. In comparison the biasing effects of negative mood

upon pain reports may be more apparent under conditions of lower pain. Given that pain is a subjective experience it is unclear what kinds of objective measures would allow examination of the degree to which the current findings are due to bias reporting associated with state or trait negative affectivity (see below for further discussion of collateral pain measures).

It should be noted that the interpretations described above only address possible mechanisms by which higher levels of state or trait negative affect may be associated with higher subsequent pain reports. It is unclear why the unexpected negative association between negative mood and pain was found for individuals lower on N. Unfortunately, very little is known about the intrapersonal or interpersonal characteristics of these individuals. It could be argued that for individuals lower on neuroticism (i.e., individuals who are less prone to negative affect), higher negative mood is more likely to be an event of relatively high salience. In comparison, for individuals higher on neuroticism (i.e., individuals who are more prone to negative affect) a higher negative mood is less likely to be a highly salient event. If so, future directions could include examining the intrapersonal and interpersonal consequences of this variable saliency of negative mood according to levels of neuroticism. Such research may help illuminate the strikingly different mood-pain nexus for higher vs. lower N individuals in the current study.

In summary the current study provides evidence that the temporal associations among mood and pain within days vary according to 1) the level of pain during the morning hours, 2) the level of negative mood during the morning hours, and 3) the degree to which one tends to experience negative distress in general. Examination of the specific biopsychosocial processes that account for these contextual and person effects in the observed associations between mood and pain within the unfolding of a single day is a recommended direction for future research.

*Coping effectiveness: Main effects and person effects*

The findings in the current study concerning coping effectiveness are consistent with the transactional/process model of stress and coping. As hypothesized, ways of coping were

significantly associated with subsequent pain reports. Importantly, the coping effects remained significant even after controlling for the effects of mood, pain and neuroticism as reviewed above. Cognitive reframing and stoic distancing each appeared to be adaptive ways of coping, while active problem solving appeared to be a maladaptive way of coping. In comparison there was no main effect for emotional expression. Of the big five traits, only extraversion was found to moderate the effectiveness of coping. Furthermore, this effect was limited to the use of cognitive reframing and emotional expression. Interpretations of the findings in regards to coping effectiveness follow below.

*Stoic distancing.*

Individuals reporting the use of stoic distancing made active attempts to proceed with their usual activities while minimizing the degree to which they thought about or communicated their chronic pain and related distress to others. Individuals reporting higher use of stoic distancing appear more likely than individuals reporting lower stoic distancing to experience lower pain later in the day, even after controlling for morning negative mood, other concurrent ways of coping, general functional disability, neuroticism and extraversion. This pattern of findings is consistent with research demonstrating that directing attention towards pain is associated with higher pain reports (for reviews see Arntz, 1991; Asmundson et al., 1999).

There were no significant personality moderators of the effectiveness of stoic distancing. It is possible that there was insufficient power to detect such cross-level interaction effects. It is also possible that the second order rather than first order personality traits moderate the effectiveness of some forms of coping. To illustrate, the broad marker of N is presumed to subsume a hierarchy of individuals differences associated with the tendency to experience negative affect such as anxiety, hostility, depression, self-consciousness, impulsiveness, and vulnerability (McCrae & Costa, 1997). It has been demonstrated that these subfacets of N capture variance between individuals that is not necessarily captured entirely by the common trait marker of N (e.g., McCrae & Costa, 1992). Within

a hierarchical model of personality, the subfacets of N (e.g., anxiety) are also presumed to subsume even more specific individual difference variables (e.g., health anxiety). Prior research suggests that these subfacets can moderate the associations between coping and pain. To illustrate, the effectiveness of distraction among chronic pain patients has been found to vary according to individual differences in health anxiety (Hadjistavropoulos, Hadjistavropoulos, & Quine, 2000). In this study, use of distraction was associated with higher affective pain ratings among health anxious individuals in comparison to low health anxious individuals. Therefore, it would be premature to conclude that personality does not moderate the effectiveness of coping efforts such as stoic distancing. Further research that examines higher and lower order personality traits and their moderating role in coping effectiveness is needed in order to make meaningful conclusions.

*Cognitive reframing.*

Like stoic distancing, higher use of cognitive reframing was also associated with lower pain within days, even after controlling for morning negative mood, other ways of coping, general functional disability, neuroticism and extraversion. However the pattern of findings also suggests that the effectiveness of cognitive reframing was moderated by extraversion. Individuals higher on E appear to experience substantial benefits from engaging in cognitive reframing; higher use of this strategy was associated with lower pain within days for these individuals. On the other hand, individuals lower on E did not appear to benefit from the use of cognitive reframing; use of this strategy was not associated with higher or lower pain within days for these individuals. Taken together this pattern of findings suggests that the use of cognitive reframing is adaptive but only for individuals higher on E. Further interpretations of the moderating role of E and other personality effects are discussed below.

The demonstration of the effectiveness of cognitive reframing (a positively oriented cognitive way of coping) adds to the existing literature concerning the role of cognition in chronic pain adjustment. In conjunction with strong empirical support, it has been argued that adaptive

outcomes in the face of chronic pain are largely determined by the degree to which one avoids negative cognitions such as catastrophizing (e.g., Geisser, Robinson, Keefe, & Weiner, 1994; Keefe et al., 1987; Reesor & Craig, 1988). The current finding suggests that specific types of positive cognitions can also play an important role in determining relatively immediate pain outcomes for at least some individuals with RA (especially for those individuals high on E). There has been a call in the literature to examine catastrophizing in conjunction with other ways of coping in determining pain and associated outcomes (Reesor & Craig, 1988). Examining the role of both positively and negatively oriented coping cognitions in the same process model may be a fruitful direction. It could be argued that adaption when coping with chronic pain may be determined by the degree to which one can minimize specific negative cognitions such as catastrophizing *and* the degree to which one can maximize specific positive cognitions such as cognitive reframing. Such a pattern of findings would be consistent with evidence suggesting that it is the combination of both positively vs. negatively valenced cognitive/affective variables are important in determining various health outcomes. To illustrate, while both clinical anxiety and depression are characterized by high levels of negative affect, low levels of positive affect appears to be a specific marker for clinical levels of depression but not anxiety (Watson & Tellegen, 1985). In other words, assessment of both positive and negative mood is required to predict anxious vs. depressed health outcomes. It has also been suggested that positive emotions may act as a buffer against the development of subsequent depression when a person is experiencing negative emotions (i.e., the combined absence of positive emotions and presence of negative emotions leads to depressed affect) (Folkman & Tedlie Moskowitz, 2000). Likewise, cognitive reframing (and other positively valenced coping responses) may serve as a buffer in the face of negatively valenced cognitions such as catastrophizing. If so, the effectiveness of clinical interventions may increased by targeting both negative and positive appraisals/coping cognitions.

*Emotional expression.*

Unlike cognitive reframing and stoic distancing, the use of emotional expression did not appear to have a significant main effect on pain experience. However the effectiveness of this strategy was moderated by levels of extraversion, even after controlling for morning negative mood, other concurrent ways of coping, general functional disability, and neuroticism. For individuals higher on E, greater use of emotional expression was associated with higher pain later in the day. For individuals within one standard deviation of the mean on extraversion, emotional expression did not appear to be associated with pain later in the day. In contrast, for individuals lower on E, greater use of emotional expression as associated with lower pain later in the day (see below for more detailed review of this finding). Prior research also suggests that the impact of emotional expression on adjustment may be moderated by the tendency to experience and express angry or hostile emotions (rather than negative emotions in general). To illustrate, the tendency to refrain from expressing angry feelings has been associated with higher levels of pain and pain behaviour (Kerns et al., 1994). These types of findings suggest that researchers may need to examine specific subtypes of emotions and emotional expression in order to assess the temporal impact of this way of coping on pain experience.[5]

*Active problem solving.*

In contrast to the other forms of coping examined in the current study, reports of higher levels of active problem solving were associated with reports of higher pain later in the day. This finding remained significant even after controlling for morning negative mood, other concurrent ways of coping, general functional disability, neuroticism and extraversion. This is consistent with prior research that has found maladaptive effects for problem focused ways of coping in the context of an uncontrollable stressor (for a review, see Aldwin, 1994). The current finding adds to this existing literature by demonstrating the maladaptive effects of active problem solving in the face of uncontrollable stress, but in regards to subjective pain rather than mood outcomes. There are at least

two possible mechanisms by which active problem solving could be associated with higher subjective pain.

First, the measure of active problem solving utilized in the current study reflects the deliberate engagement of cognitive and/or behavioural efforts. Learning to pull back appropriately from active engagement is an important component of adaption in the face of chronic pain and training in "activity-rest cycles" is often explicitly included in empirically supported cognitive-behavioural pain treatment programs (e.g., Bradley, 1996; Keefe, Beaupré, & Gil, 1996). Clinical observations also suggest that people coping with chronic pain are vulnerable to swinging between the extremes of overexertion vs. excessive inactivity/avoidance which over time leads to increased pain, fatigue, functional disability and other pain related problems such as misuse of body parts. It is possible that the use of active problem-solving in the current study was a marker for individuals who persisted in activity and exertion when a period of therapeutic rest would have been more adaptive.

Personality did not significantly predict individual differences in the impact of active problem solving on pain. If the interpretation offered above is correct, it is possible that overexertion associated with active problem solving is maladaptive regardless of individual differences in personality. However as previously reviewed it is possible that subfacets of the higher order personality traits are associated with significant between person variability in the effectiveness of active problem solving. For example, it has been suggested that individuals lower on anxiety sensitivity (degree to which one is sensitive to symptoms of anxiety) may not avoid activity even when appropriate, resulting in increased risk for overexertion (Asmundson et al., 1999). If so, individuals lower on anxiety sensitivity may be more likely than individuals higher on anxiety sensitivity to engage in active problem solving that does not include appropriate rest/avoidance periods when coping with chronic pain.

The overall main effect for active problem solving indicated this way of coping is generally maladaptive across individuals. However it is also possible that reports of this way of coping

included more than one type of active problem solving. That is, the strong positive association between active problem solving and pain outcomes may have been obtained primarily due to the particularly detrimental effects of a particular subset of active problem solving plans and efforts. As a result, it remains a possibility that at least some forms of active problem solving are adaptive in the face of chronic pain while other forms may be maladaptive and/or ineffectual. More detailed assessment of specific types of active problem solving plans and efforts would allow researchers to explore the possibility of heterogeneous forms of active problem solving that vary between and across individuals in their associations with outcome. For example, the Chronic Pain Coping Inventory (CPCI)(Jensen, Turner, Romano & Strom, 1995) allows assessment of a variety of distinct active problem solving plans or efforts (e.g., guarding, resting, asking for assistance, relaxation, task persistence, and exercise/stretching). There are additional strategies that could also be included as part of active problem solving in the face of chronic pain (e.g., pacing, ensuring medication is taken on time, alternative approaches such as acupuncture or homeopathy). Future research could examine between and within person differences in the specific components of active problem solving and their associations with pain outcomes in order to further our understanding of the current pattern of findings.

*Person effects in coping use and effectiveness*

The current study also addressed calls to examine the psychosocial mechanisms that account for the associations between personality and health (Larsen & Kasimatis 1991). Consistent with hypotheses, my findings indicate there are significant differences between people in 1) how they cope with chronic pain and 2) the impact of their coping on subsequent pain. Personality traits predicted between person differences in the use of the ways of coping examined in the current study, the nature of the mood-pain nexus, the effectiveness of cognitive reframing, and the effectiveness of emotional expression. These findings and their implications for theory and understanding are discussed below.

*Neuroticism.*

Consistent with prior research, higher levels of N were not significantly associated with higher levels of subjective pain in the current study. As hypothesized, N appears to play a significant role in the associations among negative mood, coping and pain. As reviewed above there was an interaction between neuroticism and negative mood. As expected, those higher on neuroticism had a *positive* association between negative mood and pain. That is, higher levels of morning negative mood were associated with higher levels of evening pain while lower levels of morning negative mood were associated with lower levels of evening pain. However, those lower on neuroticism had a *negative* association between negative mood and pain. That is, higher levels of morning negative mood were associated with lower levels of evening pain while lower levels of morning negative mood were associated with higher levels of evening pain. In addition, individuals higher on neuroticism tended to report higher levels of emotional expression than did individuals lower on N.

Taken together, the pattern of findings suggests that Neuroticism plays a significant role in some of the temporal aspects of the chronic pain experience; most notably those processes related to distress and negative mood (i.e., the mood-pain nexus and use of emotional expression). Contrary to hypotheses, the use of cognitive reframing was not significantly associated with N. It appears that levels of N do not seem to contribute directly to the pain experience or the use of coping strategies that are significantly associated with subsequent pain outcomes (i.e., cognitive reframing, stoic distancing and active problem solving). Further research examining how individuals high vs. low on N (or subfacets of N) experience and respond to negative affect in the context of chronic pain appears especially warranted.

*Extraversion.*

Consistent with prior research (e.g., McCrae & Costa, 1986; Lee-Baggley et al., 2002) individuals high on E appear to be highly active copers. That is, they are more likely to use a broad range of coping strategies than are individuals lower in E. Consistent with prior research (e.g.,

David & Suls, 1999; McCrae & Costa, 1986) individuals high on E were more likely to engage in cognitive reframing as a way of coping. Higher levels of E were also associated with higher use of active problem solving and emotional expression. As reviewed above, higher levels of E were also associated with increased adaptiveness of cognitive reframing and increased maladaptiveness of emotional expression on pain later in the day. The increased use and effectiveness of cognitive reframing associated with higher levels of E provides a possible explanation for the frequently documented associations between E and the tendency to experience positive affect (for a review see Watson & Clark, 1997). That is, individuals higher on E may be more likely to experience positive mood via the mood benefits associated with higher use of cognitive reframing. The current study extends these findings by suggesting that higher E individuals may also be more likely to experience more adaptive pain outcomes via the benefits associated with higher use of cognitive reframing.

Higher E is characterized by the tendency to be sociable, gregarious, and to seek the company of others. As a result, it can be reasonably assumed that the interpersonal context within which a person copes with chronic pain will vary according to levels of E. For example, individuals high on E may be more likely to be in the presence of others which in turn may increase the probability they will be asked by others about how they are managing their pain. If so, this could account for the higher use of emotional expression among individuals higher on E. It is unclear why cognitive reframing was associated with benefits for higher E but not lower E individuals. Given the dominant interpersonal features associated with higher levels of E, perhaps such individuals are able to obtain higher levels of social support as a result of their cognitive reframing. For example, higher E individuals may be more likely to seek out the company of others with whom they disclose their cognitive reframing. Social support providers may then be more likely to respond to higher E individuals in a positive, socially rewarding manner. Future research could examine the interpersonal concomitants of cognitive reframing in higher vs. lower E individuals in order to increase our understanding of the current pattern of findings.

It also remains unclear why emotional expression is associated with increased reports of subsequent pain for individuals higher on E but decreased pain reports for individuals lower on E. Expression of distress from higher E individuals who are typically warm and positive may have deleterious interpersonal effects (e.g., retraction of social support), especially if expressed in the dominant manner consistent with this trait. In contrast, the expression of emotions from lower E individuals may be done in a less dominant manner that does not repel social support providers. It is also possible that different mechanisms account for the variable associations between emotional expression and subsequent pain for higher vs. lower E individuals. To illustrate, the expression of emotion among lower E individuals indicates they are engaging in social interactions despite their lowered tendency to socialize and seek the company of others. Higher levels of emotional expression may allow lower E individuals to increase their access to adaptive social resources that are typically less available to them (compared to those higher on E who tend to seek out the company of others and socialize at higher rates). Alternatively or additionally, the expression of pain-related distress may disrupt adaptive pain-related processes that are typically associated with higher levels of E. For example, the expression of pain related distress may lower positive mood or interfere with positive reappraisals, both of which have been associated with both higher levels of E (e.g., David & Suls, 1999; McCrae & Costa, 1986; Watson & Clark, 1997) and lower pain outcomes (e.g., Zautra et al., 1995a). Taken together, these findings suggest that the associations between E, cognitive reframing and pain in the current study may have been mediated or moderated by positive mood.

Higher levels of E were also associated with higher levels of active problem solving. Given the impact of chronic pain upon social relationships and the social aspects of this trait, higher E individuals may be more motivated to use active problem solving in an attempt to prevent a loss of social resources and interactions. As a result, higher E individuals may be more likely to persist with active problem solving in the face of uncontrollable stressors such as chronic pain. Unfortunately,

given that higher use of active problem solving was associated with higher pain, this finding suggests that higher E individuals may be at increased risk of maladaptive pain outcomes due to their increased use of this way of coping.

In summary the current study suggests that the trait of extraversion is a mixed blessing in the context of chronic pain. Individuals higher on extraversion appear more likely to use both adaptive (cognitive reframing) and maladaptive ways of coping (active problem solving) than individuals lower on extraversion. In addition, a generally ineffective way of coping (emotional expression) appears to have deleterious effects on pain perception but only for individuals higher on E. Taken together these findings suggest that the active coping associated with higher extraversion is both a liability and an asset when coping with chronic pain. It is possible that due to their dominant and social nature, individuals higher on E have more trouble than individuals lower on E engaging in necessary adjustments such as appropriately pacing their activities and/or accepting those things they can not control. As a result they may cope by using as many strategies as possible and at times expend effort fruitlessly or even harmfully. Extension of the current findings to clinical settings suggests that individuals higher on E may be especially likely to benefit from training in maximizing the use of adaptive strategies while minimizing the use of maladaptive strategies.

*Openness to experience.*

In the current study higher levels of O were associated with lower levels of cognitive reframing across days after controlling for extraversion and negative mood. The finding appears counterintuitive given that individuals with higher levels of O have been described as imaginative, analytical, intellectual and perceptive (McCrae, 1994). The finding is also inconsistent with prior research showing significant positive associations between higher levels of O and positive appraisal coping (e.g., O'Brien & DeLongis, 1996; McCrae & Costa, 1986). It is possible that the current finding is spurious. However, none of the previous studies utilized statistical analyses of repeated measures data that allowed determination of the association of O with use of daily coping over time.

Furthermore, none of the previous studies examined the associations between O and coping among individuals coping with chronic pain. The use of cognitive reframing has been found to vary significantly across different types of stressors (e.g., O'Brien & DeLongis, 1996). Levels of O have also been found to interact significantly with type of stressor in predicting coping use. For example, in their study, O'Brien and DeLongis (1996) found that individuals higher on O tended to use higher levels of empathic coping when coping with interpersonal stressors involving close others. However these same individuals used lower levels of empathic coping with work/school related stressors. Given these O by situation interactions, it is possible that in the context of chronic pain stressors, higher O individuals are less likely to cope by cognitive reframing.

Why the context of chronic pain would be less likely to evoke cognitive reframing for higher O individuals remains unclear, but current theory suggests at least two possible explanations. First, it has been argued that higher O is associated with greater tolerance of emotions (McCrae, 1994). The motivation to relieve negative affect presumably acts as a catalyst for emotion-focused modes of coping such as cognitive reframing. If O is associated with tolerance of negative affect, individuals higher on O may be less likely to experience the motivation to engage in emotion-focused coping via cognitive reframing. Furthermore, perhaps this pattern of responding is only manifest in specific contexts such as chronic pain due to illness (i.e., prolonged, uncontrollable health problems). This would be consistent with modern personality theory that argues the manifestation of personality traits varies across contexts (e.g., Shoda et al., 1994). If so, this would also help explain why higher O has been associated with higher use of cognitive reframing when coping with stressors that do not involve chronic health problems (e.g., daily hassles; O'Brien & DeLongis, 1996) but lower use of cognitive reframing in the current study of coping with chronic health problems involving pain.

Individuals higher on O have also been described as creative, analytical, intellectual, aesthetically sensitive, higher on the need for variety and more comfortable with complexities (Costa & McCrae, 1992). As a result, individuals higher on O may be more sensitive to both the negative

and positive aspects of their chronic pain condition. Repetitive cognitive reframing may represent unconvincing positive illusions for individuals higher on O who are coping with the complexities of chronic pain. For example, higher O individuals may be too aware of the negative features of chronic pain (e.g., distress, discomfort, functional limitations) to obtain psychological benefits from exclusively positive appraisals (e.g., "I'm more fortunate than others", "I have changed as a person in a good way"). In comparison, individuals lower on O have been described as uncomfortable with complexities and tend to make appraisals in more conventional terms (Costa & McCrae, 1992). As a result, individuals lower on O may be more able to make positive appraisals in the face of chronic pain. If indeed the current finding is replicated within the context of chronic pain, it suggests that higher O individuals may be vulnerable to higher subjective pain as a result of their lowered use of this strategy.

*Conscientiousness.*

Higher levels of conscientiousness were associated with higher levels of stoic distancing, but not directly with pain. Given that high C individuals are characterized as hard-working and reliable it is likely that stoic distancing was utilized at higher rates by high C individuals in an attempt to facilitate task directed efforts and minimize the interference of pain. Given that the use of stoic distancing was associated with lower subsequent pain it appears that individuals high on C are able to cope adaptively by utilizing this strategy.

*Agreeableness.*

Consistent with prior research, Agreeableness was the only trait that failed to show any significant associations with the stress and coping variables examined in the current study, although none were hypothesized. Agreeableness has been associated with prosocial tendencies that promote intimacy and social cohesion (for a review see Graziano & Eisenberg, 1997). Agreeableness has also been associated with lower levels of interpersonal confrontation and higher levels of seeking social support (e.g., O'Brien & DeLongis, 1996; Hooker et al., 1994). Taken together these findings and

theory suggest agreeableness may be associated with interpersonal aspects of coping not assessed in the current study. For example, in the context of chronic pain, agreeableness may be associated with relationship-focused coping (attempts to cope in a way that maintains the integrity of relationships), confrontive coping or seeking social support (O'Brien & DeLongis, 1996). If so, stress and coping researchers may fail to find significant associations with A unless they examine a broader range of the interpersonal aspects of coping with chronic pain.

*Study limitations*

A number of cautions in regards to the current study and its findings are warranted. The current sample is best characterized as mild to moderate in disease severity and functioning. Approximately 75% of the sample reported pain at least half of the time or more, and approximately 62% of sample reporting morning stiffness more often than not. However descriptive statistics indicated that in general the current sample was only mild to moderately impaired in regards to general functional disability. As a result, caution may be warranted in generalizing the findings to the special subset of individuals with more severe levels of disease than that captured in the current study. To illustrate, cognitive reframing may be a relatively ineffective way of coping for both higher and lower E individuals who have more severe levels of disease. That is, there may be a ceiling effect when coping with chronic pain such that many forms of coping may be rendered ineffective, regardless of dispositional differences. During extremely high pain episodes, biophysiological processes may override or outweigh the impact of psychosocial variables on neurobiological gateway mechanisms that play a role in the experience of pain. It is also important to note that the current sample included only individuals with chronic pain due to Rheumatoid Arthritis. Given that the effects of coping have been found to vary by disease status (e.g., Affleck et al., 1999) it is possible that some of the current findings may not generalize to individuals with chronic pain that results from other types of conditions or diseases.

The current sample was predominantly women, which may limit the generalizability of the current findings to men coping with chronic pain, especially given evidence of gender difference in pain research (for a review see Berkley & Holdcroft, 1999). Previous research has shown that women are more likely to report higher pain, more frequent pain, and pain of longer duration than men (Berkley & Holdcroft, 1999). To illustrate, Affleck et al (1999) found that women's gender significantly accounted for between person differences in daily pain. In this study, women's pain reports were on average 72% higher than men's pain reports. In contrast, gender was not significantly associated with between person variance in pain reports in the current study. However, given the relatively low proportion of men in the current study compared to the number of women, it is unclear whether there was sufficient power to identify significant gender effects in subjective pain reports.

In summary, despite these cautions and potential limitations, both men and women with mild, moderate and severe levels of disease were represented in the current sample. In addition, similar patterns of findings have been found in a variety of coping studies using a variety of chronic pain samples. Therefore the current findings can most likely be generalized to many adults coping with chronic pain in their daily lives and particularly those coping with Rheumatoid Arthritis.

The exclusive reliance upon self-reports of pain, disease status, negative mood and coping efforts may also be problematic given that retrospective ratings can be biased by factors such as negative mood at the time of recall (Bower, 1981). This bias may be particularly problematic when examining the associations between stressors, coping efforts and mood at the same time point (Capreol, 1999). However, longer periods of retrospection are associated with higher levels of bias and memory distortion (Hedges, Jandorf, & Stone, 1985; Lewis & Williams, 1989). The current study utilized two relatively short periods of time recall within days (i.e., morning or afternoon/evening) rather than weeks or months (as typically done in standard survey studies). By

doing so, the current study minimized the bias inherent to retrospective self-reports for the daily coping, mood and pain variables (see DeLongis et al., 1992 for a discussion).

It should also be noted that the exclusive reliance upon self-reports of pain and disease status may be problematic even in the absence of retrospective recall bias. For example, there can be discordance between subjective vs. objective health reports, and this discordance can vary between individuals according to personality traits such as neuroticism (Watson and Pennebaker, 1989). In the current study higher levels of neuroticism was not associated with higher pain reports. However due to lack of collateral measures, it is unclear whether the individuals who described themselves as having more "severe" pain are the same individuals that health professionals or family members would identify as having severe pain. Although pain is a subjective experience that only the affected individual can access directly, an exciting direction for future research would be the inclusion of additional measures of pain and related variables. For example, significant others could provide daily reports upon pain behaviours (e.g., avoidance, misuse/disuse of body parts) and other indices of pain (e.g., facial expressions, verbalizations of pain related distress). Health professionals could also provide assessments of these same variables in addition to clinical assessments of pain and related symptoms (e.g., clinical ratings, biochemical assays). Many of these measures are suitable for repeated assessment and may have important temporal associations with stress, coping and pain outcomes.

Despite some of the limitations, there are also advantages to relying upon self-reports when examining the associations among coping, pain, negative mood. The person's subjective experience of coping, mood and pain is what determines the phenomenological reality for each person (Capreol, 1999). Self-reports capture the subjective, internal processes such as appraisals, cognitive coping efforts, and emotions which are presumed to play a key role in determining adjustment when coping with stressors. Self-reports are also the predominant mode of information used in most clinical settings.

It remains a possibility that the use of repeated measures resulted in reactivity or sensitization effects due to the regular self-monitoring inherent to diary methodology (see DeLongis et al., 1992; Affleck et al., 1999 for discussions). For example, participants in the current study may have been more aware of their pain or negative mood as a consequence of self-monitoring, which in turn may have altered these experiences and related processes. However it has been suggested that reactivity effects are minimized by using daily reports (Vuchinich, Tucker, & Harllee, 1988), especially if more than one behaviour is recorded and when participants are unable to review their previous reports (Hayes & Cavior, 1980). By asking participants in the current study to report on a variety of processes (mood, coping, pain) and requiring them to seal each completed diary entry, reactivity effects were minimized.

It is also possible for days of the week to confound the findings of diary studies. For example, some studies have shown that positive mood is more likely on the weekend (e.g., Egloff, Tausch, Kohlmann & Krohne, 1995). In contrast, studies have shown negative mood is higher during weekdays (e.g., Kennedy-Moore, Greenberg, Newman, & Stone, 1992) with people most likely to report the highest levels of negative mood on Mondays (the "blue Monday" effect; e.g., Stone, Neale, & Shiffman, 1993). Higher levels of work stress are more frequent at the beginning of the work week, while home stress is more likely to occur during the weekends (Almeida & McDonald, 1998). It is also possible that people cope differently during the week (when they are more likely to be at work or school), in comparison to the weekend (when they are more likely to be at home or engaging in social or leisure activities). To control for confounding day effects, the start day for the diary portion of the study was staggered across participants. Therefore it is unlikely that day effects could account for the pattern of findings in the current study.

It is also possible that participants did complete the structured diaries at the specified times (i.e., around lunchtime and before going to bed). It has been suggested that participants may even provide incorrect information to investigators regarding the date and time diaries were completed

(Observer, 2001). Retrospective bias can occur even if diaries are completed within 48 hours of when they were supposed to be completed (Stone et al., 1998). Although available evidence to date suggest that the discordance between retrospective reports and real-time daily assessments is modest, the magnitude of this discord can vary between individuals (Carney, Tennen, Affleck, del Boca, & Kranzler, 1998). Therefore, the degree of retrospective recall bias may have been higher than intended in the current study. The importance of filling out each diary section at the scheduled time was reviewed extensively with each participant. However the validity of the reported date and times of diary completion can not be verified in the absence of computerized diary data collection (e.g., ecological momentary assessment via palm pilots that automatically records date and time of diary completion; see Shiffman & Stone, 1998 for a detailed review). Therefore an important future direction will be to replicate the current findings using computerized data collection in order to better address this issue.

In regards to statistical limitations, the number of variables examined in the current study may have resulted in Type I errors (i.e., rejecting the null hypothesis when it was in fact true). However, the majority of significant findings were highly significant (i.e., would remain significant even if a more stringent level of significance was used) and several steps were taken to reduce the number of tests conducted (e.g., the use of multivariate contrasts to reduce the number of tests required to identify personality by mood or personality by coping interactions). Type II errors (failing to reject the null hypothesis when it was in fact false) were more likely a potential problem in the current study. Interactions effects are particularly vulnerable to power problems (see Cohen & Wills, 1985 for a discussion) and the power to detect same level interactions (e.g., mood by pain) is higher than the ability to detect cross-level interactions (e.g., personality by coping) in multi-level modelling (Snijder & Bosker, 1999). As a result, added caution is warranted when drawing conclusions regarding the null effects for personality found in the current study.

Interpretations of the current findings in regards to causality should also be done with caution. In the absence of an experimental design one can never draw firm conclusions regarding the causal impact of one variable on another. However, by examining the coping process from morning to evening, the current study does allow one to address process or causal issues more directly. In addition, potential confounds such as negative mood, pain at time of coping efforts, personality and disease status were included in the models, allowing many alternative hypotheses for findings to be ruled out. However it remains a possibility that some other factors (e.g., positive mood, social support) could explain some of the findings in the current study.

*Future Directions*

As previously reviewed, future research should include not only negative mood but also positive mood when examining within and between person differences in the temporal associations among mood, coping and pain. Future research could identify the mechanisms through which mood, coping and pain are associated within and across days. Possible mechanisms could include perceptual mechanisms (e.g., attention to pain), interpersonal mechanisms (e.g., social network responses to coping and mood) and biophysiological mechanisms (e.g., changes in neurotransmitters, hormones, immune functioning, etc). To illustrate, there is empirical evidence that disease activity status, interpersonal conflicts, depression and coping inefficacy are all significantly associated with immunostimulatory hormones associated with RA disease activity (e.g., Zautra, Burleson, Matt, Roth & Burrows, 1994). There is also evidence that the associations of cognitive coping efforts and appraisals are mediated via both opoid and non-opoid mechanisms (Bandura, O'Leary, Taylor, Gauthier & Gossard, 1987). These findings suggest that a promising avenue for future research would be to include repeated biophysiological markers of pain and disease activity in daily prospective studies of coping and adjustment in chronic pain. This would allow researchers to determine the biophysiological correlates of the coping process that may account for the observed findings among psychosocial variables.

Finally, coping effectiveness may vary according to specific subcomponents of subjective pain experience such as the empirically derived sensory vs. affective components of subjective pain. Geisser and colleagues (1994) found that the use of catastrophizing mediated the associations between depression and the affective or evaluative aspects of pain, but not the sensory aspects of pain. There have been calls for additional research examining the distinct components of pain experience and associated psychobiological processes (see Craig, 1999 for a review). Further research examining the associations between specific forms of coping and the multi-dimensions of subjective pain experience is needed. The use of a general pain severity rating in the current study confounded sensory, evaluative and affective components of pain. It remains a possibility that the associations between ways of coping and within day pain outcomes for the subcomponents of pain vary form those associated with overall ratings of pain. For example stoic distancing may be effective in lowering the affective components of pain by reducing the degree to which one focused on the pain, the same way of coping may fail to reduce the sensory components of pain. Research including multi-dimensional ratings of pain would also allow determination of which forms of coping are the most adaptive (or maladaptive) as reflected by their significant associations with multiple components of pain. Such findings would also have clinical implications as priority could be given in treatment programs to the ways of coping that are associated with multiple dimensions of pain or the dimensions that are most important to the patients themselves.

As previously noted it is likely that personality interacts with coping strategies not assessed in the current study (e.g., catastrophizing, relationship-focused coping, avoidance, etc.). It is also possible that personality traits moderate the effectiveness of coping efforts in regards to alternative health outcomes (e.g., negative mood, positive mood, functional ability, energy or fatigue). It is also unclear whether the associations between coping and pain outcomes are influenced by cognitive-behavioural treatment programs that target ways of coping (Affleck et al., 1999). For example, if indeed higher O individuals use lower rates of cognitive reframing, would these individuals benefit

from training in how to increase their use of this seemingly adaptive strategy. Future research is needed to examine these possibilities.

*Conclusions*

The current study extends our understanding of both general trends and individual differences in the process of coping with chronic pain and the mood-pain nexus. The patterns of results suggests that individuals vary significantly in how they experience pain related distress and the associations of this distress to their pain experience. Individuals also differ in how they cope with chronic pain in their daily lives and the impact of their coping efforts. Importantly there is evidence that several big five personality traits are useful markers for individuals who are most at risk for these adaptive vs. maladaptive temporal processes within the unfolding of a single day.

There are several clinical applications that follow from the current findings. First, inclusion of mood and stress management techniques in evidence based cognitive-behavioural pain management programs appears warranted given the relatively immediate temporal associations between negative mood and subsequent pain experience. Second, the significant temporal associations between some of the big five personality traits and mood, coping and pain processes suggests the assessment of these traits may be useful markers within clinical settings. The findings also suggest that health professionals working with chronic pain patients may need to assess the existing coping responses being utilized in daily life and then target interventions accordingly. This task will be further tempered by the need to take into account substantial individual differences in both use and effectiveness of coping processes. Overall, the presence of both nomothetic and idiographic patterns among mood, coping and pain highlights the challenging task faced in developing an effective pain management program for any one individual coping with chronic pain.

In regards to coping theory, the current findings provide information relevant to several key issues within the field. It has been argued that previous associations between coping and outcomes can be the result of third variable confounds due to dispositional variables and therefore researchers

need to control for the effects of individual differences such as trait negative affectivity/neuroticism (Watson & Pennebaker, 1989). In the current study several ways of coping (active problem solving, stoic distancing and cognitive reframing) were related to pain outcomes even after controlling for mood and dispositional variables including N and E. Therefore the current study suggests rich information is gained regarding health outcomes by knowledge of both dispositional tendencies (e.g., personality) and situationally specific variables such as mood, coping and pain. Without both forms of information, important associations in the coping process would have remained undetected. For example, without assessment of extraversion in the current study one would have falsely concluded that emotional expression had no associations with subsequent pain experience.

The current findings also add further information to the debate regarding the causal or aggravational role of negative mood. In conjunction with prior mood and pain research, the current study suggests there is likely a bi-directional relationship in the mood-pain nexus once a chronic pain condition has already developed. However this temporal mood-pain nexus is complex with its magnitude and direction within days subject to both contextual and person effects.

Interestingly, the significant associations between mood or coping efforts with pain experience later in the day seems to support the approach of "coping one day at a time". Such an approach is common in the western world view of coping and is often encouraged in cognitive-behavioural pain management programs. The current study suggests that the fundamental assumption underlying this approach (i.e., that ones' mood and coping efforts will have an impact upon pain experience within the unfolding of a single day) is warranted.

In closing, the current study provides evidence that the process of coping with chronic pain is a complex endeavor, and one that changes day by day according to a variety of person and contextual factors. There are significant within day associations between mood, coping efforts and pain outcomes. Furthermore, these within day associations vary across people according to individual differences in personality. The findings provide support for transactional models of

coping and biopsychosocial models of pain that incorporate state and trait affective, cognitive, behavioural and interpersonal variables in predicting health outcomes. The current study also provides clues for likely fruitful directions in regards to extending our understanding of both general trends and individual differences the temporal associations among mood, coping, and pain. Further use of process methodology with a range of theory driven biopsychosocial variables will continue to advance our understanding of day to day adjustment in the face of chronic pain. The current study demonstrates the utility of such an approach for stress, coping and pain researchers. Pain outcomes in the context of chronic pain appears to be a dynamic ever changing state that is determined by who we are, what we do to cope and under what circumstances we find ourselves coping with chronic pain.

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## Appendix 1

*Hierarchical Linear Modeling: Specifications and Equations.*

HLM include several analysis options that maximize the meaningfulness of the slopes and intercepts. For the present analyses, pain (0-100) will be centered on the overall sample mean. Rheumatoid Arthritic pain is known to cycle and fluctuate unpredictably (Rodnan & Schumacher, 1983). As a result, certain participants may have been in the study during a less acute phase of their disease, whereas others may have participated during a particularly acute phase. Under these circumstances, some individuals may report data that would result in biased estimates of an individual's true average level of pain. Furthermore, the ratings of pain severity are based exclusively upon subjective judgments regarding what constitutes low versus severe levels of pain. Presumably what constitutes low versus high levels of pain will vary between participants due to individual differences in perceptions (i.e., there may be biases in subjective perceptions of what constitutes low versus high levels of pain). Therefore for a variety of reasons, the sample mean across all time points is assumed to provide a more reliable and valid estimate of average levels of RA pain experienced by the general RA population. One can reasonably assume that the individuals experiencing a relatively dormant phase of their disease (or those underreporting their symptoms) will be counterbalanced by those individuals experiencing a relatively active phase of their illness (or those over-reporting their symptoms) when the sample mean is calculated. By "grand sample mean centering" pain severity interpretation of intercepts and slopes remains relative to overall normative trends. In addition to making the slopes and intercepts more meaningful, centering the data in this way will facilitate comparisons with previously reported normative trends. All predictor variables (i.e., morning mood, morning coping, disease status variables and personality factors) were also centered around the grand sample mean for each variable. In this way "higher" vs "lower" levels of these predictors are relative to overall trends across all individuals in the current sample.

Level 1 of the multi-level models examine the within day relationships among independent variables (i.e., morning coping and morning negative mood) and the dependent variable (i.e., evening pain). HLM estimates a regression line for each participant based upon their own repeated measures data (i.e., an intercept and slope(s) are calculated for each individual). HLM then calculates a grand mean or average intercept for the dependent variable and a grand mean or average slope for each independent variable. Note that due to standardization the grand mean intercept will always have an expected value of zero. In addition the interpretation of each slope assumes an average value of all other independent variables included in the model (i.e., the degree of pain associated with the independent variable under average levels of other included predictors).

All variables were standardized in accordance with recommendations (Aikens & West, 1991; Snijders & Bosker, 1999). First, for ease of interpretation, it is preferable to have the intercepts and slopes in standard units. By standardizing pain severity, the tested models utilized the most reliable estimate of "average" pain severity. The grand sample mean is the point of comparison for "higher" (i.e., above average) versus "lower" (i.e., below average) levels of pain severity. As previously reviewed, use of a meaningful marker of "average pain" is particularly important with RA populations given evidence that RA pain tends to fluctuate and cycle unpredictably (Rodnan & Schumacher, 1983). Second, standardization of all variables is particularly important when examining interaction terms between two independent variables as it is assumed that the coefficients of the main effect X are to be interpreted as the effect of X when $Z = 0$, while the coefficients of the main effect Z are to be interpreted as the effect of Z when $X = 0$ (Snijders & Bosker, 1999). In addition the recommended approach for interpreting interactions typically involved examining the effects of each variable at the mean minus one standard deviation (low), and the mean plus one standard deviation (high) (Aiken & West, 1991).

Several additional procedures were followed (Bryk & Raudenbush, 1992; Snijders & Bosker, 1999; Kreft & De Leeuw, 1998). First, the effects for each of the independent variables were fixed in the tested models (i.e., the between-person residual for slopes was set to zero). Leaving slopes for the independent variables free to vary can result in unreliable estimates, particularly when using relatively small sample sizes with relatively low numbers of observations (Kreft & Jan De Leeuw, 1998; Snijder & Bosker, 1999). Models with random slopes also result in substantially less power, especially when examining cross-level interactions (Snijder & Bosker, 1999) and make estimation and interpretation of the between person variance much more complex in comparison to fixed slope models (Kreft & De Leeuw, 1998). Second, insignificant predictors were dropped from the model in accordance with modeling recommendations (Kreft & De Leeuw, 1998). Third, the number of predictor variables was limited in order to balance precision of the models with bias. Too many predictors can result in models that have low bias but also such low precision that the predictive utility of the model is rendered useless. For this reason it is recommended that a limited number of variables are chosen on the basis of theory in combination with data exploration prior to attempting to fit a multi-level model (Kreft & De Leeuw, 1998; Snijders & Bosker, 1999).

*Null Model Specification*

The following null model was analyzed in order to determine the degree of variability in evening pain severity.

$$Y_{ij}(\text{PM PAIN}) = \beta_{0j} + \varepsilon_{ij}$$

$$\beta_{0j} = \phi_{00} + \upsilon_{0j}$$

With substitution, the overall null model for evening pain can be represented by the following equation:

$$Y_{ij}(\text{PM PAIN}) = \phi_{00} + \upsilon_{0j} + \varepsilon_{ij}$$

This equation was used to predict evening pain for each individual at each of the seven evening timepoints. The average intercept estimate ($\phi_{00}$) represents the grand sample mean of evening pain severity across all R's and timepoints. As previously stated, this value will always be zero due to standardization. Two sources of variance are then added to obtain time-specific pain severity estimates for each individual at each specific timepoint. First, the between-person residual parameter, $\upsilon_{0j}$ (i.e., the difference between the grand sample mean and the individual's own mean across all timepoints) is added. This value contributes to the between-person variance. Second, the within-person residual parameter, $\varepsilon_{ij}$ (i.e., the difference between the individual's own mean pain severity across all timepoints and their pain severity score for any one particular timepoint) is added for each timepoint for each participant. This value contributes to the within-person variance. As reviewed in the results section, the null model indicates whether there is sufficient within and between person variability in the dependent variable (i.e., whether modeling of predictor variables is appropriate).

*Multi-Level Model: Mood-Pain Nexus*

The following model was used in order to examine the mood-pain nexus:

$$Y_{ij}(\text{PM PAIN}) = \beta_{0j} + \beta_{1j}(\text{AM PAIN}) + \beta_{2j}(\text{AM MOOD}) + \varepsilon_{ij}$$

$$\beta_{0j} = \phi_{00} + \upsilon_{0j}$$

$$\beta_{1j} = \phi_{10}$$

$$\beta_{2j} = \phi_{10}$$

The morning pain slope ($\beta_{1j}$) reflects the level of evening pain severity associated with each one-unit increase in morning pain severity ($\phi_{10}$). With morning pain entered as a control variable the slope for negative mood reflects the additional fluctuations in pain from morning to night associated with each one unit of change in negative mood

*Multi-Level Model: Mood, Coping, Personality and Pain*

The following multi-level model was tested via HLM in order to examine the effects of mood, coping and individual difference variables:

$Y_{ij}$(PM PAIN) = $\beta_{0j}$ + $\beta_{1j}$(AM Pain) + $\beta_{2j}$(AM Negative Mood) + $\beta_{3j}$(AM Negative Mood by AM Pain) + $\beta_{4j}$(AM Cognitive Reframing)+ $\beta_{5j}$(AM Stoic Distancing) + $\beta_{6j}$(AM Emotional Expression) + $\beta_{7j}$(AM Active Problem Solving) + $\varepsilon_{ij}$

$\beta_{0j} = \phi_{00} + \phi_{01}$ (Functional Disability Status) $+\upsilon_{0j}$
$\beta_{1j} = \phi_{10}$
$\beta_{2j} = \phi_{20} + \phi_{21}$ (Neuroticism)
$\beta_{3j} = \phi_{30}$
$\beta_{4j} = \phi_{40} + \phi_{41}$ (Extraversion)
$\beta_{5j} = \phi_{50} + \phi_{51}$ (Extraversion)
$\beta_{6j} = \phi_{50}$
$\beta_{7j} = \phi_{50}$

Because all level 1 and level 2 variables are standardized the interpretation of any particular effect size assumes an average standing on all other variables in the model. Note that the effects for all of the level 1 were fixed (i.e., there was no between-person residual added to the average effect of each independent variable by fixing these residuals to zero).

*Multi-Level Models: Coping Use*

Similar models examining predictors of the predictors (i.e., morning coping) were also tested. The following is an example of the multi-level model fitted for cognitive reframing::

$Y_{ij}$(AM COGNITIVE REFRAMING) = $\beta_{0j}$ +$\beta_{1j}$(AM MOOD) + $\beta_{2j}$(FUNCTIONAL DISABILITY)+ $\beta_{3j}$(EXTRAVERSION) + $\beta_{4j}$(OPENNESS)$\varepsilon_{ij}$

## Footnotes

1. Given evidence that neuroticism is closely associated with trait negative affectivity (Watson & Clark, 1984), studies examining either of these two variables are included in the review of neuroticism and its associations with stress, coping and pain variables.

2. In the context of multi-level modeling, "reliability estimates" do not reflect reliability estimates in the traditional sense (e.g., calculation of scale reliability via alpha coefficients). Instead, reliability estimates in the context of multi-level modeling reflect the proportion of reliable variance in the dependent variable. This index helps the researcher determine whether the remaining residual variance is reliable enough to warrant further modeling of additional predictor variables. As the reliability estimate value approaches a value of 0, remaining variance is increasingly less stable and further modeling of additional variables would become increasingly invalid and unreliable (see Bryk & Raudenbush, 1992 for detailed review of these issues).

3. Although not the focus of the current study, a follow-up analysis was conducted in order to examine whether the temporal associations between pain and negative mood were bi-directional. HLM analyses revealed that morning pain was significantly associated with evening negative mood within days ($\beta = .06$, $t(441) = 2.20$, $p < .05$), even after controlling for the highly significant effect of morning negative mood ($\beta = .76$, $t(441) = 17.26$, $p < .001$).

4. Multi-level modeling is best suited for theory driven models in which key predictors are selected from a larger set of potential variables. Too many predictors in a model can reduce the precision with which parameters are estimated and it is also recommended that insignificant predictors are removed from models. For these reasons, non-significant variables were dropped from the model as their inclusion would have falsely inflated the sampling variance and standard errors of the estimates (both of which influence precision of the estimates; see Kreft & de Leeuw, 1997 for a detailed review of these issues).

5. Although not the focus of the current study, follow-up analyses were conducted in order to determine whether effectiveness of coping was moderated by negative mood, or pain at the time of coping efforts. All morning coping by morning mood interactions (including emotional expression by negative mood) were non-significant in their associations with evening pain after controlling for the main effects of morning pain, mood and all forms coping. All morning coping by morning pain interactions were also non-significant after controlling for the main effects of morning pain, mood, and all forms of coping.