Pain Appraisals, Coping, And Adjustment In Daily-Life With Chronic Pain:

An ecological momentary assessment study

A thesis submitted for the degree of Doctor of Philosophy at The University of Queensland in March 2005

Benjamin J. Chadwick

B.A. (Hons)

School of Psychology

Statement of Originality

I certify that this thesis is my own original work. I certify that it does not incorporate without acknowledgement any material previously submitted for a degree or diploma at any university, and that to the best of my knowledge and belief it does not contain any material previously published or written by any other person except where due reference is made in the text.

Candidate: _____

Principal Advisor: _____

Acknowledgements

Firstly I would like to thank my supervisor, Justin Kenardy, for his proof-reading, advice, support, and guidance. It was Justin who introduced me to the methodology that became the focus of my PhD and which will continue to feature in my future research interests. It became apparent to me that throughout the years he has kept his ears and eyes attentive for opportunities that might benefit me and, importantly, journal articles that I had *somehow* missed. Thanks Justin. Your time, effort, and patience are greatly appreciated.

I would very much like to thank my wonderful Sally, for her support and encouragement with my PhD, but also just for her presence in my life. Strangely, work on my PhD has grown exponentially since meeting her almost two years ago, although one might have expected the opposite effect. Thank you, Sally, for your love, practical and emotional support, and your patience and understanding. Thanks for making me a happier person.

Thank you to my family – Mum and Dad, Matthew, Nathan, Kirsty, and April. Thanks for your encouragement and practical (and financial) support. Although I haven't spent as much time as I would have liked, there has been nothing like a day at the farm or an afternoon at Anstead to provide an escape from the seeming never-ending presence of the PhD. Thanks also to mum for her assistance, proof-reading, and her suggestions and insights.

Thank you to Professor Cramond and her team at the Royal Brisbane Hospital Multidisciplinary Pain Centre – especially Adele Summers and Sue Pearce. Of course, these guys helped me enormously with recruitment of participants, but it was also through work-experience at the centre after graduating Honours that I first developed an

interest in working with chronic pain populations. Professor Cramond provided valuable input in the crucial early stages of the project, and was gracious in allowing me to continue to attend team meetings and to use those meetings to share some of my findings. Thank you to all of you.

Special thanks to Paul Jackson for his invaluable IT support and his crucial work in developing the program that was so central to the entire project. Also, a special thanks to Len Dalgleish and Gillian Yeo who, at different times, helped me navigate the tricky maze of statistical analysis.

To my friends, who I have neglected over recent months, I apologize and extend my thanks for your support, encouragement, and for prompting me into dysfunctional passive coping habits. A special thank-you goes to those who helped enter data – a vital but tedious job that through history has served as a valid test of true friendship. For this I especially thank Craig, Tan, Michelle, and Travis.

Talking about friends, I would like to express my gratitude to Carmel Hill and the other members of the team of The Park Road Group, including Melinda, Challee, Jayne, Jessica, Frances and Lorraine, and those who are no longer as involved with the group, including Giac, Sarah, Brooke and Peter Cotton. I would especially like to thank Melinda Wilson for her ongoing friendship and comradery.

There are a number of additional people I would like to thank who have provided support for an input into the project at various stages. To Michelle Stirling, Lisa Nissen, Michael Nicholas, Jenny Strong, Tian Oei, Philippe Delespaul, Charles “Chip” Benight, Diana Colpoys, Jim Steele (my uncle), and Pauline Ryan and Anthony Connelly: please accept my sincere gratitude.

A huge thank-you (saving the best ‘till last) to all my participants. You know who you are. Thank-you for being so giving with your time, energy, and faculties of insight, and thank-you for trusting me with your private thoughts and feelings. Although I have undoubtedly gained in more selfish ways from these gifts of yours, I sincerely hope that something has come back to you, or to the world in general, that would justify the work we have done together. If nothing else, I know I have learnt something from you over these past years. It is something along these lines: While it is true that everybody is different, it is also true that everybody is just the same. We all suffer adversity, but its face is different for each of us. We all undergo tribulations, but we all make the best decisions we can in light of the resources, life experiences, and natural traits we have at our disposal. From the viewpoint of realizations such as these it becomes very difficult to be judgmental of any person’s actions or life circumstances. At a time in history when humans’ judgments about other humans seem to be bringing further unnecessary adversity to whole populations, these insights are a true gift. Thank you all very much.

Presentations by the Candidate Relevant to the Thesis

Chadwick, B.J., & Kenardy, J. (2005, August). "*Momentary Pain Appraisals and Coping Demonstrate Independent Effects on Distress, Function, and Activity-Level in Subsequent Hours in a Heterogenous Chronic Pain Sample*", Poster presentation at the 11th World Congress on Pain, International Association for the Study of Pain, Sydney, Australia.

Chadwick, B.J., & Kenardy, J. (2004, October). "*The Intra-Individual Dynamics of Coping With Chronic Pain: A computerized Ecological Momentary Assessment of daily life with chronic pain*", Paper session for the Annual Conference of the APS College of Clinical Psychologists, National Conference, Sydney, NSW.

Chadwick, B.J., & Kenardy, J. (2004). "*Psychological Factors Associated with the Experience of Pain: Partial findings of a computerized diary study*", Presentation to the Multidisciplinary Pain Centre, Royal Brisbane Hospital, Brisbane, QLD.

Chadwick, B.J., & Kenardy, J. (2003). "*Cognitions, Coping and Day-to-Day Adaptation to Chronic Pain: Preliminary validation of the Pain Assessment and Monitoring Survey*", Poster presentation at The Australasian Society for Behavioural Health and Medicine annual conference, Brisbane, QLD.

Chadwick, B.J., & Kenardy, J. (2000). "*Ecological Momentary Assessment and Chronic Pain: Enhancing the ecological validity of within-subjects designs*", Presentation given at the School of Psychology, University of Queensland, Brisbane, QLD.

Chadwick, B.J., & Kenardy, J. (2000). "*Cognitions, Coping And The Daily Experience Of Chronic Pain: An ecological momentary assessment using palm-top*

computers", Poster presentation at the International Conference for Behavioural Medicine, Brisbane, QLD.

Chadwick, B.J., & Kenardy, J. (1999). "*Ambulatory Monitoring of Chronic Pain Patients: Applications of ESM Methodology*", Presentation to the Australian Pain Society, Queensland Branch, Annual General Meeting, Brisbane, QLD.

Chadwick, B.J., & Kenardy, J. (1999). "*Real-life Assessment of Chronic Pain Using Palm-top Computers: Exploring the Interplay Between Cognitions, Coping and Clinical Outcomes*", Presentation for the Multidisciplinary Pain Centre, Royal Brisbane Hospital, Brisbane, QLD.

Pain Appraisals, Coping, And Adjustment In Daily-Life With Chronic Pain: An ecological momentary assessment study

Abstract

Models of chronic pain guided by Lazarus and Folkman's (1984) Stress and Coping Theory have long suggested key psychological variables that may maintain chronic pain syndromes and influence psychosocial adjustment. Such research justifies psychological interventions for chronic pain management, and provides an evidence-base for targeting specific classes of behaviour and cognition for therapeutic change. However, the vast majority of this literature is based on between-subjects designs. It cannot be assumed that such designs reveal what occurs within people, with some research suggesting that findings from the two approaches may yield differences in the strength and direction of relationships observed. Micro-level within-subject designs are required to explore the relationship between pain, psychological factors and adjustment in daily life.

The current study sought to test the hypothesis, derived from Stress and Coping Theory, that pain appraisals and coping are both important in influencing a chronic pain sufferer's moment-by-moment adaptational states (measured as psychological distress, physical/social functioning, and activity-level), and that their effect is not attributable to pain-intensity. It employed Ecological Momentary Assessment (EMA) – a potentially fruitful methodology that has been developed to address within-person research questions. EMA also minimizes the risk of additional limitations associated with cross-sectional questionnaire-based methodologies, such as questionable ecological validity and potential recall and judgment biases. EMA's "daily-diary" format allows for

longitudinal real-time assessment of pain and associated psychosocial variables in participant's every-day environments.

In the first study the Pain Ambulatory Monitoring Survey (PAMS) – a short (54 item) measure of pain, appraisal, coping and adaptation – was developed and validated. PAMS was then used to investigate the independent effects of coping and appraisal in a conventional between-subjects study (n=124). It was found that coping and appraisal played independent roles in predicting distress, whilst only appraisals appeared to be related to function. Activity-level, on the other hand, appeared unrelated to either coping or appraisals.

In Study Two, PAMS was applied in an intensive week-long palm-held-computer based EMA study of 55 individuals with a variety of chronic pain conditions. Part A of Study Two consisted of a set of methodology-related analyses exploring compliance, convergent validity between momentary and recall-based measures, and possible measurement reactivity. In Part B, a set of repeated-measures multilevel models was used to assess whether pain appraisals were associated with the three indices of adjustment after controlling for pain-intensity and coping, and whether coping was associated with the adjustment indices after controlling for pain intensity and appraisals. Separate analyses were conducted to investigate these effects when the predictor variables were in the same-lag as (that is, measured at the same time as) and prior-lag to (that is, measured some hours before) the outcome measures. Findings supported a stress and coping model. Analyses of distress and activity-level revealed that appraisals reported in the same lag were associated with both outcomes. Same-lag coping behaviors (performed in the period immediately preceding the reported outcome) were associated with activity-level but not

distress. Delayed effects were also apparent – appraisals and coping behaviors reported in the prior lag demonstrated independent effects on all outcome indices.

In conclusion, the quality of daily life amongst people with chronic pain appears to be influenced by both the strategies they volitionally use to cope with pain and the ways they appraise their pain, which are presumably less open to volitional control. These effects appeared to be at least somewhat independent, and could not be accounted for by the momentary intensity of pain. Therapeutic strategies targeting both appraisal and coping would appear to be justified, though on the basis of current findings encouragement of active coping may be a less important goal than limiting passive coping. The different pattern of results between studies one and two supports the need for within-subjects approaches, and the electronic-diary methodology appeared to be a useful means of obtaining the kind of macro-level within-person data unavailable to conventional questionnaire-based research designs. Applications for PAMS monitoring in clinical settings is discussed.

Table of Contents

List of Tables and Figures

1. INTRODUCTION

A large body of research has established that people who suffer from chronic pain are not a homogeneous group – they differ in terms of their functional adaptation and quality of life and these differences cannot be attributed to differences in the nature or severity of their medical condition (Flor and Turk, 1988). Consistent with calls from the stress literature (eg. Weber, 1997), adjustment to chronic pain has been investigated as it relates to a wide range of functional outcomes, including emotional, physical, and social functioning (Jensen, Turner, Romano & Karoly, 1991). The factors associated with differences between people in their adjustment to pain have been widely studied in cross sectional research, and include a range of psychological factors, including pain appraisals, pain beliefs, and coping strategies (Jensen, Turner, Romano & Karoly, 1991). Much of this research has been guided by Lazarus & Folkman's (1984) Stress and Coping theory, which provides a heuristic framework for understanding adaptation to chronic pain. Namely, pain, the stressor, is presumed to interact with person variables, appraisal and coping, to influence adaptation. Stress and Coping theory would suggest that we need to understand the intra-psychic processes in order to predict adaptation to pain. That is, adaptation to pain is determined not by pain *per se*, but by the mediating influence of cognitive appraisal and coping responses. Stress and Coping theory would also suggest that, although appraisal and coping may be interrelated, they would nonetheless have independent effects on adaptation. Few studies have investigated these processes in the context of chronic pain (c.f. Jensen & Karoly, 1991; Turner, Jensen & Romano, 2000).

Pain varies not only between people – it fluctuates within people. Within-person research has established that the pain experience fluctuates within people over a variety of time-courses, such as within the course of their condition (Sedlak, 1985; Burton, Tillotson, Main & Hollis, 1995), the week (eg. Stone, Broderick, Porter & Kaell, 1997), and the day (eg. Jamison & Brown, 1991). As with cross-sectional findings, within-person research has established that people change, over similar timeframes, in their adaptation to the condition (eg. Affleck, Urrows, Tennen & Higgins, 1992; Feldman, Downey & Schaffer-Neitz, 1999). However, only a small amount of research has been done to explore the processes involved in within-person fluctuations in functional status. This is despite the fact that Stress & Coping theory places emphasis on the intra-individual elements of adaptation: the stressor, appraisals, and coping behaviors are presumed to interact dynamically over time to affect changes in adaptational status within people. Consistently with Lazarus and Folkman's position, a number of major theorists in the field of pain research suggest that factors associated with adjustment to pain, namely coping, are best studied over time as dynamic processes (eg. Tennen & Affleck, 1996; Jensen & Karoly, 1991; Lazarus, 2000). Importantly, a number of researchers have made the point that within-person and between-person research addresses separate questions, and the conclusions of one cannot necessarily be extended to the other (Stone, Schwartz, Neale, Shiffman, Marco, Hickox, Paty, Porter & Cruise, 1998). Indeed, Howard Tennen, Glenn Affleck (Tennen & Affleck, 1996) and others (eg. Shiffman, Fisher, Paty, Gyns, Hickcox & Kassel, 1994) have demonstrated that conclusions can differ when the same variables are investigated on those two levels, and that relationships can differ not only in strength

but in direction. Thus, within-person research is necessary to address within-person questions, such as those posed by Stress and Coping theory.

Following from this point, the processes underlying clinical change in chronic pain, for example from Cognitive Behaviour Therapy, are often cited from cross-sectional between-subjects research, and these interventions have been structured and justified on the basis of such findings. Clinical change, however, is in essence a within-person phenomenon. Psychological interventions are not aimed at transforming one person – with all their traits and dispositions – into another, but at inducing change within people by modifying the way they appraise and respond to their internal and external environments. Thus, within-person research is also needed for the purposes of investigating processes of change associated with clinical interventions.

Stress and coping theory would suggest that it is not pain *per se*, but appraisal and coping mechanisms that account for intra-individual fluctuations in adaptation. Unfortunately, if research into the relationship between pain and adjustment within people is sparse, then research into factors that may explain the relationship is even more-so. Although some clues as to the relevant factors may be gleaned from the between-persons literature, it should not be assumed that the same mediating factors responsible for differences between people have the same functional significance within-people, or that they have any role at all. Again, such issues need to be addressed by within-person designs. Along these lines, Catley (1999), Grant (1998), and Keefe, Affleck, Lefebvre, Star & Caldwell (1997) have demonstrated that a range of appraisals and coping strategies have important influences on adaptation to pain at the intra-individual level of analysis. Unfortunately, the functional outcomes assessed in this body of research are narrow, consisting entirely

of emotional outcomes such as positive and negative affectivity, and depressed or anxious mood. There is a notable absence of research into physical function as an index of adaptation. Also, the range of psychological (appraisal and coping) constructs investigated in these studies is limited.

In the following chapter, adaptation to chronic pain is given a more in-depth treatment. Firstly, pain and chronic pain are defined, and biomedical and biopsychosocial models of the transition from acute to chronic pain are briefly reviewed. Next, findings regarding adaptation are reviewed – the extent and nature of the pain problem for individuals and society is discussed, drawing attention to the notion that marked differences exist in the adaptational status of individuals within the chronic pain population. This is followed by a brief review of methods for measuring adaptation to pain. Finally, a distinction is drawn between adaptation – which in the current study is understood as a person's general level of functioning and wellness – and momentary adaptational status, which is understood as a person's status on a given measure of adaptation at any specific point in time.

Chapter three begins with a description of and rationale for Ecological Momentary Assessment (EMA; Stone & Shiffman, 1994) – a methodology for exploring momentary adaptational status. Momentary adaptational status is then elaborated, and measures that have been used to assess changes in adaptational status in every-day life will be reviewed.

In chapter four Stress and Coping theory will be described, including its utility as a model of adaptation to chronic pain. This model provides the structure and rationale for the following review of psychological factors that may play a role in momentary adaptational status in chronic pain.

Chapter four then presents a review of research into the role of appraisal and coping in adaptation to chronic pain. The research reviewed in that chapter is inter-individual in nature, reflecting the majority of research available in the literature. Chapter four ends by describing intra-individual chronic pain research into appraisal and coping, leading into the aims and hypotheses of the current studies.

1.1 Overview of the current project

The aim of the current project is to explore whether pain appraisals and pain coping play separate roles in determining the adaptational status of a person with chronic pain in the course of their every-day life. Consistent with calls for assessment of multiple indices of adaptation, three outcome variables are investigated: psychological distress, involvement in functional activities, and physical activity level. Specifically, the study addresses two issues posed by Stress and Coping theory and investigated in previous cross-sectional research (Jensen & Karoly, 1991; Turner, et al., 2000): Are pain appraisals and coping associated with adaptation above and beyond the effect of pain on adaptation?; and, do coping and appraisals have independent effects on adaptation, or can one be accounted for by the other? To address these questions this study employed EMA, a methodology specifically designed for addressing intra-individual questions in an ecologically valid way. This methodology requires assessments to be conducted repeatedly over extended periods of time, in a momentary fashion (eg. “What is happening right now…”), in the participant’s natural environment (Stone & Shiffman, 1994).

In most within-person research concerned with adaptation to chronic pain, predictors and outcomes are measured at the same time and the relationship between them is analysed accordingly. These types of analyses will be referred to here as *same-lag* analyses.

However, there is a temporal sequence inherent in EMA data (that is, one entry is followed by another entry, which is followed by another, and so on) that allows for investigation of effects across time. Predictors from one time-point (such as in the morning) can be used to predict the outcome at a subsequent time-point (such as in the evening). In this paper, such analyses are referred to as *cross-lag* analyses. The current study is primarily concerned with cross-lag analyses of all three outcomes, and the potential causal effects such analyses may suggest (Bateman & Strasser, 1984). See Section 4.5.2 for a more full discussion of the definition of same-lag and cross-lag analyses and the distinction between the two.

The first study describes the development and validation of the Pain Ambulatory Monitoring Survey (PAMS). This self-monitoring instrument was designed for use in an EMA study, using a minimal item-set and momentary question formats. After being developed (in Part A of Study One), PAMS is then used in a conventional cross-sectional study of adaptation to chronic pain (in Part B of Study One).

In the second study, PAMS was administered via palm-held computers to 55 people with chronic pain, assessing pain, appraisals, coping, and adaptation up to nine times per day for up to nine days. Methodological issues are addressed first, in Part A of Study Two, relating to compliance rates, convergence between the PAMS data and standardized questionnaires, and evidence for any reactivity effects on measurement that might be attributable to the methodology. Findings of the EMA study will be presented in Part B of Study Two.

In the current study, EMA data was analysed using multi-level modelling via the Hierarchical Linear Modeling (HLM; Raudenbush, Bryk, Congdon, 2001) software. This

statistical method allows for variance in the outcome variables to be partitioned into that accounted for by differences between people, and that which exists within people. The focus of analyses in the current study was on explaining variance within persons.

2 ADAPTATION TO CHRONIC PAIN

2.1 Nature and Extent of the Problem

Pain has been defined by the International Association for the Study of Pain (IASP) as "An unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage" (Merskey & Bogduk, 1994). This definition underscores that pain is a psychological phenomena involving perception, emotion, and the attribution of meaning. The contemporary recognition of the centrality of psychology in the experience of pain can be attributed to Melzack and Wall's (1965) influential Gate Control Theory of pain, which conceptualised pain as having sensory (physiological), affective (emotional and motivational) and evaluative (cognitive) dimensions and allows for the modification of pain sensation by psychological factors including memory, meaning, emotion, and attention (Price, 1999).

Chronic pain has been defined as pain that persists beyond normally expected healing time (Bonica, 1985). The term incorporates a wide range of conditions characterised by or associated with persistent pain, incorporating pains of nociceptive, inflammatory, and neuropathic bases, including migraine headache, low-back pain, rheumatoid arthritis and osteoarthritis, fibromyalgia, complex regional pain syndrome, irritable bowel syndrome, myofascial pain, post-herpetic neuralgia, and temporomandibular disorder (Merskey & Bogduk, 1994).

Acute pain appears to be very common in the general population, and whilst persistent pain appears to be less frequent it nonetheless seems to be a widespread problem. For example, 58% to 84% of individuals experience low back pain at some stage of their lives

(Dionne, 1999), with prevalence rates of chronic low back pain falling between 10% to 63% of the general population (von Korff & LeResch, 2005). A brief overview of the prevalence (in one year or less) of a range of chronic pain conditions, adapted from a recent review by Von Korff and LeResche (2005), is presented in Table 1.1. The breadth of these figures demonstrates that the precise extent of pain in the community is difficult to determine, partly due to the wide variety of possible conditions, variation in the application of duration and severity criteria, and poorly standardised or non-existent diagnostic criteria (Von Korff, 1999).

Table 1.1 Reported Prevalence of Chronic Pain Conditions in Community Samples (periods of one year or less)

Condition	Range	Median	Number of studies reviewed
Migraine headache	2% and 48% (females) 0 to 46% (males)	15% (females) 6% (males)	32
Low back pain	10% and 63%	37%	11
Knee pain	10% and 29%	18%	11
Shoulder pain	2% and 61%	7%	5
Neck pain	10% to 40% (females) 3% to 29% (males)	16% (females) 12% (males)	4
Chronic wide-spread pain (eg. Fibromyalgia)	0.66% to 10.7%	8%	8
Temporomandibular disorder	5% to 14% (females) 3% to 10% (males)	9% (females) 5% (males)	10

A large body of literature has amassed in an attempt to elucidate the processes whereby individuals with acute pain conditions go on to suffer chronic pain. Research guided by biomedical models suggests that whereas acute pain can be explained via more straight-forward nociceptive mechanisms (ie. perceived acute pain is usually proportional to tissue injury or disease activity), numerous alternate mechanisms may be operational in chronic pain conditions that may account for their chronicity (Merskey, Loeser, & Dubner, 2005). Briefly, such possible mechanisms include peripheral sensitisation, where

inflamed primary afferent nociceptive nerves respond to weak, normally non-painful stimuli to produce sensations of pain. This process may be mediated by the activity of inflammatory mediator substances, such as Substance P. Central sensitisation involves second- and third- order sensory neurons in the central nervous system demonstrating abnormal responses to normal input from the primary sensory afferents. This can be attributed to numerous mechanisms, including chemically mediated alteration of nociceptive processing in the dorsal horn of the spinal cord, or abnormal or persistent afferent inputs. Damage to afferent nerves (for example, due to trauma, infection, poor nutrition, toxins, or auto-immune attack) can generate firing of spontaneous nociceptive signals, cause the nerve to become hypersensitive, and lead to abnormal interactions and "cross-talk" between nerve fibres. Finally, changes to modulatory (both inhibitory and facilitatory) descending processes may mean that the usual means by which higher-order processing modifies incoming nociceptive signals is disrupted. For example, under usual circumstances nociceptive signals may be inhibited by factors such as attention and emotion by descending control from the periaqueductal gray (PAG), via serotonergic neurons in the raphe magnus of the medulla which act to inhibit the firing of spinal dorsal-horn nociceptive cells.

Recognition of the inadequacy of biomedical models of chronic pain to account for the full nature and functional impact of these conditions (Turk & Okifuji, 2002) has led to the formulation of numerous biopsychosocial models of the transition to pain chronicity. Factors including attention (eg. Van Damme, Crombez, & Eccleston, 2004), coping strategy usage (eg. Hadjistavropoulos & Craig, 1994), beliefs about pain (Goubert, Crombez, & De Bourdeauduij, 2004), and classical and operant conditioning (Fordyce,

1976) have been proposed. Behavioural models (eg. Fordyce, 1976; Linton, Melin, & Gotestam, 1984), for example, suggest that activities, settings and daily tasks become associated with pain, fear and/or tension via classical conditioning. Subsequent avoidance of these cues develops due to negative reinforcement via operant conditioning. Finally, avoidance contributes to increasing disability and prolongation of the pain condition via physical disuse and deconditioning (Bortz, 1984).

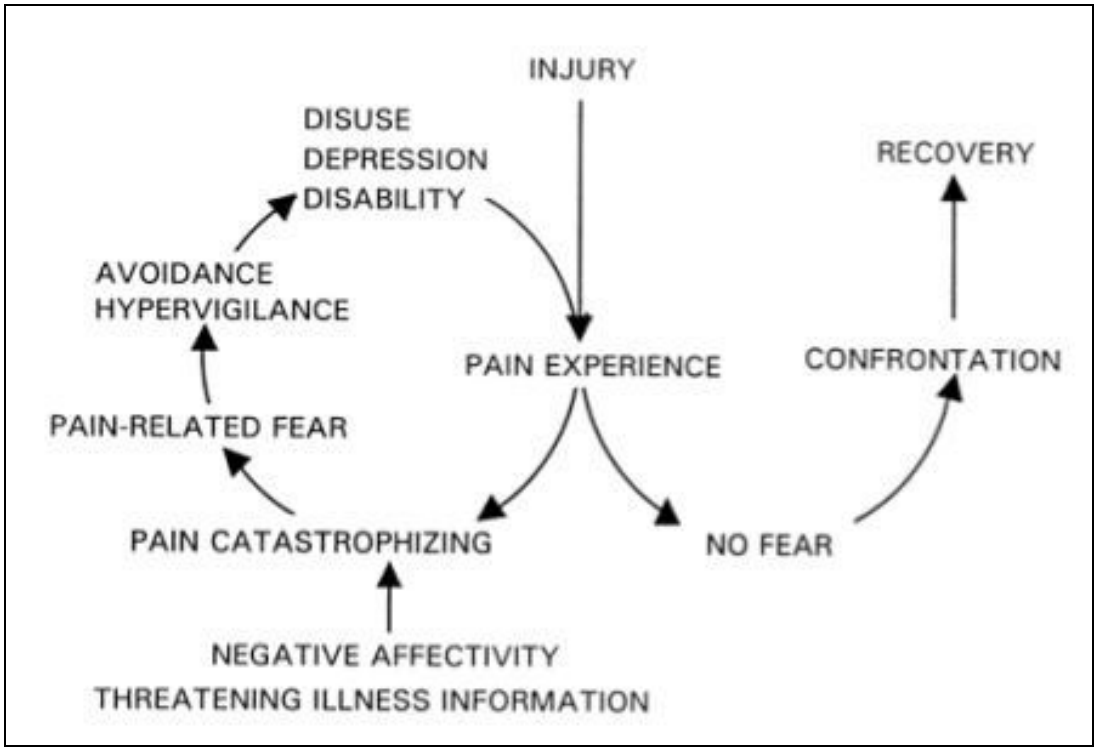


Figure 1.1 Fear-Avoidance Model of Chronic Pain (reproduced from Asmundson, Norton, and Vlaeyen, 2004)

Early behavioural conceptions of pain and pain behaviours have evolved in more recent years into the so-called 'fear-avoidance' models of chronic pain. These models attempt to explain the disability and physical deconditioning that result from pain, and presumably play a role in perpetuating the pain condition, via both behavioural and cognitive mechanisms (Vlaeyen & Linton, 2000). Vlaeyen, Kole-Snijders, Rotteveel, Ruesink, and

Heuts' (1995) early version of the fear-avoidance model is demonstrated in Figure 1.1. It suggests that an individual's initial appraisal of the pain resulting from an injury is important in determining the subsequent trajectory of the person towards recovery or disability. Those who are subject to certain risk factors (including prior exposure to threatening pain-related information, and dispositional factors such as 'anxiety sensitivity') will be more likely to perceive the pain in catastrophic terms. These individuals will experience fear as a result of this catastrophic thinking. The consequences of fear, including perceptual and information-processing biases (such as hypervigilance to threat-cues and misinterpretation of otherwise innocuous bodily sensations) and avoidance of threat-related situations and activities, contribute to physical deconditioning (reduced cardiovascular fitness and muscular disuse and/or abnormal patterns of coordination and activation), depression, and generalised disability. Such outcomes purportedly contribute to the pain condition, thus setting up a vicious cycle of ongoing pain, catastrophising, fear, avoidance and information-processing abnormalities, and depression, disuse, and disability. According to the model, those who do not catastrophize do not experience fear, are more liable to approach customary daily tasks and confront physical limitations, and progress to eventual recovery of functioning if not pain amelioration. A more recent model (Asmundson, Norton, & Vlaeyen, 2004) suggests the same central role of catastrophic appraisals in determining the pathway to recovery or into the vicious cycle of disability. This model, however, distinguishes between fear, experienced in the presence of pain or pain-related activities, and anxiety, experienced in anticipation of pain or pain-related situations or activities. Both fear and anxiety are related to information-processing biases, physiological arousal, and

behavioural responses. In the case of fear, escape behaviours will be enacted to immediately reduce pain or fear whereas anxiety will be associated with avoidance behaviours to prevent possible pain and avoid the fear associated with pain-related activities. A further addition to the model is the role of pain-beliefs, involving beliefs about the meaning of pain and the relationship between activities and pain. Each successful escape and avoidance attempt reinforces these beliefs, and (consistent with general avoidance theory) this supposedly makes avoidance behaviour particularly resistant to extinction because the individual is rarely or never exposed to situations that provide information to disconfirm the pain beliefs.

Although the Fear-Avoidance models represent an important step forwards in our understanding of the development of chronic pain and disability, they will not feature heavily in the current research, which focuses on psychological and physical functioning in those who already have chronic conditions. However, the models do make important predictions about the role of factors such as catastrophic thinking, expectations about pain, and avoidant (passive) coping, and they will be mentioned in these contexts.

2.2 Inter-Individual Differences in Adaptation

Pain represents a significant medical, social, and economic challenge to society. The significant economic costs of pain are attributable to factors such as medical care and, more significantly, occupational disruption including absenteeism and lost workplace productivity. Van Tulder, Koes, and Bouter (1995) estimated that in 1991, costs relating to back pain in the Netherlands accounted for 1.7% of the gross domestic product, with 93% of this being associated with disability and absenteeism and only 7% being related to medical care. Stewart, Ricci, Chee, Morganstein, and Lipton (2003) estimated that

common pain conditions – mainly headache, back pain, and arthritis – were associated with lost productivity during a three month period in 13% of their sample of 29,000 US workers. Over three-quarters of this was due to reduced performance rather than absenteeism. In the UK, the costs of back pain relating to productivity loss and informal care were six times greater than the cost of medical care (Maniadakis & Gray, 2000). Chronic pain has also been associated with a range of adverse psychosocial outcomes that impact negatively on the quality of life of sufferers (Hitchcock, Ferrell & McCaffery, 1994). Those with chronic pain demonstrate declined participation in social, recreational, vocational, and domestic activities (Kerns & Jacob, 1993), and they report lower levels of activity and greater interference in their lives (Kerns and Haythornthwaite, 1988). One study found that, on average, 30% of the waking time of chronic pain patients was spent lying down (Follick, Ahern, Laser-Wolston, Adams & Molloy, 1985).

Depression and chronic pain appear to be highly related (Feldman, et al., 1999), and depression is certainly the psychopathological condition most researched in terms of its relationship to chronic pain (Banks and Kerns, 1996). It is more prevalent in chronic pain populations than the general population, and more prevalent than in those with acute pain (Banks & Kerns, 1996; Erdal & Zautra, 1995). Interestingly, there is some suggestion that it is more prevalent in chronic pain populations than amongst those with other chronic medical conditions (Banks & Kerns, 1996), including cardiac disease (Schleifer, Slater, Macari-Hinson, Coyle, Kahn, Zucker, & Gorlin, 1991), stroke (Morris, Robinson, & Raphael, 1990), and Parkinson's disease (Mayeux, Stern, Cote, & Williams, 1984). Chronic pain has demonstrated co-morbidity with a range of psychopathological conditions and negative emotional states, including Post-Traumatic Stress Disorder (eg.

Roy-Byrne, Smith, Goldberg, Afari & Buchwalk, 2004; Sharp & Harvey, 2001), other anxiety disorders (Fishbain, et al., 1986), and alcohol and drug abuse (eg. Fishbain, et al., 1986; France, et al., 1986).

Chronic pain has also demonstrated strong links with anger and hostility (eg. Taylor, Lorentzen & Blank, 1990) and in particular inhibited anger ("anger-in"), passive-aggression, and "cynical hostility" (see a review by Fernandez & Turk, 1995). Pilowsky and Spence (1976) reported that 53% of patients with chronic intractable pain demonstrated "bottled-up anger" – a higher incidence than the 33% observed in an outpatient sample. Wade, et al. (1990) found that chronic pain patient's anger-in significantly predicted depression scores, and in a path-analysis Tschannen, Duckro, Margolis and Tomazic (1992) found that anger-in accounted for 32% of variance in depression. Wade, Price, Hamer, Schwartz and Hart (1990) demonstrated that whilst depression, anxiety, frustration, anger and fear were all prevalent emotional states experienced by chronic pain patients the most prevalent was frustration.

Whilst adverse emotional states are an understandable response to chronic pain they may also feed back to influence the pain experience. Fernandez and Milburn (1994) found that, controlling for a range of other emotional states, a subset of emotions consisting of anger, fear and sadness accounted for the largest proportion of variance in pain affectivity. Chronic pain patients who are also depressed report higher levels of pain than non-depressed patients (Magni, 1987; Haythornthwaite, Sieber, & Kerns, 1991). In a sample of depressed and non-depressed chronic-pain inpatients, Fisher, Haythornthwaite, Heinberg, Clark and Reed (2001) found that depression was associated with greater reports of pain and poorer psychosocial function. Longitudinally, depression was

associated with an increase in musculoskeletal pain after a 5-year interval (Leino and Magni 1993), and over a one-month period amongst women with myofascial pain (Zautra, Marbach, Raphael, Dohrenwend, Lennon, and Kenny, 1995). By contrast, Summers , Rapoff, Varghese, Porter and Palmer (1992) found anxious and depressive symptomatology did not contribute any further unique variance to the 33% of variance in pain severity accounted for by anger/hostility ratings.

Other outcomes associated with chronic pain, which have been the focus of empirical investigation, include use of health care facilities and prescription medication (eg. Jensen & Karoly, 1991), marital discord (eg. Bermas, Tucker, Winkelman, & Katz, 2000), and abuse of medication and illicit substances (eg. France, Krishnan, & Trainer, 1986; Bermas, et al., 2000).

Despite the apparent negative psychosocial impact of chronic pain, it is clear that not all people with chronic pain could be considered “maladjusted”. Numerous studies have demonstrated that people who have chronic pain differ along a range of adaptational outcomes, and these differences are not attributable to characteristics of their pain, medical status, or pain history (Flor and Turk, 1988; Jensen, Turner, Romano & Karoly, 1991). Though many people in the general population experience chronic pain, the majority continue to work and do not require high levels of medical care such as use of multidisciplinary chronic pain centres (Taylor & Curran 1985). That is, chronic pain does not equate to maladjustment *per se*.

For example, whilst the majority of those in pain continue working – though their job performance may be negatively impacted – a minority account for the majority of

disability costs. Cathey, Wolfe, Kleinheksel, and Hawley (1986) report that their sample of 81 patients with fibromyalgia reported an average of nine days off work in the previous year, though this figure was skewed by a minority of patients with over 30 days absent – more than half of the sample did not report any lost work days. According to research by the Quebec Task Force on Spinal Disorders (Spitzer, LeBlanc, & Dupuis, 1987), 74% of those with acute back pain resume work within four weeks of pain onset and only 8% remain off work after 6 months. Hashemi, Webster, and Clancey (1998) found that 5% to 9% of compensation claimants with back-pain accounted for 65% to 85% of total worker's compensation costs and 78% to 90% of disability days.

The prevalence of psychopathology in pain populations also demonstrates that pain is not synonymous with maladjustment. Depression is a case in point. Although studies have placed the incidence of depression in chronic pain populations between 10% and 100% (Banks & Kerns, 1996), in a review of fourteen studies employing standardized criteria nine placed the incidence between 30% and 54% (Banks & Kerns, 1996). Amongst those who do attend pain clinics, Turner and Romano (1984) found that only approximately one-third of chronic pain patients met diagnostic criteria for Major Depression. Love (1987) observed a greater incidence of depression in a sample of chronic pain patients than amongst a sample without chronic pain, though amongst chronic pain patients those with depression represented a minority. Fishbain, Goldberg, Meager, and Rosomoff (1986), surveying 283 pain-clinic patients, found that 56.2% had a history of some form of depressive condition, though only 4.6% had a current diagnosis.

Similarly, whilst anxiety conditions appear to be commonly co-morbid with pain, not everyone with pain suffers from anxiety. For example, Fishbain, et al. (1986) found that

62.5% of their chronic pain sample had a history of Anxiety Disorder, with 15.2% having had Generalised Anxiety Disorder.

In terms of management of chronic pain and prevention of chronic disability it is crucial to develop a greater understanding of who will demonstrate poor adjustment as a result of chronic pain. A biomedical model would suggest that those with a more severe condition will suffer more adverse psychosocial outcomes, but such a model is not well supported by current evidence (Turk & Okifuji, 2002). For example, whilst the majority of evidence suggests that pain predicts the onset of depression, rather than depression predicting pain (Banks and Kerns, 1996; cf. Dworkin, Hartstein, & Rosner, 1992), the evidence for pain predicting depression remains ambiguous. Amongst rheumatoid arthritis patients, pain severity predicts depression over six (Brown (1990) and 24 month (Nicassio & Wallston, 1992) periods, though Zautra, et al. (1995) found no effect of pain intensity on distress over one-month in a sample of women with myofascial pain.

The relationship between pain and physical indices of functioning is also ambiguous. Strong. et al., (1990) reported that although the assumption would be that those who are more physical active and engage in more functional activities would be likely to experience more intense pain or more frequent flare-ups, they found no relationship between reported pain intensity and self-reported function. Linton (1985) found declining relationships between pain and activity level as the method of assessing activity-level became more objective, suggesting that although people may perceive that such a relationship exists this may not necessarily be the case. In his study, all thirty of the chronic pain patients he sampled believed that their pain intensity was influenced by the activities they engaged in, and they were able to provide examples of specific activities

they believed would increase (eg. bending, walking, vacuuming, sitting) and decrease (eg. lying down, taking a bath, massage) their pain. A checklist of ADLs, completed at the end of one week, was negatively related to the average of pain ratings taken twice daily for one week (r=-.69; controlling for pain at the time of ADL ratings). However, this relationship disappeared when the ADL checklist was measured on a daily basis and the average of these ratings was correlated with the average of pain ratings. Furthermore, no significant relationship was found between distance cycled in a bicycle task and either pain rated prior to the task or the average of pain ratings in the prior week.

The lack of findings of a consistent relationship between activity involvement and chronic pain may be partly attributable to the complex casual direction of such a relationship – both positive and negative relationships are theoretically plausible. A positive relationship found in cross-sectional research may reflect increased pain prompted by physical activity (Strong, et al., 1990) whilst a negative relationships may also be supported, reflecting poorer functioning amongst those with worse pain conditions (Linton, 1985) or greater pain due to physical deconditioning associated with activity avoidance (Bortz, 1984). A negative relationship between pain and activity may also be supported on the basis of evidence of pain-reduction following acute exercise (eg. Koltyn, Garvin, Gardiner, & Nelson, 1996; Pertovaara, Huopaniemi, Virtanen, & Johansson, 1984), though this may occur only for exercises performed above 75% maximal aerobic capacity (Koltyn, et al., 1996) and such findings appear to be limited to experimentally-induced pain in non-clinical samples.

Ambiguities and inconsistencies in the observed relationship between pain and indices of adaptation are largely due to the correlational, cross-sectional design of the majority of

studies. Whilst prospective studies predicting long-term adaptation from pain may serve to clarify the direction of relationships, a better understanding of how pain is associated with adaptation may be gained by analyses on a more micro-level, of the processes that unfold within people. Studies observing pain and functioning as they co-vary within individuals over time-frames such as days or hours may, for example, help to clarify the direction and nature of the relationship between pain and physical functioning. Crucially, such studies may contribute to the identification of processes that determine individual differences in adaptation to pain. Such studies will be described further in Section 2.4. First, methods for assessing the differential adaptational status of individuals with chronic pain will be briefly reviewed.

2.3 Measurement of Adaptation to Chronic Pain

The selection of appropriate outcome variables is a crucial factor in all stress and coping research (Weber, 1997). In the case of pain, a number of outcomes have been studied, including indices of psychological well-being, social- and role- functioning, and physical health and functioning (Jensen, Turner, Romano & Karoly, 1991).

Physical outcomes have included mobility, physical strength, activity level, and engagement in exercise. In terms of social- and role- functioning, outcome indices have included employment status and engagement in activities-of-daily-living (ADLs). Most measures of pain-related disability appear to incorporate features of physical, social, and role dysfunction. Studies have utilised a variety of standardised measures of functioning and disability, including the Activity Scales of the Multidimensional Pain Inventory (MPI; Kerns, Turk, & Rudy, 1985), the Health Assessment Questionnaire (HAQ; Fries, Spitz & Young, 1982), the Roland and Morris Disability Questionnaire (DQ; Roland &

Morris, 1983), the Sickness Impact Profile (SIP; Bergner, Bobbit, Carter, & Gibson, 1981), the Oswestry Disability Index (Fairbank, Couper & Davies, 1980), the Life Impact Scale (LIS; Armentrout, Moore, Parker, Hewett, & Feltz, 1982), the Pain Disability Index (PDI; Tait, Pollard, Margolis, Duckro, & Krause, 1987), the Self-Care Assessment Schedule (SCAS; Barnes & Benjamin, 1987), or the Medical Outcomes Survey – Short Form-36 (SF-36; Ware & Sherbourne, 1992). Many of these questionnaires measure function by having participants endorse activities they engage in, or the frequency of engagement in functional activities (eg. MPI-Activity Scales, HAQ, SCAS). Others include statements indicating specific functional difficulties (eg. DQ, SIP), whilst others ask for general ratings of perceived function and impairment due to illness, disability or pain (eg. SF-36). In most cases, measures of functioning provide unidimensional scores reflecting functional adaptation, though other scales reflect functioning in different domains (such as the MPI's Activity scales) and different aspects of functioning (such as physical, social, emotional, and role functioning in the SF-36). Other studies have examined performance in a standardised physical task as a behavioural index of physical functioning (eg. Lackner, Carosella, & Feuerstein, 1996; Murphy, Lindsay, & Williams, 1997).

Psychological outcomes include psychiatric morbidity (especially depressive conditions), depressed mood, anxiety, anger, and general distress. Depressive and anxious conditions are typically measured using standardised questionnaires such as the Beck Depression Inventory (BDI; Beck & Steer, 1987), Beck Anxiety Questionnaire (BAI; Beck, Epstein, Brown, & Steer, 1988), Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983), Centre For Epidemiological Studies Depression Scale (CES-D; Radlof,

1977), or the State-Trait Anxiety Inventory (STAI, Speilberger, Gorsuch, & Lushene, 1970), whereas general psychopathology and psychological symptomatology has been measured with the Symptom Checklist-90 - Revised (SCL-90-R; Derogatis, 1983).

Some studies are concerned not with psychopathology and symptomatology of emotional disorders, but with normal affectivity as experienced in the general population. Such an index of psychological functioning was employed in the current study. Negative and positive affect (NA and PA), general mood, and distress are commonly measured via rating scales of affect adjectives, such as selected items from the Profile Of Mood States (POMS; McNair, Lorr, & Droppleman, 1971), or the Positive Affect – Negative Affect Scale (PANAS; Watson, Clark, & Tellegen, 1988).

Other pain-related outcomes have included medication usage, health-service utilisation, pain severity, and pain behaviours (such as leaning, guarding, grimacing, and pain vocalisations). Scales such as the Pain Behaviour Questionnaire (PBQ; Philips and Jahanshaahi, 1986) have been used to provide standardized measures of pain behaviour. Scales measuring pain severity have been incorporated into measures of adaptation, such as the SF-36, MPI, and SIP. The McGill Pain Questionnaire (MPQ; Melzack 1975) was specifically designed to measure pain intensity and includes a rating of pain severity, the Present Pain Intensity (PPI) scale, and a set of adjective-based checklists of pain descriptors, the Pain Rating Index (PRI), which measures affective, sensory, and evaluative aspects of the pain experience, as well as a total PRI score. Many studies use single item measures of pain, or averages taken from maximum, minimum, and average ratings of daily or weekly pain. Common single item pain rating scales include (Turk & Melzack, 1992; Jensen, Karoly & Braver, 1986; Karoly & Jensen, 1987) numerical

ratings scales (NRS), including 6-point (eg. Sullivan, Rodgers, Wilson, Bell, Murray, & Fraser, 2002), 10-point (eg. Sindrup, Anderson, Madsen, Smith, Kim, & Jensen, 1999), and 101-point (eg. Jensen & Karoly, 1991) NRSs, verbal ratings scales (VRS) and, perhaps the most frequently used and well-validated single-item measures, the visual-analogue scale (VAS; eg Lackner, et al., 1996).

2.4 Levels of Analysis of Adaptation

Section 2.2 described findings relating to differences between people in their adaptation to chronic pain, and highlighted the finding that not all people with pain demonstrate poor psychological, social, or physical functioning. The focus was on adaptation at the inter-individual level – a perspective that contrasts with studies that are concerned with how adaptation varies within people over time. Adaptation can be seen as an ongoing process occurring within individuals, changing from moment to moment. The importance of intra-individual findings was briefly discussed in terms of identifying the direction of the relationship between pain and adaptation and illuminating the processes that may account for differences in adaptation. In the current study this intra-individual conceptualisation of adaptation will be referred to as *momentary adaptational status*. The distinction between intra-individual adaptation and momentary adaptational status is increasingly drawn in the literature (eg. Stone, et al., 1998), and is based on findings that indices of adaptational status vary within people over time (eg. Vendrig & Lousberg, 1997) and that relationships at the two separate levels of analysis, even within the same study sample, can be different (eg. Tennen & Affleck, 1996; Shiffman, et al., 1994). This research will be reviewed further below.

For the purposes of the current study, inter-individual findings are those that establish differences between people. For example, Rudy, Kerns & Turk's (1998) model of depression and pain is an intra-individual model because it suggests that people with chronic pain differ in the intensity of their pain and the degree to which they manifest symptoms of depression (the model elaborates the role of appraisal factors in the pain/distress relationship, suggesting that people who report greater tendencies towards certain ways of thinking are more vulnerable to depression). Inter-individual models of adaptation are usually tested via cross-sectional research, usually questionnaire-based, though between-persons experimental research is also inter-individual in nature. This kind of research is essentially correlational and cannot make strong claims about the causal nature of the relationship between the variables in question. Further, strong claims cannot be made about the role of processes in adaptation – the constructs investigated are essentially construed as being trait-like.

In contrast, momentary adaptational status is concerned with variance within people along adaptational dimensions. Its measurement involves tracking, from time-point to time-point, changes in mood, frequency of health-service utilization, activity-levels, social involvement, capacity to perform daily tasks, or other indices of adaptation. When an individual is measured on two or more occasions their adaptational status – reflected by indices such as mood or psychosocial functioning – is likely to show variation that is not entirely attributable to measurement error. Change in adaptational status may take place within days, over days, over months, or over the course of some other time-frame, and presumably covaries with other factors that may play a causal role in these fluctuations. Examples of some of the key questions addressed in intra-individual

research are "Is X index of adaptation stable within people?" and "Does a person's adaptational status improve when they adopt Y appraisal style, or engage in Z behavior". For example, Feldman, et al., (1999) demonstrated that pain intensity varied across days, and that it was associated with previous-day depressed mood.

Intra-individual questions can only be researched using within-person designs. Within-person designs that adopt a small number of data-points, such as laboratory-based experimental designs and pre- post- intervention designs, qualify as intra-individual designs. However, questions of momentary adaptational status are increasingly investigated using methodologies that sample participant's daily-life, in their natural environments, longitudinally over multiple time-points. This family of research methodologies has been referred to as Ecological Momentary Assessment (EMA). A variant, or sub-class, of possible EMA designs is Experience Sampling Methodology (ESM; Csikszentmihalyi, Larson & Prescott, 1977). A central aspect of ESM is that the data collected represents a random sample of the participant's daily life. The timing of measures is given a random element (for example, the day may be broken into time-slots with one measurement occasion occuring at a random time within each timeslot) so that the participant cannot anticipate when they will be asked to make their next data-entry. This helps to ensure that entries are not associated with external or internal events and consequently biased by the context of data collection – that they are *ecologically valid*. The time-schedule of sampling is operationalized using a signalling device, such as a wrist-watch or pager, to signal the participant to make a data-entry.

EMA methodology, and the rationale for using it, will be described further in Chapter Three when its applications to models of adaptation to chronic pain are reviewed.

The current chapter described some of the adaptational dimensions on which people appear to differ, including emotional states and psychopathology, activity-levels, and physical, social and role functioning. Some of the measures that have been used to assess these outcomes were reviewed. It concluded by suggesting that individuals also vary over time along these dimensions, and that momentary adaptational status needs to be investigated as a phenomenon distinct from inter-individual adaptation.

The following chapter is intended to review the literature regarding momentary adaptational status. It begins by introducing EMA – a methodology used to assess momentary adaptational status – and concludes with a review of how pain and adaptation vary and covary within people over time.

3 ECOLOGICAL MOMENTARY ASSESSMENT, AND MOMENTARY ADAPTATIONAL STATUS

Lazarus (1993) points out that only within-person designs allow researchers to investigate processes of coping and the way processes vary over time and according to a diversity of environmental contexts. Such approaches allow researchers to differentiate between coping states, characterized by variation in individuals' coping over time and contexts, and coping traits, characterized by stability in individuals' coping over time and contexts. EMA developed out of the need for a technique that was true to the ecological perspective, provided within-person data, and minimized risk of recall and judgment biases. Such methodologies, also labeled "daily-diary" approaches, have been put forward as a solution to some of the shortcomings of questionnaire-based designs (Lazarus, 2000; Tennen, Affleck, Armeli, & Carney, 2000). EMA and, specifically, ESM methods are able to gather information (a) over relatively long periods of time; (b) in the subject's own milieu; (c) at times not contingent on any environmental event; (d) using a technique that minimizes reactivity; and (e) using a technique which minimally disturbs the individual's environment (Hurlburt, 1979).

EMA (Stone and Shiffman, 1994) involves longitudinal momentary assessment of constructs within the natural environment of the participant. That is, participants are asked to monitor the constructs of interest at multiple time-points in the course of their every-day life. They are (usually) asked to report on what was occurring at the point in time they are completing the question or when they were signalled to make an entry. This approach minimises the risk of recall bias. Such studies often involve having participants

carry a recording device (such as a questionnaire booklet) and a prompting device (such as a wrist-watch alarm) that signals participants to complete a data-entry. Depending on the nature of the study, prompts can be given at random time points (thus capitalising on EMA's ability to provide a random sample of "moments", reducing the risk of systematic context biases and anticipation effects), or they can be given at pre-set time-points. These are referred to as *signal-contingent* protocols. Other studies employ *event-contingent* protocols whereby participants are asked to make entries in response to events, whether they are internal – such as a panic attack – or external – such as a social interaction (Stone and Shiffman, 1994).

3.1 Rationale for EMA

EMA appears to offer a number of advantages over traditional cross-sectional and experimental designs. Namely, the methodology minimizes the risk of biases and inaccuracies in recall and judgment, enhances the ecological validity of data, and, most importantly for the purposes of the current study, allows the researcher to draw conclusions about intra-individual processes.

Recall and Judgment Problems. Traditional questionnaire-based measures are subject to a number of shortcomings that appear to be especially relevant in the case of research with pain (Torgangeau, 2000; Stone & Shiffman, 1994; Keefe, 2000; Kihlstrom, Eich, Sandbrand, & Tobias, 2000). Part of the inadequacy of questionnaire-based studies lies in the fact that standard questionnaires are recall based. They ask participants not only to think back over a period of time, but also to make a summary judgment about (usually abstract) dimensions of experience that have occurred in that time. This introduces a number of sources of potential error related to encoding, storing, recalling, and making

summary judgments about autobiographical information (Torgangeau, 2000). Memories tend to fade over time, and this forgetting appears to be more likely and extensive over longer periods of time, and depends on the type of information being stored (Stone & Shiffman, 1994). Memories may also be biased given that recall is not simply a process of retrieving information but of reconstructing memories using recall heuristics (Torgangeau, 2000). For example, *effort after meaning* involves biased retrieval of information in a way that is more consistent with the retriever's schematic representations. Retrieved information can also be biased by *retroactive-reconstruction*, where recall is influenced by information obtained subsequent to storage of the original information. Recall strategies such as *availability heuristics* may bias memories to be more consistent with recent or highly salient memories (Torgangeau, 2000). Tennen and Affleck (1996) made the important point that:

> More important than inaccuracy *per se* is the source of the error [in recall]. We need to be concerned not only with the random error, but especially with systematic error in the recall of pain, coping, and events. Individuals who differ on other study variables (or worse, in key ways not measured) may report differentially accurate data or use different cognitive heuristics to assist their recall… In this vein Larsen (1992) demonstrated that neuroticism predicts not only day-to-day reports of illness symptoms, but also the subsequent accuracy with which these symptoms are later recalled. (p154)

Issues of recall bias may be especially relevant for research involving recall of mood states or pain, where recall of either state may be overly biased by current states (Keefe,

2000; Kihlstrom, 2000). For example, Smith and Safer (1993) demonstrated that recall of pain and medication-use differed between two samples of chronic pain patients – one who had just completed physical therapy (thus rating their current pain as being lower) and a control group. The physical therapy group recalled their usual and highest pain for the previous day and week as being lower than the control group. They also under-estimated their prior-week pain compared to diary records kept throughout the previous week. Control patients over-estimated their lowest and highest pain for the previous day and usual and lowest pain in the previous week, compared to their diary entries. The physical therapy group recalled their previous week's medication usage as being lower than both the control group and their own diary entries.

The heuristics involved in making summary judgments are complex, and people are unlikely to accurately recall weekly pain or mood let alone accurately "average" those experiences to produce a representative summary score (Menon & Yorkston, 2000). We cannot assume that questionnaires that ask participants to recall phenomena over (usually) one or two week periods accurately reflect real-world constructs that take place in a variety of contexts over time. Differing degrees of convergence between recall and momentary reports have been observed in studies that compare one- or two-week retrospective questionnaires to the average of a series of momentary measurements collected over the same period of time (eg. Catley, 1999; Tennen & Affleck, 1996). Indeed, some studies demonstrate a lack of correlation between recalled and momentary versions of certain scales.

Pain recall appears to be related to the average of momentary recordings, however, pain generally appears to be remembered as being worse than the momentary ratings would

suggest. Lousberg, Schmidt, Groenman, Vendrig and Dijkman-Caes's (1997) comparison between the MPI Pain Severity scale and analogous items measured throughout the course of a week demonstrated a significant relationship (r=.75). Similarly, Catley (1999) found a significant correlation of r=.65 between the MPI Pain Severity scale and momentary reports of pain. Tennen and Affleck (1996) found that although pain-recall was correlated with momentary reports, participants consistently recalled their pain as being more intense than it was according to momentary reports. Peters, Sorbi, Kruise, Kerssens, Verhaak, & Bensing (2000) confirmed this finding – the MPI Pain Severity scale consistently over-predicted the average weekly pain ratings, though the two scales were correlated r=.4 (this increased to r=.7 for a subset of 12 subjects who completed the MPI whilst conducting the monitoring).

Comparisons between recalled and momentarily reported outcome-measures have also been described. Lousberg, et al. (1997) found that the MPI scale measuring involvement in Household Chores demonstrated a significant relationship (r=.4) with daily-diary ratings, whilst General Activity (r=.16) and Affective Distress (r=.2) scales did not. For a range of momentary scales designed to reflect SF-36 scales Peters, et al. (2000) found correlations of r=.73 (SF-36 Physical Functioning) and r=.38 (SF-36 Role Functioning). They reported a momentary/recall correlation of r=.42 for MPI Affective Distress. Catley (1999) reported that the BDI was correlated significantly with momentary measures of NA and PA (r=.05 and r=-0.39 respectively). Finally, Gil, Carson, Porter, Ready, Valrie, Redding-Lallinger and Daeschner (2003), in a sample of adolescents with sickle-cell disease, found correlations of r=.43 and r=-0.36 between the Global Severity Index of the SCL-90 and daily ratings of NA and PA, respectively.

Finally, psychological scales measuring cognitive and coping constructs have also demonstrated varying degrees of convergence between recall and momentary reports. Lousberg, et al. (1997) reported a significant relationship for perceived Life Interference reported on the MPI (r=.6), but not perceived Life Control (r=.25). Peters, et al. (2000) observed a correlation of r=.34 for MPI Life Interference, and for the Coping Strategy Questionnaire (CSQ; Rosenstiel & Keefe, 1983) they found significant correlations of r=-0.66 (Catastrophising) and r=.41 (Diverting Attention and Ignoring/Denying Pain). A "Positive Self-Talk" scale of the CSQ did not correlate significantly with the repeated daily records. Stone, et al., (1998) found an average correlation of r=.6 between standard and momentary versions of the Ways of Coping questionnaire subscales (Folkman & Lazarus, 1980), and an average correlation of r=.51 between the individual items when measured in the standard manner and during daily recordings. Correlations between individual items ranged from r=-.06 ("Found new faith") to r=.83 ("Ate/drank/smoked etc to feel better"). They also inspected over-reporting (ie. when participants recalled they used the strategy but momentary reports indicated that they didn't) and under-reporting (ie. recalling non-use of the strategy when the strategy was reportedly used according to momentary records) for individual items. Specific Ways of Coping strategies were under-reporting by as few as 5% of participants ("Concentrated on the next step"), and up to 100% of participants ("Found new faith") who reported using that strategy during momentary recordings (averaging a 29% under-reporting rate across all items). Strategies were over-reported by as few as 7% of participants ("Found new faith") and as many as 69% of participants ("Let your feelings out somehow") who reported not having used a strategy during momentary recordings (averaging a 31% over-reporting rate across all

items). Tennen and Affleck (1996) reported that recalled and momentary reports of coping strategy usage were correlated, however momentary reports of strategy usage demonstrated a wider range of strategies used than retrospective reports. Strategies used on less than five days per month tended to be overlooked in retrospective reports.

Ecological Validity. According to Brunswick (1949), ecological validity refers to the occurrence and distribution of stimulus variables in the natural or customary habitat of an individual. If the stimulus variables of a psychological method are representative of those in the individual's habitat then it is said to be ecologically valid (Hormuth, 1986). Promoting ecologically valid assessment requires that data collection occur across all contexts in which the phenomena of interest exists (Buse & Pawlik, 1984).

The push for ecologically valid research is driven by an understanding of the limitations of laboratory and questionnaire-based studies. Pawlik (1996) argues that traditional research in differential psychology takes a cross-sectional approach, allowing the researcher only a narrow "snap-shot" of life. For example, often subjects may be given a series of questionnaires, placed in a highly controlled laboratory setting where an experimental manipulation may occur, and then given a series of post-experimental questionnaires. The external validity of data gathered in this way is constrained by internal characteristics of the experimental environment (eg. implicit and explicit reward schedules, physical setting, the means by which manipulations are administered) and characteristics of data collection. Questionnaires are necessarily limited in their external validity. They provide a single sample of the target construct and are usually answered either retrospectively or prospectively (Pervin, 1985).

At the heart of the push for ecological validity is a recognition that naturalistic research (ie. conducted in real-life situations) is most amenable to application (Fahrenberg, 1996). An ecological perspective strives to overcome biases produced by intrusive data collection methods, including recall biases, social desirability and reactivity (Hormuth, 1986). By assessing across all life-contexts, ecological assessment allows the researcher to look at causal processes at work longitudinally – giving the researcher an opportunity to begin untangling the effects of trait and situational variables and to determine the extent to which they interact (Pawlik, 1996).

Karoly and Jensen (1987) stress that the experience of pain is extremely context-dependent, and attempts to understand it should reflect this. A person's experience of pain will depend, amongst other things, upon their situational context. In other words, an accurate, comprehensive, and useful investigation of the pain experience must be ecologically valid and minimally intrusive.

Importantly, Karoly and Jensen (1987) endorse a circular model of pain – such as that presented by Elton, Stanley and Burrows (1983). They suggest it is important that data captures the ongoing and developing nature of pain, and reflects a process where pain acts as both an effect and a cause. This requirement raises the need for research designs that provide ongoing monitoring, thereby allowing demonstration of the changing nature of the pain condition, the factors that contribute to it, and those that are influenced by it.

Intra-individual processes. Although many findings of cross-sectional studies of adaptation to chronic pain have been assumed to apply within-persons, this assumption may not be a safe one to make. As a practical example, a relationship might be demonstrated between people (for example, those with greater self-efficacy are likely to

be less distressed), and clinical interventions (which are essentially concerned with within-person processes) targeting those factors are justified on the basis of those findings. Between-person methodologies have been criticized as being inadequate to capture the dynamic transactional relationship between stressors, appraisal, coping and outcomes. They are cross-sectional and rely on recall and judgment, and this precludes the assessment of how psychological constructs relate on a moment-to-moment basis and co-vary over time within persons (Stone, et al., 1998; Stone & Shiffman, 1994;Tennen & Affleck, 1998).

Tennen and Affleck (1996) makes the point that within- and between-person methods address different questions, and that both the magnitude and direction of associations can differ between these approaches. Indeed there is a substantial body of evidence suggesting that the assumption that within-person questions can be addressed via between-person designs is indeed invalid – what is true of individual differences is not necessarily true of within-person processes (Stone, et al., 1998; Tennen and Affleck, 1996). Tennen and Affleck (1996) demonstrated the importance of using EMA methodologies for addressing pain-related within-person questions by finding that a between-subjects analysis of daily events in the lives of rheumatoid arthritis patients revealed a positive relationship (r=.5) between the occurrence of positive- and negative-events, whereas a within-person analysis revealed a negative (r=-0.25) relationship. That is, those who experienced positive events were also likely to experience negative events, but individuals who experienced a positive event in a day were less likely to experience a negative event in the same day, and visa versa. A similar discrepancy was reported by Shiffman, et al. (1994) who found that questionnaire-based reports of the co-occurrence

of drinking and smoking found no relationship between the two – people tended not to report that they smoked more when drinking. However, self-monitoring data of drinking patterns did reveal such a relationship. In between-subjects analyses, Keefe, et al. (1997) found that greater use of a variety of coping strategies was related to greater pain. Within-person analyses, however, revealed that use of certain strategies was associated with decreased next-day pain, and improved next-day mood. As a final example, Catley (1999) found that whilst pain and affect (both PA and NA) were not significantly related in between-subjects analyses, significant relationships in the expected direction were found for both PA and NA at the within-subjects level. Whilst Catley's (1999) sample size was negligible (n=45), perhaps accounting for the lack of significance of between subject relationships, it does illustrate the point that if she had not conducted a within-person analysis her conclusions about the pain/affect relationship would have been different.

Other benefits. Because within-person designs investigate the relationship between variables as they operate within persons, these designs avoid the potential confounding effects of person variables. That is, pre-existing differences between people cannot act to confound the within-person effects, though they can be responsible for differences in effect between people (Feldman, et al., 1999). Similarly, individual response biases (such as exaggerating or down-playing reports of pain) are not necessarily problematic in such analyses (Vendrig and Lousberg 1997).

Palm-held computers in EMA. The palm-held computer (or, *personal digital assistant;* PDA) represents one of the biggest steps in the advancement of ambulatory monitoring (Fahrenberg, 1996). PDAs have an in-built clock, LCD display and auditory

signalling device, and sufficient memory and battery-life to suit the requirements of most EMA studies. More recent models (eg. the Casio E-10 and E-11) operate on Windows CE platforms which enable the use of flexible and innovative formats. PDAs have a number of advantages over paper-and-pencil methods (Kenardy & Adams, 1993; Newman, Consoli & Taylor, 1997; Fahrenberg, 1996):

a) The PDA's small size and weight makes it convenient for subjects to carry. It is unobtrusive (it looks like a personal organiser) and fits into a pocket or handbag.

b) The computer prompts compliance with the monitoring schedule through an auditory tone. It can be programmed to emit extra reminder signals until the subject commences monitoring. These measures ensure that monitoring is completed at the intended time – thus protecting the ecological validity of the data. Alternatively, if the computer is used for event recording, the subject can easily activate it at any time.

c) The computer automatically dates and times all entries. This ensures that, unlike paper-and-pencil methods, entries cannot be made retrospectively. Also, the computer is able to keep a record of delays in recording entries and the time taken to complete an entry.

d) All data is coded and can be downloaded frequently. This helps ensure that the subject's confidentiality is maintained.

e) Large amounts of data can be easily stored, analyzed and presented automatically. This cuts down on time and energy expenditure, and reduced paper usage. In addition, the probability of scoring or data transposition errors is minimised.

f) The structure imposed by the PDA in making a response to questions ensures that invalid responses cannot be made.

g) Information can be obtained in a more user-friendly way. Subjects can be presented with multiple-choice formats, scales, graphic representations or any number of alternative methods for providing answers. Questions can be ordered in a flexible way.

h) A greater amount of more useful information can be obtained in a more time-efficient way. Branching questions cut down on otherwise redundant items and provide useful information based on subject's previous answers. The sequence and hierarchy of questions can be tailor made.

i) Computers can be programmed not to proceed until an item is responded to, thus providing an incentive for increasing compliance.

j) As a further means of encouraging compliance, the PDA can be programmed to signal the participant if they are taking too long on an entry (or if they have abandoned it).

k) Previously recorded answers are concealed from the subject, helping to eliminate reactivity due to feedback.

l) PDA's can be used concurrently with ambulatory physiological instruments (see Lint, Taylor, Fried-Behar & Kenardy, 1995).

3.1.1 Methodological Issues in EMA

3.1.1.1 Signal compliance

The more signals participants respond to and the shorter their response latency, the more confident the researcher can be that the method is truly representative of every-day

experience. Overall compliance rates (the percentage of total possible entries that were actually completed) have varied from an average of 80% (Csikszentmihalyi & Larson, 1987) to 86% (deVries, Delespaul, Dijkman & Theunissen, 1986). Compliance rates for Csikszentmihalyi & Larson's (1987) sample varied from 73% for blue-collar workers to 85% and 92% for clerical and managerial workers, respectively. They found that in 64% of cases subjects responded to the signal immediately, and 87% responded within 10 minutes. Hormuth (1985; cited in DeVries, 1992) found that half of signals were responded to immediately. Response latencies of up to 5 minutes were observed in 80% of cases and up to 18 minutes in 90% of cases. However, Stone, Shiffman, Schwartz, Broderick & Hufford (2002) provided convincing evidence that reported compliance rates of paper-and-pencil diaries cannot be trusted. They paid forty chronic pain patients $150 to make three paper-and-pencil EMA records per day over an average of 20.5 days. Special diaries were used – they were fitted with photo-sensors that could validate actual entry times against reported entry-times. Subjects were considered to have been compliant if they responded to an alarm within 15 minutes. The authors found that whilst 90% of entries were reported to be compliant, photo-sensor recordings demonstrated that only 11% were. The actual compliance rate rose to 20% if a more liberal 90-minute compliance window was allowed. In contrast a 94% compliance rate was obtained by a separate sample of 40 participants using palm-held computers. Fourty-percent of participants "hoarded" at least once – that is, they made entries during a subsequent entry slot, claiming compliance for the previous entry. On 32% of days no entries were made at all, yet participants reported a 92% compliance rate on those days.

PDAs can be programmed to ensure that entries are made in close proximity to the time of the signal. This assurance, which cannot be made using paper-and-pencil approaches, is likely to have important effects on compliance rates. In their EMA study, Pawlik and Buse (1982) reported that subjects responded to an average of 86% of PDA signals. Similarly, in Kenardy, Fried, Taylor, and Kraemer's (1992) study, subjects monitoring panic symptoms on PDAs had a mean compliance rate of 87.7%. These rates are comparable to most EMA studies, in which between 80% and 90% of signals are responded to (eg. Csikzentmihalyi & Figurski, 1982; Dellespaul & deVries, 1987). In contrast, Hank and Schwenkmezger (1996) found that whilst paper-and-pencil monitoring procedures produced a near perfect compliance rate, subjects who monitored using PDAs only responded to 75% of signals. Although these findings appear to reflect badly on the PDA, the authors interpreted them as resulting from subject's disregard for instructions in the paper-and-pencil condition. That is, subjects using PDA were forced to answer immediately, whilst those using paper-and-pencil methods were far more likely to have completed entries after the assigned 10 minute cut-off time – a suggestion later supported by Stone, et al. (2002).

In terms of chronic pain populations, comparable compliance rates have been found – such as the 94% compliance reported by Stone, Broderick, Schwartz, Shiffman, Litcher-Kelly and Calvanese's (2003) PDA users. Peters, et al. (2000) found a total compliance rate of approximately 88% in their PDA-based study of 88 general chronic pain patients. Of the 116 signal-contingent entries planned for each participant they obtained an average of 108.4 responses per person (ranging from 77 to 140, excluding one participant with 41 entries). They found that an average of 10.6% of signal-contingent entries were

not responded to, 5.1% were missed due to technical problems, and 1.5% were voluntarily skipped. All participants received a monetary reward of 100 Dutch guilders. Catley (1999), who also offered a monetary incentive, obtained a 91% compliance rate – however this was after removing subjects with poor compliance (defined as those making fewer than six of the 12 total prompts over two days). Keefe, et al. (1997) found a 97.6% compliance rate in a sample of 53 rheumatoid arthritis patients (92% women) making daily ratings over 30 consecutive days. Participants were offered a monetary incentive. Of Feldman, et al's (1999) sample of 153 RSD patients who were asked to complete four weeks of end-of-day paper-and-pencil recordings, 70% provided at least one week of monitoring data. A total compliance rate of 91% was obtained. In terms of timeliness of their end-of-day entries, they reported that 98% of entries were made on the correct day, with 2% completed one day late, and 0.4% completed 2 to 3 days late. Participants were given a small monetary reward for being involved in the project ($5). Gil, et al. (2003) found a slightly lower compliance rate of 76% amongst 37 adolescents with sickle-cell disease. Participants completed one entry per day over up to 6 months, and were given a monetary incentive.

Stone, et al. (2003) found that varying the demand of the monitoring-schedule did not influence compliance. In their PDA-based study of 91 general chronic pain patients they found no significant difference in compliance rate between participants completing three, six and twelve entries per day (compliance rates were 93.5%, 93.9% and 95.5% respectively). The three groups did not differ on average number of monitoring days completed, with all three completing an average of slightly over 14 days of monitoring. There was also no difference between groups in terms of the number of entries that were

postponed per day (0.62, 0.73 and 0.92 respectively). Stone, et al. (2003) offered a monetary reward of $100 to participants who completed the project.

Lousberg, et al. (1997) found that the rate of missing entries differed between measurement scales. The lowest compliance was found for the MPI Affective Distress and General Activity scales (missing data rates were 24% and 27% respectively) whilst the greatest compliance was found for the spousal response scales (missing-data rates of 6% were found for Solicitous and Distracting Responses, and 5% for Punishing Responses).

3.1.1.2 Stability

Although one of the intrinsic values of EMA data is its ability to reveal temporal fluctuations in the variables it measures, there should nonetheless be a certain amount of stability within individuals over time. Csikszentmihalyi & Larson (1987) hoped to assess rating stability for activity frequencies and psychological states (including affect, activation, motivation and cognitive efficiency) by comparing the first half of the sampling week to the second half in a sample of both adolescents and adults. Average activity levels only changed for adolescents, and this appeared to be due to the occurrence of more weekend ratings in the first half of the week. No change was found in mean psychological states. When analyses were conducted on the intra-subject level, significant correlations were consistently observed between the two halves of the week for both mean scores and standard deviations. Both Wells (1985) and Pawlik and Buse (1982) found confirmatory results.

Two-year test-retest data generated from a sample of 28 adolescents by Freeman, Csikszentmihalyi & Larson (1986) displayed significant correlations ranging from r=.45

to r=.75 on various psychological variables. Hormuth (1986) observed that rating categories that are rarely used are less stable, and those that are frequently used may display inflated stability because of a response-set bias.

3.1.1.3 Reactivity to Monitoring

Reactivity refers to the possibility that the EMA procedure itself may induce artificial changes in the nature of subject's self-reports (Hank & Schwenkmezger, 1996; Csikszentmihalyi and Larson, 1987). Hypothetically, the method may influence the amount of time subjects spend in certain situations (*situational selectivity*), or the way they behave (*behavioural variability*). Although the ecological focus of EMA stresses minimising the intrusiveness of the data-collection technique, the risk remains that the recording method is at least partially responsible for situational selectivity and behavioural variability. That is, subjects may be more or less likely to be involved in certain activities or go to certain places knowing that he/she may have to engage in self-monitoring (Hank & Schwenkmezger, 1996).

Possible means by which reactivity to monitoring may occur is by providing feedback, prompting self-focussed attention, or by being intrusive (Hank & Schwenkmezger, 1996). The technique does not appear to be seen as intrusive by a majority of participants. Thirty-two percent of Csikszentmihalyi and Larson's (1987) sample reported that the technique was disruptive or annoying after one week of monitoring. In Hormuth's (1986) study 22% of participants felt that the method disrupted their daily routine, however, 75% agreed to monitor themselves a second time.

The EMA approach promotes quite intense self-observation and introspection (Hormuth, 1986). When induced, self-awareness has been shown to improve the validity of self-

report questionnaires (Gibbons, 1983). However, self-awareness has also been shown to alter subjective perceptions of a situation and to change behavior, for example by increasing social conformity (Wicklund, 1975; Hormuth, 1982). The proportion of occasions subjects have reported self-focussed thoughts at the time of a monitoring alarm varies from 8% (Hormuth, 1984) to 31% (Csikszentmihalyi & Figurski, 1982) and 41% (Franzoi & Brewer, 1984). Although these findings are inconclusive, Hormuth (1986) concludes "unless specific self-awareness manipulations or instructions at the time of the signal are included, the influence of the method does not seem to be strong enough to change the situation nor increase the accuracy of perception" (pp. 285-286). Csikszentmihalyi and Larson (1987) tested for reactivity effects by looking for systematic changes in mean responses over one week. No items (including affect, activation, motivation and cognitive efficiency) changed their mean values over the course of the week, suggesting that the monitoring procedure did not influence a drift in subject's responses. However, the variance of certain psychological variables decreased in the second half of the week. Decreased variability in psychological states was not attributable to changes in responsiveness to environmental factors – it was related to greater predictability in individual participant's response-styles. Csikszentmihalyi and Larson (1987) interpreted this as meaning that participants developed "more precise self-anchoring on the rating scales" (p530). Perrez and Reicherts (1992), comparing responses from the first half of the monitoring week to the second, found some differences in the way certain variables interacted. Although the implications of these findings were ambiguous, Hank and Schwenkmezger (1996) warn that once one receives feedback

about one's behavior and its context-relatedness the stage is set for self-initiated behavior change.

It is possible that PDA-based assessment may induce reactivity because participants do not want to be seen with the device, or because the beep is intrusive. However, in studies by Kenardy, et al. (1992) and Taylor, Fried and Kenardy (1990) less than 5% of participants reported that one beep every two hours was intrusive.

Subjects using PDAs have no access to prior entries and must answer questions in a standard order, whilst paper-and-pencil methods provide immediate feedback and allow freedom to answer in any order. Such freedom in response order afforded by paper-and-pencil questionnaires may be disadvantageous in terms of maintaining consistency over repeated monitoring episodes. Furthermore, the concealment of previous entries made possible by PDA approaches may reduce the risk of biased or "stereotyped" responses over repeated measurement occasions.

In the case of pain, ratings of pain could increase during the course of monitoring because, for example, participants may become more aware of and sensitive to their pain experience. Alternatively, sensitivity to pain may be reduced by fatigue, which may be affected by the monitoring schedule. Over the course of a monitoring study, participants responsiveness to monitoring may reduce (for example, if they become frustrated or bored with the procedure) and their responses may become more similar. That is, the variability of scores may reduce over the course of monitoring.

A number of studies have sought to determine whether reactivity is indeed an issue in the repeated measurement of pain:

Von Baeyer (1994) had 54 low-back pain patients keep daily records for eight days. Three groups differed in terms of the intensity of their daily monitoring requirements – either the McGill scale, a brief pain diary, or a non-pain-related diet list. Before and after the eight days of monitoring, participants rated pain-related emotional states and their worst, least and usual pain. Von Baeyer found no post-monitoring differences between the groups on any dependent measure, suggesting that reactivity did not influence ratings. Cruise, Broderick, Porter, Kaell, & Stone (1996) tested for reactivity to diary self-assessments of pain by using EMA conducted via PDAs. They found no evidence of reactivity – participants' responses did not alter systematically after one-week of assessment with seven signals per day. Similarly, Peters, et al. (2000) found no systematic change in pain ratings over the course of their 4-week study, though they found a slight increase in the incidence of missing and skipped entries over that time. Stone, et al. (2003) sought to determine whether reactivity effects may occur as a function of the density of monitoring schedules. Participants were asked to complete three, six or 12 samples per day. They found that ratings of the presence/absence of pain was unrelated to linear effects of time over two weeks of monitoring, either for the whole sample or according to the different monitoring densities. When they analyzed pain-intensity for those entries where pain was reported as being present, the authors found that the three-sample group demonstrated a negative trend over the monitoring fortnight, the six-sample group demonstrated a positive trend, and the 12-sample group displayed no trend. The authors concluded that reactivity to pain monitoring was possible, although they found no systematic effect to suggest that it was likely.

Stone, et al. (2003) also hypothesized that the density of the monitoring schedule might have reactive effects in terms of influencing recall of weekly pain. They found that the groups differing in monitoring density did not differ in their recall of pain from a control group who did no daily monitoring. Also, for the groups doing daily monitoring there was no difference in pain recall between weeks when EMA monitoring was conducted and non-monitored weeks. Thus, by both accounts, EMA self-monitoring appeared to have no reactive effect on memory for pain intensity.

The findings of these studies are encouraging for the validity of computerized EMA for the assessment of chronic pain, and contrast with findings that self-assessment influences ratings of acute (eg. labour and post-operative dental pain) and experimentally induced pain (eg. Leventhal, Leventhal, Shacham & Easterling, 1989; Levine, Newton, Smith & Fields, 1982).

3.1.1.4 Limited item-sets

Given that EMA requires participants to complete multiple assessments, usually over a number of days and often with a number of entries per day, the item pool for a comprehensive cognitive-behavioural assessment must be reduced markedly. Cross-sectional studies often require participants to complete approximately five questionnaires, each with ten to thirty items. For example, the five pain belief and coping measures investigated by Jensen, Keefe, Lefebvre, Romano, and Turner (2003) contained a total of 200 items. Such an item pool would clearly be problematic for studies involving intensive repeated measurements. If participants are required to complete too many items per entry they are likely to be less compliant with the monitoring schedule. Alternatively, non-compliance may be more likely in specific contexts where completing a long diary entry

is seen as impractical, thus limiting the extent to which diary data is representative of ecological contexts.

3.2 Measurement of Momentary Adaptational Status in Chronic Pain

Measurement, given the small item-set problem, has been handled in different ways by EMA researchers in the field of adaptation to chronic pain. Generally, studies have either (a) adopted a subset of items from a questionnaire generally used in cross-sectional research, (b) used existing scales outright, (c) devised single-item or small-item scales for assessment of specific constructs, or (d) employed questionnaires specifically designed for use in EMA research. For example, the first of these approaches was taken by Affleck Pfeifer, Tennen, and Fifield (1988), Keefe, et al. (1997), and Peters, et al. (2000), who adopted selected scales of the POMS-B. Items from standard questionnaires may need to be adapted for use in EMA studies. Peters, et al. (2000) adapted existing scales of the MPI, CSQ and SF-36 by changing the wording of items to be relevant for momentary assessments. Presumably some amount of effort should be expended to validate the new format, though in Peters, et al.'s case this was not explicitly done.

Sometimes existing questionnaires are simply administered over multiple time-points. For example, Keefe, et al.'s (1997) measure of RA pain was via the Rapid Assessment of Disease Activity in Rheumatology (RADAR), in which subjects rate 20 joints or joint groups on a 4-point numerical scale. In these cases, the scope of a study generally needs to be quite specific, allowing measurement of a small number of constructs with a larger pool of items. Also, the scale needs to be relevant for EMA application (eg. enquiring about state-like constructs in a momentary fashion), or else modified.

An example of the third approach is Vendrig and Lousberg's (1997) single-item likert scales to measure pain intensity, mood, and activity level. Jensen, et al. (2003) constructed one- and two- item measures of a range of constructs via thorough empirical means. They selected those items from the Survey of Pain Attitudes (SOPA; Jensen, Karoly & Huger, 1987), Chronic Pain Coping Inventory (CPCI; Jensen, Turner, Romano, & Strom, 1995), CSQ, Pain Beliefs and Perceptions Inventory (PBAPI; Williams, Robinson, & Geisser, 1994), and the Arthritis Self-Efficacy Scale (ASES; Lorig, Chastain, Ung, Shoor, & Holman, 1989) that had the highest item-total correlations, greatest sensitivity to change from pre- to post-treatment, and greatest relationship with pain intensity, depression, and disability.

Finally, in their investigation into coping amongst people with rheumatoid arthritis, Affleck, Urrows, et al. (1992) used the Daily Life Experience Checklist (Stone and Neale, 1982), which was developed for repeated use within people.

The current study employed custom-made scales, largely derived from items in existing scales, which were developed and validated (see Study One) for use in Study Two. The six scales, measuring a range of constructs, consist of one to three continuously measured items, or up to thirteen dichotomously scored items.

3.3 Intra-Individual Models of Adaptation

3.3.1 Variation Within- and Between- Days

Pain conditions have been classified by the IASP according to the temporal properties of the pain experienced: Continuous or nearly continuous, non-fluctuating; Continuous or nearly continuous, fluctuating; Recurring, irregularly; Recurring, regularly; Paroxysmal; and, sustained with superimposed paroxysms (Merskey 1986). A growing body of

research focuses on this notion that the experience of pain varies not only between people, but it fluctuates within people, and that part of this fluctuation is associated with factors such as mood and activity level (Stone, et al., 2003).

The majority of studies investigating momentary adaptational status in pain appear to run analyses on a daily basis. Fewer studies have conducted multiple within-day analyses. Of the former studies, a number have compared the variation of pain and mood within-people to the variation between people, demonstrating that significant proportions of variation exist at the within-person level. Grant (1998), over 30 days of nightly monitoring, found that 32% of variance in pain intensity was within-people, as was 47% of depressed mood, and 43% of anxious mood. On 11-point NRSs for pain intensity, within-person ratings of pain varied by an average standard deviation of 1.46, compared with an average between person standard deviation of 2.13. Keefe, Affleck, Lefebvre, Underwood, Caldwell, Drew, Egert, Gibson, and Pargament (2001) found that 21.9% of variability in the pain reports of rheumatoid arthritis (RA) patients was within-people, over 30 days of once-daily monitoring. Focht, Ewing, Gauvin & Rejeski (2002) investigated variations in pain and mood both over days and within days in a sample of 32 overweight individuals with osteoarthritic knee pain. Sampling was conducted via booklets six times per day for six days. Like Grant (1998), approximately one-third of the variance in both pain and negative affect was within-people.

Affleck, Tennen, Urrows, & Higgins (1994), over 75 days of daily-monitoring with RA patients found that mood (measured on 27-point scale) had an average standard deviation of 2.83, compared to between person variation of SD=1.6. Joint pain (on a 60 point-scale)

displayed an average standard deviation of 4.16, and varied to a lesser extent between people (SD=2.3).

Affleck, Tennen, Urrows and Higgins (1991) clearly illustrated that the experience of pain varies within- as well as between- people. They sought to explore the temporal sequencing of rheumatoid arthritis pain in fine-grained analyses via monitoring the daily pain of 47 RA sufferers over 75 days. On a 60-point scale (the RADAR) where each of twenty joints are rated from 0 (no pain or tenderness) to 3 (severe pain or tenderness) they noted a mean score of 13.3 (SD= 9.77), with a mean standard deviation of 4.05 (SD=2.18). The majority of cases (52.8%) displayed a significant positive skew in pain ratings, and negative skew was present in only two cases. The majority of cases also showed a significant trend (49.6%), with 61% of these being upward over the monitoring days, and 49% being a downward trend. Pain was predictable from one day to the next (first-order autocorrelation) in 87.2% of cases (70.2% of cases when the effect of trending was statistically removed). Controlling for both first-order autocorrelation and trending, 36% of cases displayed autocorrelation effects over two to nine days. Affleck, et al. (1991) then sought to identify *outlier* days, where the pain was either absent (painless days), or more severe than usual (painful days). On average, people experienced 2.2 painful days and 0.37 painless days. Painless and painful outlier days were identified in the majority (63.9%) of cases. Of these, 80% demonstrated at least one day of unusually high pain and no pain-free days. Half of the participants that demonstrated more than one painful day displayed a series of two to three consecutive painful days. Affleck, et al. (1991) also investigated correlates of temporal characteristics of pain. Higher RA disease activity was associated with worse average pain, more variable pain,

steeper trending, fewer outlier days and shorter duration of outlier periods, and greater predictability from one day to the next (first-order autocorrelation). Physical disability was associated with higher mean pain, more variable pain, and a more normal pain distribution. Finally, depression was associated only with higher mean pain.

3.3.1.1 Diurnal Trends in Pain

A small number of studies have investigated within-day patterns of pain. It appears clear that diurnal trends exist, however it is apparent that there is great variability in within-day patterns between individuals. The most common pattern appears to be an increasing diurnal trend in pain, though this is not a consistent finding (Focht, et al., 2002). Pain associated with rheumatoid arthritis appears to peak in the morning (eg. Stone, et al., 1997; Labrecque & Vanier, 1995), whereas pain from osteoarthritis, for example, tends to increase during the day (eg. Bellamy, Sothern, & Campbell, 1985). There appears to be mixed evidence that diurnal trends are associated with other person variables, such as depression and neuroticism, though the within-day co-variation of pain and distress appears to be reasonably well established.

Early work by Folkard, Glynn and Lloyd (1976), with 41 chronic pain outpatients, demonstrated that daily ratings displayed reliable variation within days, but there were no indications of day-of-week effects or an interaction between day-of-week and time-of-day. Specifically, pain ratings increased over the course of the day, with an estimated peak at 10:27pm. They reported no significant difference in diurnal course between sub-groups with differing pain diagnoses, though sample sizes were quite small. Interestingly, introverts reported more pain between 10:00am and 2:00pm than extroverts – demonstrating a “phase shift” such that pain levels appeared to rise earlier than they did

for extroverts. Also, participants with high neuroticism scores demonstrated an earlier daily rise in pain-levels than those without. Females demonstrated a greater rise in pain ratings than males, and reported higher pain levels over-all. Participants who stayed at home during the day reported higher pain levels over-all compared to those who went out to work, but those two groups also demonstrated different profiles. Participants who worked away from home demonstrated a morning drop in pain level, which did not rise until approximately 6:00pm. The at-home group demonstrated a morning rise in pain that levelled-off at midday and remaining constant for the rest of the day. The at-home group also rated their pain as being worse in the evenings.

Jamison and Brown (1991) identified diurnal profiles in a sample of 195 chronic pain patients. They identified groups of participants who demonstrated an increase (35%) or decrease (8%) in pain from morning to evening, and U-shaped profiles where pain was worse at midday (14%) or in the morning and evenings (7%). Eight percent demonstrated complex slopes, and 28% no slope at all. Those who displayed no apparent diurnal trend were more emotionally distressed than participants who displayed a trend. Focht, et al. (2002) also identified an inverted U-shape in pain monitored six timed per day in a sample of 32 individuals with osteoarthritic knee pain. Modelling their daily pain ratings against linear, quadratic, and cubic trends, they found that only the quadratic trend was significant – accounting for 2.3% of within person variance in pain-intensity.

In a general sample of chronic pain patients Vendrig and Lousberg (1997) found that those who displayed a positive relationship between their mood and pain experienced more pain and distress in the mornings and evenings, whilst individuals who displayed no

pain/mood relationship demonstrated no such within-day fluctuation. In both cases individuals displayed a steady decline in activity level in the course of a day.

Stone, et al. (1997) had 35 people with rheumatoid arthritis engage in seven days of monitoring, with seven entries per day, separated by approximately two-hour intervals. They found no variation in pain over days of the week, but substantial within-day variation. Almost 40% of their sample displayed diurnal variation, with pain at its worst in the morning, and decreasing by midday to a steady rate over the rest of the day. Neuroticism, trait-anxiety, and depression did not discriminate between those who displayed a diurnal pattern and those who did not.

Peters, et al. (2000) conducted a PDA-based EMA study with 80 participants with a range of chronic pain conditions and differing durations of pain-history (3-6 months; 6-12 months; over 12 months). They conducted monitoring over four weeks, taking entries four times per day between 8:00am and 9:30pm, as well as participant-initiated entries prior to bed and upon waking. They found an increasing diurnal trend in pain that did not differ between the three pain-history groups. At a subject-level analysis an increasing trend was prominent in 47.5% of subjects, however another 47.5% displayed no significant trend. A decreasing trend was seen in 2.5% of subjects, and a U-shaped trend was seen in another 2.5%. As with Stone, et al. (1997), differences in trend were not related to depression, symptomatology, gender, or work status.

3.3.1.2 Diurnal Trends in Mood

A range of emotional states have also demonstrated predictable diurnal variation, and this has been demonstrated in normal (eg. Fahrenberg, Brugner, Foerster & Kappler, 1999),

psychopathological (eg. Kenardy, et al., 1992), and to a lesser degree, chronic pain (Focht, et al., 2002) populations.

Fahrenberg, et al. (1999) found that "angry/irritated" mood-states followed an inverted-U shape, with a peak in the middle of the day. Whilst Hartwig (2000) found no diurnal pattern for state anxiety in a student sample, such variation has been demonstrated in samples with Generalised Anxiety Disorder (GAD; Hopkins, 1995) and Panic Disorder (PD; Kenardy, et al., 1992; Geraci & Uhde, 1992). Hopkins (1995) had 23 GAD patients monitor morning, afternoon and evening anxiety for two weeks. A diurnal pattern was apparent in 39% of participants, with approximately half of these demonstrating a peak in the afternoon. Kenardy, et al. (1992) found that in a sample of PD patients, both panic symptomatology and anxiety increased during the morning and reduced in the evening. Geraci and Uhde (1992) also observed diurnal variation in anxiety amongst those with PD, but found that it interacted with depression – those with a history of depression or a current depressive episode demonstrated greater diurnal variation, with more panic attacks in the morning and afternoon.

Diurnal variation also appears to exist in depressive mood-states, though there appears to be significant variability between people. In a sample of 18 inpatients with major depression, Barbini, Benedetti, Colombo, Guglielmo, Campori and Smeraldi (1998) observed daily rhythms in a VAS mood rating in only 44% of the sample.

A "morning-prominent" pattern appears to be the most common finding (eg. Taub & Berger, 1974; Tolle & Goetze, 1987; Stallone, Huba, Lawlor & Fieve, 1973), though "evening-prominent" patterns in depressive mood have also been observed (eg. Haug & Fahndrich, 1992). There are suggestions that morning-prominent depression may be

associated with a more severe depressive syndrome and a wider range of depressive symptoms (which may be endogenous) whereas evening-prominent depression may be associated with non-clinical depression or chronic but milder forms of depression (eg. Robbins & Tanck, 1987). Indeed, morning-prominence has been demonstrated most strongly in clinical samples (eg. Taub & Berger, 1974) whereas evening-proneness has been observed in student and non-clinical samples (eg. Haug & Fahndrich, 1992). Rusting and Larsen (1998) found no prominent diurnal trends in depressive mood in their sample of 46 students, though evening-proneness was correlated with dispositional factors such as neuroticism, anxiety and private self-consciousness.

Findings by Wood and Magnello (1992) support a distinction between positive and negative affect in diurnal trending. They found that positive mood demonstrated variation, peaking in the afternoon, whereas negative affect demonstrated no diurnal trend. The authors suggested that PA may be more related to biological processes such as cortisol fluctuations whilst NA may be more environmentally determined. Stone, Smyth, Pickering & Schwartz (1996) set about untangling the influence of environmental factors on a range of mood-states from more natural (possibly biologically-driven) variation. They had 94 insurance-company employees monitor a range of mood-states, their location, and activities on a 15-minute basis for one day. Ratings were combined into hourly scores to investigate daily profiles of annoyed, happy, tired, anxious, angry, bored, rushed, sad, tense, and stressed moods. Prior to controlling for activities and location a number of mood-states demonstrated variation, including “annoyed”, “anxious”, and “happy”. Annoyed and anxious moods demonstrated downward linear trends that accounted for only 0.3% of variance in each variable. Happy mood demonstrated a linear

trend that accounted for approximately 1.8% variance and a quadratic trend that accounted for 0.2%. The variable displayed a relatively even low profile in the morning that increased at midday but elevated quickly from mid-afternoon to a peak in the evening. After controlling for environmental factors a number of changes in daily mood-trends were apparent. The trend of some moods became non-significant, such as anxious mood. Other mood-states changed their profile, such as annoyed mood, which revealed a significant quadratic trend (a dip in the middle of the day) that accounted for 1% variance. Happy mood also changed profile, demonstrating only an upward linear trend that accounted for 1% variance. Sad mood demonstrated a significant trend that appeared to have been suppressed by the influence of environmental events – 0.4% of sadness was accounted for by a quadratic trend whereby peaks were observed in the morning and evening. In all cases environmental factors accounted for more variance in the mood-states than did time-of-day, accounting for 12.8% in happy mood to 1.2% in anxious and sad moods.

Daily patterns in the mood-states of pain populations appears to have received very little research attention. Focht, et al.'s (2002) study involving 32 older obese patients with osteoarthritic knee pain is an exception, reporting that NA decreased throughout the day in a linear fashion – accounting for 1.2% variance.

3.3.2 Covariation of Pain and Mood

The within-person relationship between mood and pain has also attracted EMA research, looking at this relationship on both across- and within- day levels.

Findings vary in terms of the across-day relations between pain and negative-mood. The general picture that emerges is that whilst the average effect is in the positive direction,

there is significant variation between people. Affleck, et al. (1994) found that the overall beta-weight between same-day negative-mood and pain, ß=0.11, was not significant, however the value ranged from -0.23 to 0.52. Affleck, Urrows, et al. (1992), investigating the daily reports of 75 RA patients over 75 days, found an average across-day correlation between pain and positive mood of r=-.037.

Affleck, Tennen, Urrows, & Higgins (1992) found that amongst 54 RA patients who were monitored over 75 days, the daily pain/*positive*-mood association was generally negative, displaying an average beta-weight of -0.19 (SD=0.2). This effect varied from beta-weights of -0.81 to 0.2. On a case-by-case basis, pain was related to same-day lower mood in 40.7% of cases. No cases displayed a significant effect in the opposite direction. The pain/mood relationship was weaker for those who were more neurotic, with a shorter illness duration, less disability, less disease activity, and lower average daily pain intensity.

Gil, et al. (2003) conducted a more complex multi-level analysis in a sample of 37 adolescents with sickle-cell disease. They found that positive mood and pain shared a negative relationship (ß=-0.4), and negative mood and pain were positively related (ß=0.36). However the effect of negative mood vanished when entered into an analyses simultaneously with stress and positive mood. Also using multi-level analyses, Feldman, et al. (1999) investigated the relationship between pain and mood across days. They had 109 people with reflex sympathetic dystrophy complete end-of-day diary entries over 28 consecutive days. Previous-day depression predicted increased pain, though previous-day anxiety and anger did not. Conversely, previous-day pain predicted greater depression, anger, anxiety, and a general distress composite of all three mood-states. They found that

the relationship between pain and subsequent-day distress was mediated by the perception of social support. That is, for those with greater perceived social support, pain had a reduced impact upon negative mood.

Gil, et al. (2003) also investigated lagged effects, but unlike Feldman, et al. (1999) they found no lagged relationship between positive or negative mood and pain either one or two days later. On the other hand, both pain from sickle-cell disease and pain from other sources were related to lower positive mood on the next day (ß= -0.01 for sickle-cell pain and –0.03 for other pain) and the day after (ß= -0.02 for sickle-cell pain and –0.01 for other pain). Negative mood was only predicted by previous day non-sickle-cell disease pain (beta=0.03).

Fewer studies have examined the relationship between pain and mood within-days. Perhaps not surprisingly, these studies reveal much the same picture as across-day findings. Vendrig and Lousberg (1997) had 57 chronic pain patients monitor their pain, mood, and activity level eight times per day for six days. They calculated pair-wise correlation coefficients for each participant, then calculated mean coefficients across individuals. They found a significant overall correlation between pain and positive mood in the negative direction (r=-0.22). Approximately 40% of participants demonstrated a significant negative relationship between pain and positive mood (averaging r=-.51). These participants displayed significantly higher pain reports and worse mood than other participants. Eight-percent of participants displayed significant correlations in the opposite direction (averaging r=.44). The authors suggested that the latter individuals may involve themselves in more rewarding positive activities at the cost of an increase in

pain. Catley (1999) reported a negative average relationship between same-moment pain and PA (ß=-0.21) and a positive, but somewhat smaller, relationship with NA (ß=.023). In summary, although it appears clear that there is a relationship between pain and mood, few studies (Feldman, et al., 1999; Gil, et al., 2003) have explored possible causal relationships. Further analyses involving cross-lag analyses, such as the current study, are needed to further explore these issues.

In a related area, a number of EMA studies have identified a stress-reactivity pattern where occurrence of stressful events impacts negatively upon the experience of pain. Stone, et al. (1997) found that the occurrence of stressful events in the interval prior to entries was associated with greater pain, and a positive relationship was observed between pain and the reported stressfulness of the event.

In their study of 75 people with rheumatoid arthritis Affleck, Urrows, et al. (1992) calculated time-series coefficients for each participant, and then looked for inter-individual effects via meta-analytic techniques. They found no consistent relationship between the occurrence of daily stressors and next-day pain. However, they found that individuals with more active arthritic states (measured by examination of joint swelling and an immunological marker of inflammation) displayed such a relationship. A positive stressor/next-day-pain relationship was also found for individuals who had experienced a major stressful event in the prior 6-month period.

3.3.3 Covariation of Pain and Function

A small amount of research has investigated the within-person relationship between pain and function. There appears to be sparse evidence for a clear relationship between the two, with the direction of any relationship appearing equivocal, and apparent variation

between people. Linton (1985) calculated within-person correlations between daily pain and daily involvement in ADLs, measured over at-least a two-week period. Of 15 participants, only six displayed a significant correlation (between r=-.66 and .45). Only one participant demonstrated a significant positive correlation. Vendrig and Lousberg (1997) investigated the relationship between activity level, pain and mood. They found a non-significant relationship between pain and activity level (r=.01ns) and between mood and activity level (r=.06ns). Approximately 27% of participants demonstrated a positive pain/activity relationship (averaging r=.4), whilst 11% demonstrated an effect in the opposite direction (averaging r=-0.41). Whilst Linton demonstrated a predominant negative relationship and Vendrig and Lousberg a more prominent positive relationship, both effects could be interpreted in plausible ways. Namely, when people experience greater pain they may escape from or avoid ADLs, and any activity that is performed may be associated with increased pain.

Focht, et al. (2002) sought to address the effects of acute physical exercise on pain and mood in a more fine-grained analysis. They had 32 people with osteoarthritic knee pain monitor their pain and mood six times per day over six days. Exercises – consisting of a five minute warm-up, two 15 minute walks, a 20 minute strength-training session, and 5 minutes cool-down – were performed on three of those days, with additional diary entries performed immediately before and after exercises. Entries were then classified as being on non-exercise days, prior to exercise on an exercise day, immediately prior to exercise, immediately after exercise, and post-exercise on an exercise day. Citing prior findings that, amongst osteoarthritis sufferers, pain intensity was negatively related to time spent in aerobic exercise (Rejeski, Brawley, Ettinger, Morgan, & Thompson, 1997), the

authors suggested that acute exercise may exacerbate pain symptoms and that these flare-ups may serve as a disincentive for compliance with further exercise. In support of this, they found that even after controlling for time-of-day, stress, and medication use, pain demonstrated a significant elevation immediately after exercise. Relative to non-exercise days, pain remained somewhat elevated during the remainder of the day on exercise days, though at a lower intensity compared to the post-exercise pain. Such findings support the possibility that positive within-person correlations between pain and activity may be attributable to the "flare-up" phenomena whereby activity induces pain. The authors noted that alternative exercises, such as non-weight bearing activities, may have differing effects. Interestingly, exercise demonstrated no effect on negative affect.

Further research involving experimental designs and naturalistic studies employing lag-analyses (as is done in the current study) appears to be needed to illuminate and disentangle the two-way relationship between pain and activity.

This chapter introduced EMA – a methodology designed to capture repeated momentary data from within participants' natural environments. Literature was reviewed suggesting that EMA data has significant advantages over traditional cross-sectional research designs – it minimizes the risk of recall and judgement biases, maximises the ecological validity of the data, and, importantly, allows the researcher to observe dynamic processes that unfold within people. The current chapter also reviewed literature that justifies within-person approaches to chronic pain – pain and associated adaptational indices, such as distress and functioning, vary within people over time. Some of this variation appears to relate to diurnal patterns, though the literature suggests that pain also varied with factors such as mood and activity-level. The following chapter goes into greater depth

regarding factors that may be responsible for within-person changes in pain, mood and function. Stress and Coping theory is introduced, as are a number of appraisal and coping constructs that have been implicated by research taking a Stress and Coping perspective as being important in distinguishing between people in terms of their adaptation to life with chronic pain. Research suggesting that these factors may also be operating within people is discussed, leading into an overview of the aims of the current study.

4 THE STRESS AND COPING MODEL AND ADAPTATION TO CHRONIC PAIN

4.1 Psychological Factors As Explanatory Mechanisms

Psychological (cognitive, emotional, and behavioural) factors have been implicated as mechanisms that may explain differences in the adaptational status of people with chronic pain (Gamsa, 1994) and, to a lesser extent, as mechanisms influencing momentary adaptation status (eg. Keefe, et al., 1997). Research efforts have focused on such factors as appraisals, attitudes and beliefs (eg. Crombez,Vervaet, Baeyens, Lysens & Eelen, 1996; Lackner, et al., 1996; Rudy, et al., 1988; Strahl, Kleinknecht, & Dinnel, 2000; Sullivan, et al., 2002), avoidance-learning and fear (Lethem, Slade, Troup, & Bentley, 1983; Murphy, et al., 1997; Asmundson, Norton, & Norton, 1999), interpersonal interaction patterns (Subramanian 1986; Mikail, Henderson & Tasca, 1994; Murphy 1994; Schiaffino and Revenson 1995), and usage of coping strategies (Rosenstiel & Keefe, 1983; Spinhoven & Linssen 1991; Rokke & al' Absi, 1992; Grant, 1998).

Some support for models implicating psychological factors in adaptation to chronic pain comes from outcome research involving cognitive-behavioural therapy (CBT) – a set of interventions that aim to alter non-adaptive cognitive and behavioural patterns. CBT programs have been shown to effectively reduce psychopathology, decrease functional disability, decrease usage of health care services, and, in some cases, reduce the experience of pain (Turner 1980; Turner 1982; Holroyd and Panzien 1990; Nicholas, Wilson, & Goyen, 1991; Nicholas, Wilson, & Goyen, 1992).

Theoretical accounts of psychopathology and functioning have been applied to understanding adaptation to pain, including Social Learning Theory (Bandura, 1986),

Seligman's (1972) Learned Helplessness theory of depression, Lewinsohn's (1974) behavioural model of depression, Locus of Control Theory (eg. Smith, 1970; Calhoun, Cheney, & Dawes, 1974), and Beck's (1967) Cognitive theory of emotional disorders. For example, Rudy, et al.'s (1988) cognitive-behavioural model, derived from Lewinsohn and Seligman's models of depression, proposed that depression would be associated with perceptions of helplessness and lack-of-control, as suggested by Learned Helplessness theory, and limited availability of reinforcement and engagement in positive activities – evidenced by perceptions of life interference – as proposed by behavioral models. Accordingly, in their cross-sectional path model Rudy, et al. (1988) demonstrated that depression was related to participant's perceptions that pain interfered in their life and contributed to lack of life-control, but not to pain intensity *per se*.

Another, more general, model that has been widely applied to understanding adaptation to chronic pain, and which provides a framework for understanding possible psychological factors that may be involved, is Lazarus & Folkman's (1984) Stress and Coping theory (Jensen, Turner, Romano & Karoly, 1991).

4.2 The Stress And Coping Model

In Lazarus and Folkman's (1984) Stress and Coping model, stress is defined as "a relationship between the person and the environment that is appraised by the person as taxing or exceeding his or her resources and endangering well-being" (Lazarus and Folkman 1984, p19). Lazarus and Folkman suggest that stressors do not directly determine adaptational outcomes, but that adaptation is determined by how individuals cognitively appraise the stressors in their environment on an ongoing basis, and how they respond to the stressor in terms of coping efforts.

Lazarus and Folkman (1984) suggest that though appraisals are generally constrained by and reflective of the reality of the environment, they are imperfectly correlated with the environmental reality owing to individual differences such as personality factors. Lazarus and Folkman make a distinction between primary and secondary appraisals. Primary appraisals are judgements about the severity or intensity of the stressor, that is, whether it is irrelevant, positive, or associated with harm/loss, threat, or challenge in terms of its significance for the individual. Secondary appraisals are judgements about what can be done about the stressor, including the availability of coping options, whether coping efforts will produce a desired effect upon the stressor, and whether the individual is capable of enacting the strategy or set of strategies.

Lazarus and Folkman (1984) distinguish between appraisals and beliefs. Appraisals, which can be viewed as more micro-level cognitive constructs, vary from moment to moment, and these fluctuations are said to interact with stressors, coping responses, and adaptational outcomes in a dynamic, ongoing manner. Beliefs are "pre-existing notions about reality which serve as a perceptual lens" which influence appraisal in that they "determine what is fact, that is, 'how things are' in the environment, and they shape the understanding of its meaning" (Lazarus and Folkman 1984, p63). That is, beliefs can be thought of as more stable, macro-level constructs that, though they play a role in influencing the nature of appraisal, do not influence coping and adaptation at the momentary-level in the same way appraisal does.

Stress and coping theory suggests that appraisals not only influence adaptational outcomes directly, but also indirectly, via their influence on the selection and application of coping behaviours. Coping is defined as "constantly changing cognitive and

behavioural efforts to manage specific external and/or internal demands that are appraised as taxing or exceeding the resources of the person". Folkman & Lazarus (1980) classify coping into emotion-focussed and problem-focussed strategies. Problem-focussed coping involves strategies "directed at managing or altering the problem causing the distress" and emotion-focussed coping "is directed at regulating emotional response to the problem" (Lazarus and Folkman 1984, p150). Coping is considered to be behaviour and cognition that is effortful and deliberate, as opposed to adaptive processes that are enacted without volition or awareness. According to Stress and Coping theory, emotion-focussed coping is considered to be more likely when the stressor is appraised as being unamenable to change, whereas stressors appraised as being subject to control are more likely to be acted upon with problem-focussed strategies.

A stress and coping model of pain is in general concordance with how other cognitive and behavioural models approach adaptation to pain. For example, cognitive models of depression and anxiety (eg. Beck, 1967) suggest that depression does not arise directly from negative life experiences, but from mediating cognitive processes such as catastrophic thinking patterns and other erroneous cognitive styles. Seligman's (1972) learned helplessness theory, and locus-of-control theory (Smith, 1970; Calhoun, et al., 1974) propose other control-related cognitive mediational mechanisms by which appraisal may directly influence depression and other psychological indices of adaptation. These cognitive-emotional theories are consistent with Lazarus' (1993) view that cognition is necessary and sufficient in determining the nature and intensity of emotional reactions. Also consistent with Stress and Coping theory, social-learning theory (Bandura, 1977; 1986; 1997) provides a means of understanding how appraisal

constructs such as self-efficacy and expectancy relate to the selection, initiation, and maintenance of behaviours such as coping responses.

Importantly, the various elements within Stress and Coping theory are presumed to interact in an ongoing and dynamic way, such that the result of coping efforts and aspects of adaptation feed back to influence the stressor and the ongoing process of reappraisal (Lazarus & Folkman, 1984; Lazarus, 1999).

4.2.1 Application of Stress and Coping Model to Chronic Pain

Lazarus and Folkman's stress and coping model (Lazarus and Folkman 1984) provides a heuristic framework for understanding the possible pathways linking pain, the stressor, to adaptational outcomes (Jensen & Karoly, 1991; Jensen, Turner, Romano & Karoly, 1991). Research concerning adaptation to chronic pain that has applied this model construes the experience of pain as a stressor that interacts in an ongoing way with cognitive appraisals of pain, strategies aimed at coping with pain, and various adaptational outcomes. Appraisals may influence adaptation to the stressful experience of chronic pain directly via influences on mood and engagement in functional activities, or indirectly via selection and initiation of, and persistence in coping strategies (Jensen & Karoly, 1991). A large number of psychological factors have been studied in terms of their possible impact upon adaptation amongst people with chronic pain. In concordance with the distinction made in Stress and Coping theory, these are generally devisable into appraisal and coping factors. For example, in terms of cognitive factors, Jensen, Turner, Romano and Karoly (1991) identified seven general categories of pain-relevant cognitions that have been investigated in the literature: beliefs about general locus of

control; beliefs about control over pain; attributional style; cognitive errors; self-efficacy beliefs; outcome expectancies; and other pain cognitions.

Although still of interest, the unique effects of specific appraisal and coping constructs was not of primary interest in the current study. Rather, a representative selection of important appraisal and coping measures were used to assess the more general hypotheses that appraisal and coping are important in understanding momentary adaptational status, that these effects are independent of pain intensity, and that appraisal and coping have independent effects.

The following sections review cross-sectional evidence regarding specific appraisal and coping factors in adaptation to chronic pain. The first section provides a brief overview of literature concerning the four appraisal constructs investigated in the current study – catastrophising, perceived interference, pain self-efficacy, and pain expectancy – followed by a brief review of the pain-coping literature with a special focus on the coping dimensions of interest to the current study – active and passive coping. Finally, integrative investigations of coping and appraisal will be discussed.

4.3 Inter-personal Mechanisms of Adaptation to Pain

Prior to a review of appraisal constructs, a significant issue in the adaptation to chronic pain literature is noted (eg. Jensen, Turner, Romano & Karoly, 1991) – namely, confusion over definitions of constructs and conceptual overlap between constructs. For example, wide variety can be observed in the operationalization of some of the appraisal constructs mentioned below. In the chronic pain literature, self-efficacy has been measured as any combination of general self-efficacy, functional self-efficacy, and pain self-efficacy, and expectancy has been measured as pain expectancies, injury

expectancies, and coping outcome expectancies. Sometimes no clear description is provided of exactly what construct is being measured. For conceptual clarity and to adequately test specific theoretical predictions, clear distinctions between different aspects of appraisal and coping constructs must be made.

Another issue relates to the conceptual understanding of catastrophising. There has been some debate in the literature about whether to understand catastrophising as an appraisal, a coping strategy, or as merely an aspect of the syndrome of depression. For example, the inclusion of the Catastrophising scale in the CSQ implicates the construct as a form of coping strategy. A number of authors (eg. Stewart, Harvey and Evans, 2001; Jensen and Karoly, 1991) dispute the inclusion of catastrophising in the CSQ factor structure, noting that according to a Stress and Coping interpretation, catastrophising is misrepresented as a coping strategy and should be conceptualised as part of the appraisal process. Although the details of this debate will not be discussed in this paper, we have taken the latter approach – dealing with the construct as being part of the appraisal process.

4.3.1 Appraisal and Adaptation

4.3.1.1 Catastrophising and Cognitive Theories of Emotional Disorders

Catastrophising is characterised by an unrealistic belief that the current situation will lead to the worst possible outcome (Katz, Ritvo, Irvine, & Jackson, 1996). Pain catastrophising has been defined as an exaggerated negative “mental set” manifested during an actual or anticipated painful experience (Sullivan, Thorn, Haythornthwaite, Keefe, Martin, Bradley, & Lefebvre, 2001), and as “negative and worrying thoughts about pain and the prognosis for the future” (Turner, 1991, cited in Grant, 1998, p2). Catastrophising is perhaps an obvious example of the kind of thinking style that would be

classified as one of Lazarus & Folkman's (1984) primary appraisals. Beck's (1967) cognitive model of emotional disorders links erroneous thinking, such as catastrophising, directly to emotional distress (eg. Winterowd, Beck, & Gruener, 2003). In the domain of pain theory, fear-avoidance models accord a central role to catastrophising, suggesting that this type of appraisal generates pain-related fear, increasing risk of disability, depression, and prolongation/exacerbation of the pain condition (Vlaeyen & Linton, 2000). It has been linked empirically to a range of adaptation outcomes, including psychological and physical functioning, and experienced pain intensity (eg. Sullivan, Bishop, & Pivik, 1995; Sullivan, et al., 2002), as will be reviewed below.

Catastrophising has been operationalized in a number of standardized questionnaires, notably the Pain Catastrophising Scale (PCS; Sullivan, et al., 2002), and the catastrophising scale of the CSQ. Factor analysis of the PCS demonstrated three factors, labelled *Rumination*, *Magnification*, and *Helplessness* – different aspects of cognitive distortion that the authors viewed as separate aspects of catastrophising.

The content of catastrophising scales typically involve such items as "There is nothing I can do to reduce the intensity of the pain" (PCS Hopelessness), "Its terrible and I think its never going to get any better" (PCS Hopelessness and CSQ), "I keep thinking about how much it hurts" (PCS Ruminations), and "I wonder whether something serious may happen" (PCS Magnification). One laboratory study operationalised the "magnification" aspect of catastrophising with a single item involving participants' fear of re-injury during an exercise task (Crombez, et al., 1996).

Sullivan, Bishop, and Pivik (1995) demonstrated that students classified as catastrophisers, according to PCS cut-off scores, were more likely to report negative

pain-related thoughts, greater distress, and higher pain intensity during and after a cold-pressor task. Pain patients reported more negative pain-related thoughts, greater distress, and higher pain intensity during and after an aversive electro-diagnostic medical procedure. Sullivan and colleagues (1995) also demonstrated that catastrophising was correlated with fear of pain, negative affect, trait anxiety, depression, and pain intensity in a sample of students doing a cold-pressor task. Analysed concurrently with these other constructs, only the average PCS score significantly predicted pain intensity experienced during the cold-pressor tasks (semipartial r=.29, zero-order r=.46).

In a follow-up study, Sullivan, et al. (2002) demonstrated that catastrophising predicted behavioral engagement in physical activity independently of pain intensity and mood. After completing the PCS they had 50 students indicate their pain intensity and number of pain locations before and after a standardized exercise protocol. Participants repeated these ratings and a rating of negative mood before a replicated exercise protocol 48-hours later. Catastrophising was related to pain intensity ratings on all three occasions, and to negative mood on day two. It was associated with the proportional reduction in weight lifted from day one to day two, but not with the reduction in number of exercise repetitions. Further, it was not related to exercise performance on day one, which the authors interpreted as meaning that pain catastrophising may have an effect only in the presence of experienced pain, not in the absence of pain. They found that catastrophising predicted 10% of variance in the proportional reduction in weight lifted, once pain and mood prior to exercise on day two were controlled. However, when the subscales of the PCS were analysed, the *helplessness* scale demonstrated the greatest predictive power,

suggesting a greater role of control-type secondary appraisals than primary-appraisal constructs in Sullivan, et al.'s (2002) findings.

Sullivan's work (Sullivan, Bishop, & Pivik, 1995; Sullivan, Tripp, Rodgers, & Stanish, 2000) is supplemented by a number of studies suggesting the importance of catastrophising in pain experience, pain-related distress, and functioning. For example, Robinson, Riley, Myers, Sadller, Kvaal, Geisser, and Keefe (1997) found significant positive correlations between catastrophising (measured on the CSQ) and MPI Pain Severity (r=.29), MPI Affective Distress (r=.38), the BDI (r=.5), and McGill PRS affective (r=.27), sensory (r=.18), and total (r=.23) scales.

Geisser, Robinson, and Henson (1994) found that catastrophising was associated with distress, even controlling for depression – CSQ Catastrophising was associated with MPI Affective Distress, controlling for BDI score, McGill total PRI, age and education. Further, catastrophising was entered into the same step of a hierarchical regression analysis with other CSQ coping strategies, demonstrating that the effect of catastrophising was independent of coping. This finding was confirmed by Turner, et al. (2000), who reported that catastrophising was significantly related to depressive symptoms even when demograhic variables, coping strategies, and a range of pain beliefs were controlled in previous steps of a hierarchical regression analyses.

Robinson, et al. (1997) provided support for the role of catastrophising in functioning, demonstrating a significant negative relationships between catastrophising and MPI scales reflecting involvement in activities (r= -0.17 to –0.29). However, Geisser, et al. (1994) found that catastrophising was not a significant predictor of perceived life-interference after controlling for demographic variables, depression, pain-intensity, and

coping strategies. Turner, et al. (2000) also found a potential role of coping in accounting for the effects of catastrophising on function – catastrophising was not significantly related to physical disability once age, sex, pain intensity, pain beliefs, and coping strategies were controlled.

In a more behaviorally based laboratory study, Geisser, Haig & Theisen (2000) also found disconfirmatory evidence for a unique role of catastrophising in function. In a sample of 133 people with heterogeneous pain conditions (predominantly with low-back pain; n=101) they found that the belief that pain represents damage or significant harm to the body was related to the amount of weight participants lifted from waist to shoulder, but not from floor to waist. However, this effect vanished once demographic, pain-related, physical-condition, and psychological (depression and belief in the importance of activity-avoidance) factors were accounted for.

Finally, catastrophising has also demonstrated prognostic importance for adjustment six months later in a sample of 223 rheumatoid arthritis patients (Keefe, Brown, Wallston & Caldwell, 1989). CSQ Catastrophising at lag one accounted for small but significant amounts of unique variance in pain (sr^2=0.009), AIMS Physical Disability (sr^2=0.006), and CES-D depression (sr^2=0.043) at lag two (six months later), controlling for age, sex, SES, pain history, disability support status, and lag one pain, disability, and depression. Thus, whilst catastrophising appears to be consistently and independently related to distress – even after controlling for depressive symptomatology – the effect of catastrophising on function may not be separable from depression *per se*, and may be attributable to the effects of other psychological factors such as pain beliefs or coping strategy usage.

4.3.1.2 Perceived Interference and the Behavioral Model of Depression

An aspect of primary appraisal related to catastrophising is perceived interference. The degree to which pain is believed to interfere with a person's functioning and general-life has usually been measured via the *Life Interference* scale of the MPI. Robinson, et al. (1997) reported a correlation of r=.35 between that scale and CSQ Catastrophising. This cognitive construct has been linked to depression in Rudy, et al.'s (1988) model, as suggested by Lewinsohn's (1974) model of depression. Put simply, depression is presumed to be related to limited availability of reinforcement from one's environment. The perceived interference construct is presumed to be the phenomenological manifestation of limited access to reinforcement. It is within this model that the role of perceived interference in adaptation to chronic pain has almost exclusively been investigated.

Rudy, et al. (1988) conducted structural-equation modeling of data obtained from a sample of 127 mixed chronic pain patients. They found that the relationship between pain and depressive symptomatology was mediated by perceived interference and perceived lack of life- and pain- control, with lack-of-control proving to be the more powerful predictor. The direct path from pain to depression was found to be non-significant. In a subsequent study, Jacob, Kerns, Rosenberg and Haythornthwaite (1993) replicated this model, although they found that a direct relationship remained between pain and depression in an older population, whereas in a younger population the pain/depression relationship was completely accounted for by the appraisals.

Maxwell, Gatchel and Mayer's (1998) elaboration on this model, which included cognitive distortions measured by the Cognitive Error Questionnaire (Lefebvre, 1981),

found that pain and pain-related disability did not significantly predict depression once the effect of appraisal variables was entered (the effect of age, gender, education, and pain duration were controlled). A total of 53.5% of variance in the BDI was accounted for by pain and cognitive factors, with cognitive distortion accounting for 11.3% of unique variance, perceived interference accounting for 3.5%, and self-control accounting for 6%.

Cately (1999) retested the cognitive-behavioral model, with two noteworthy adaptations. Firstly, she tested the model on both positive affect and negative affect. Secondly, her measures of pain intensity and affect were averaged over numerous momentary ratings made over two days. Thus, some of the issues regarding recall and judgment effects in cross-sectional research may have been more adequately addressed. Contrary to expectations, she found no relationship between pain and any of the affectivity measures. Perceived life control was negatively related to momentary measures of pain and the MPI Pain Severity scale, the BDI, PA, and NA. Perceived life interference, on the other hand, was not related to PA or NA, but was positively related to the BDI and both measures of pain intensity. Thus, although perceived interference demonstrated no relationship with summary measures of momentary affectivity, it maintained a relationship with depressive symptomatology – as might be suggested by Lewinsohn (1974).

In summary, perceived interference has demonstrated links to distress and depressive symptomatology that are not attributable to pain intensity or other cognitive factors such as cognitive errors or perceptions of life control. However, these other appraisals have demonstrated effects of equal or greater magnitude than have been shown for perceived interference. The potential link between perceived interference and disability-related

outcomes has been neglected, however the current study intends to explore such a relationship.

4.3.1.3 Self-Efficacy and Social Learning Theory

Self-efficacy is a central construct in social-learning theory (Bandura, 1986; 1997). Bandura defined it as "people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances" (Bandura & Schunk, 1981, p587). He stated that "it is concerned not with the skills one has but with the judgments of what one can do with whatever skills one possesses" (p587). Self-efficacy is said to influence individuals' choice of activities, the amount of effort they expend, and persistence in the face of obstacles and aversive experiences (Bandura, 1977). Self-efficacy can be understood as falling within the framework of secondary appraisal (Lazarus and Folkman, 1984).

The construct of self-efficacy has been applied to pain as *pain self-efficacy* – a person's judgment about the degree to which they have the ability and resources to cope with, manage, and/or control the pain (Jensen & Karoly, 1991). Thus, social learning theory would suggest that self-efficacy may influence pain via engagement in coping behaviours that impact upon adaptation. However, perceptions of control may have a more direct relationship with emotional distress as suggested by learned helplessness (Seligman, 1972) and locus-of-control theory (Smith, 1970). Indeed, pain self-efficacy is associated with numerous adaptational outcomes, including psychological and physical functioning, use of coping strategies, and exercise/activity involvement (Jensen, Turner, Romano & Karoly, 1991).

Litt (1988), in a sample of 102 undergraduate students doing the cold-pressor task, found that persistence in the task was related to prior ratings of self-efficacy for the task, even after the effects of prior performance were accounted for. He suggested that this supports the notion that self-efficacy plays a causal role in the production of behaviour, as opposed to being just a correlate to change-in-behaviour. In a second experiment, Litt demonstrated that self-efficacy interacted with perceived control over the task. Specifically, participants were either instructed that they had to remain in the water for a non-specified period of time or that the amount of time they spent in the water was dependent upon their performance in a biofeedback hand-warming task. He found that performance in the cold-pressor was positively related to self-efficacy for the biofeedback task, but those who had high self-efficacy and perceived control over the task performed better still. Such findings linking control and self-efficacy beliefs to task performance may explain how these constructs impact on more general psychosocial functioning. For example, Strong, et al. (1990) found a correlation of –0.54 between belief in ability to control pain, as measured by the SOPA and functional status measured by the Pain Disability Index. Jensen, Turner, Romano, and Lawler (1994) also found that this measure of perceived ability to control pain accounted for unique variance in physical functioning (measured via the SIP), controlling for pain intensity, age, and gender. Buckelew, Murray, Hewett, Johnson, and Huyser's (1995) study involving 79 fibromyalgia patients demonstrated that pain self-efficacy was associated with less pain and better functioning, controlling for age, education, symptom duration, disease severity (tender-point pain threshold), and negative affect. Finally, Strahl, et al., (2000), in a sample of 154 rheumatoid arthritis patients, found that self-efficacy for arthritis

symptom-control was associated with social and emotional functioning, and pain self-efficacy was associated with physical functioning and reduced arthritis pain. Health status, demographic, and pain history variables were covaried.

Buckelew, Parker, Keefe, Deuser, Crews, Conway, Kay, and Hewett (1994) found that self-efficacy for pain control was also related to lower levels of objectively rated pain-behaviours in a sample of 73 fibromyalgia patients. Tender-point pain thresholds (on examination) were co-varied in these analyses.

Jensen and Karoly (1991) investigated the association between appraisals of personal control over pain, behavioural/social functioning, and psychological distress, controlling for pain intensity and coping strategies, in a sample of 118 general chronic pain patients. Their findings suggest that pain control self-efficacy may involve more complex interactive effects with pain-intensity and coping behaviors. In contrast to the studies above, Jensen and Karoly (1991) found a significant interaction between pain control appraisals and pain intensity, indicating that pain control appraisals were related to function only for those with less intense pain.

Contrasting with Strahl, et al.'s (2000) finding of a direct relationship between self-efficacy appraisals and emotional functioning, Jensen and Karoly (1991) found that although pain control appraisals were associated with distress, the relationship was accounted for by coping strategy usage. They suggested that the action of control appraisals may not be directly on psychological well-being, as proposed by learned helplessness theory, but via the application of adaptive coping as suggested by social-learning theory.

Investigating a related concept, pain locus of control, Crisson & Keefe (1988) found that a *chance,* but not an *internal* or *powerful other* locus of control, was related to activity avoidance, depressive, anxious and obsessive-compulsive symptoms, and greater general distress.

Self-efficacy for capacity to function or engage in certain activities has been referred to as *functional self-efficacy*. Functional self-efficacy has been defined as a person's judgment of their ability to execute or achieve tasks of physical performance (Lackner, et al.,1996). A person low in functional self-efficacy will, according to theory, be less likely to initiate or persist in functional activities such as ADLs (Barry, Zhenchao, Kerns, Duong & Reid, 2003).

Lackner, et al. (1996) measured functional self-efficacy for a range of work-related physical tasks prior to having 85 chronic pain patients perform a range of standardised physical tasks. Pain intensity, pain expectancies, and injury expectancies were also measured prior to task engagement. Functional self-efficacy correlated with performance in all five tasks (static pushing, static pulling, bilateral carrying, lifting from waist to eye level, and lifting from floor to waist) even once pain and injury expectancies, gender, and pain intensity were controlled.

In a study of 1045 war veterans, Barry, et al. (2003) found that those with moderate or low functional self-efficacy were more likely to have experienced days of restricted activity due to pain in the prior month, adjusting for depression, pain intensity, chronic health conditions, social support, drinking and smoking, and demographic variables. However, the retrospective nature of this study would appear to suggest that in this case

functional self-efficacy could not have causal primacy in its relationship with prior impairment.

Like pain self-efficacy, Buckelew, et al. (1994) demonstrated that functional self-efficacy, also, was related to reduced pain behavior amongst fibromyalgia patients (controlling for tender-point pain).

In summary, self-efficacy, both for pain and functioning, and control-related appraisals appear to have been strongly linked to functioning, disability, and task-engagement. As predicted by Social Learning Theory, this link appears to be a direct one, being independent of such factors as mood and pain intensity (though there is some suggestion that the self-efficacy/function relationship exists only at low levels of pain intensity). Whilst pain self-efficacy and control appraisals have also been linked to emotional functioning and distress, as predicted by cognitive theories of distress, the evidence for such a direct effect appears to be less conclusive. Indeed, there is some suggestion that any link between self-efficacy and distress may be an indirect one, mediated by coping strategy usage as suggested by Social Learning Theory.

Self-efficacy constructs relating to pain and pain-control have been measured via a wide range of standardised questionnaires, including: the SOPA's pain-control scale; the ASES; the Multidimensional Locus of Pain Control Questionnaire (MLPC; ter Kuile, Linssen & Spinhoven, 1993) which contains scales reflecting beliefs in *internal*, *chance*, *physician*, and *medication* loci of pain control; and, the Pain Self-Efficacy Questionnaire (PSEQ; Nicholas, 1988). In addition, two pain control items included in the CSQ (perceived ability to control pain and perceived ability to reduce pain) measure what might be described as pain coping self-efficacy – one's perceived ability to reduce or

control pain via use of one's coping repertoire. Measures differ markedly in item content, with some scales focusing exclusively on pain control (such as the CSQ scales) and others focusing on self-efficacy for functional activities. The content of the PSEQ, for example, reflects self-efficacy beliefs relating to coping with pain (eg. "I can cope with pain without medication"), though it focuses primarily on self-efficacy relating to performing daily activities and functions (eg. "I can still do many of the things I enjoy doing, such as hobbies or leisure activities, despite the pain"). Certain studies measuring functional self-efficacy have devised single items or a set of single items regarding the participant's belief that they are capable of engaging in a particular activity, such an exercise bout or physical task that serves as the criterion variable. For example, Dolce, Crocker, Moletteire and Doleys (1986) used a single item "How many repetitions of this exercise do you feel you are capable of doing right now?". Lackner, et al. (1996) devised their own Functional Self-Efficacy Scale that consists of a list of 33 physical requirements of work (such as lifting, pulling, carrying). Participants rated the tasks they considered to be essential to their own work, their belief that they can perform those tasks, and their confidence that they could perform the tasks sufficiently to complete a job. A similar scale was used by Barry, et al. (2003), measuring participant's confidence that they could perform ten activities required for functional independence (eg. house cleaning, preparing a meal).

4.3.1.4 Pain Expectancies and Expectancy Theory

Social learning theory suggests that expectations play an important role in the determination of an individual's behaviour (Bandura, 1986). Outcome expectancies, for example, involve an individual's belief that a given action will result in a certain outcome

(Bandura, 1977). This construct has been used in pain research to investigate the role of beliefs that given behaviours or coping strategies will result in pain reduction (Jensen, Turner, Romano & Karoly, 1991). However, once self-efficacy beliefs are controlled, outcome expectancies have generally demonstrated little predictive utility (eg. Council, Ahern, Follick, & Kline, 1988; Jensen, Turner & Romano, 1991).

Individuals' expectations about the intensity of subsequent pain have also been examined. Theoretically, a strong pain expectancy is a disincentive for investing effort into goals and persisting in goal-related behaviour. Thus, pain expectancies are said to contribute to dysfunction via avoidance and behavioural disengagement, which contribute to problematic consequences of pain behaviour, such as muscular disuse and atrophy, and/or guarding and muscle tension (Dolce, et al., 1986; Turk & Rudy, 1992). Though not mentioned formally in fear-avoidance models of pain, pain expectancy tacitly play a central role in these models. Predictions of pain increases (presumably associated with expectations about pain-related activities) are thought to generate anxiety, which directly contributes to behavioural avoidance (Asmundson, Norton, & Vlaeyen, 2004).

A number of studies have linked pain expectancy to performance and behavioural avoidance in standardized exercise tasks. Lackner, et al. (1996) found that pain expectancy correlated significantly with performance in three of five behavioural tasks: static pushing ($r=-0.31$), bilateral carrying ($r=-0.34$), and lifting from waist to eye level ($r=-0.24$). Injury expectancy correlated with only carrying ($r=-0.37$). However, controlling for functional self-efficacy, pain expectancy showed only one significant partial correlation, with bilateral carrying ($r=-0.29$).

Murphy, et al. (1997) suggested that chronic pain patients tend to under-predict the pain they will experience upon exertion, and that under-prediction is associated with a subsequent increase in predicted pain, and subsequent avoidance of exertion. Murphy and colleagues compared pain expectancies to actual pain experienced after 20 chronic pain patients completed each of three sets of standardized exercises. They found that predicted pain increased from the first to the third exercise, but experienced pain did not. At their initial rating of pain expectancy, 60% of participants under-predicted pain, 25% over predicted, and 15% correctly predicted. For those who under-predicted, greater under-predictions of pain prior to the first exercise were associated with larger increases in prediction over subsequent trials. Absolute pain expectancies, but not actual pain, was related to anxiety – those who expected more pain tended do report greater anxiety. Conversely, actual pain experienced during the exercise was related to performance on the exercise, but pain predicted for that exercise was not. However, the discrepancy between predicted and actual pain on the first exercise was related to performance on subsequent exercises – those whose experienced pain exceeded their expectations engaged less in the subsequent exercise task.

Crombez, et al. (1996) had 29 low-back pain sufferers perform a series of standardized exercise bouts, making between-bout ratings of current pain, maximum pain during the previous bout, pain expectancy for the subsequent bout, and fear of injury during the previous bout. Contrasting with Murphy, et al.'s (1997) findings, they found that participants initially over-predicted pain, and corrected their predictions over subsequent trials to more closely match actual pain levels experienced. Pain expectancy had no

impact on the amount of subsequent pain experienced, though it was associated with an elevated expectation of injury and a reduction in subsequent performance.

The possibility that the effects of pain expectancy are due to more catastrophising-like appraisals, such as expectations of harm or injury, was explored by Cipher & Fernandez (1997). They had 39 general chronic pain patients undergo a cold-pressor task to measure pain tolerance, and, as a measure of avoidance, asked them to indicate their willingness to engage in a further trial. Prior to the cold-pressor task subjects indicated how much pain they expected to experience (pain expectancy), how long they predicted they would be able to hold their hand in the water (response expectancy), how confident they were of maintaining their hand in the water for that amount of time (self-efficacy expectancy), and how much harm or danger they believed was associated with the task (danger expectancy). They found that only response expectancy predicted pain tolerance, whereas only danger expectancy predicted avoidance. They concluded that avoidance of activity amongst chronic pain patients may be related more to expectations about possible harm, rather than expectations of increased pain *per se*.

In summary, laboratory tasks suggest that pain expectancies are not necessarily accurate, with initial inaccuracies being corrected over time. Expectancies appear to be linked to task performance and persistence, and to anxiety experienced during the task. Part of these effects may, however, be due to catastrophic thinking about injury or harm. Murphy, et al.'s (1997) work suggested that behavioural avoidance may be more likely when pain expectancies are low and "mismatch" with high levels of subsequent pain. Research by Van Damme, Crombez & Eccleston (2002) suggested that pain expectancy (specifically, predictions of the likelihood of pain following a pain-related cue) plays an

attentional role by drawing attention to pain-related cues thereby disrupting processing of non-painful stimuli. Further, they suggested that pain expectancies may play a more primary role in attentional allocation than catastrophising. They subjected 40 undergraduate students to an experimental attention-allocation task whereby either pain- or neutral cues (presentation of the words “pain” and “tone”) were presented prior to either a pain (electric shock) or non-pain (tone) stimuli. There was no contingency between the cue and stimulus (the pain- and neutral- cues were randomly followed by either of the stimuli), however participants nonetheless reported expectancies that the pain cue would be followed by a painful stimulus. Van-Damme and colleagues found that those classified as catastrophisers, according to the PCS, took longer to disengage their attention from pain cues. That is, their response to neutral stimuli following pain cues was more delayed than non-catastrophisers. However, pain-expectancies accounted for this effect. The degree to which participants (erroneously) expected a pain cue to be followed by a painful stimuli was associated with the amount of attentional allocation to pain-related cues.

In terms of the measurement of pain expectancy, Lackner, et al. (1996) developed a Functional Reinjury-Pain Expectancy Scale (incorporated in their Functional Self-Efficacy Scale) measuring participant’s beliefs that a list of job-related physical tasks would result in pain and reinjury. However, all other studies described above adopted single item measures of pain expectancy. For example, between exercise bouts, Crombez, et al.'s (1996) participants rated the pain they expected to experience on the same verbal-graphical rating scale they used to measure current pain intensity. Murphy, et al. (1997) used the same visual analogue scale to measure expected and actual pain before and after

exercise bouts. For Cipher and Fernandez's (1997) cold-pressor task they had participants rate "How much pain do you expect to experience while your hand is in the water?" on a ten point scale.

There appears to be a scarcity of studies that look at the impact of pain expectancies outside laboratory environments. This may be because of the challenge presented in using cross-sectional designs to look for meaningful relationships between stable outcomes (such as depression) and pain expectancy – which is inherently an appraisal that changes from moment to moment. Thus, little is known about how pain expectancies fluctuate in the natural environment, or about the antecedents or adaptational consequences of free-flowing pain expectancies. In the current study, natural variations in pain expectancies are monitored throughout the course of participants' daily lives, and the adaptational consequences of those expectancies are investigated.

4.3.2 Coping and Adaptation

The nature, determinants and consequences of pain-coping strategies have received a large amount of research attention (Jensen, Turner, Romano & Karoly, 1991). It is an area of research with obvious implications for clinical practice, helping guide clinicians to identify and reshape patients' coping repertoire to suit individual differences in pathology and personality.

Pain coping strategies have been classified along a number of dimensions. Probably the most utilized method of assessing coping is via scales Rosenstiel and Keefe (1983) developed on an *a priori* basis for the Coping Strategy Questionnaire – *Diverting Attention, Reinterpreting Pain Sensations, Coping Self-Statements, Ignoring Pain Sensations, Praying or Hoping, Increasing Activity Level,* and *Catastrophising*.

Using six of the original CSQ scales (omitting the Catastrophising scale) Jensen and Karoly (1991) found that ignoring pain, coping self-statements, and increased activities were associated with greater psychological well-being.

According to Robinson, et al. (1997), the praying scale of the CSQ was related to depression measured by the BDI. No other coping strategy was associated with depression with the exception of the CSQ Catastrophising scale. Robinson, et al. (1997) found that both the ignoring pain-sensations and coping self-statement scales of the CSQ were related to better functioning according to the MPI Activity scales (r= 0.19 to 0.26). In contrast, Jensen and Karoly (1991) found that ignoring pain, coping self-statements, and diverting attention were associated with better functioning, only for people reporting lower pain intensity.

In Robinson, et al.'s (1997) study, the distraction and praying scales were related to greater pain severity on the MPI (r= 0.2 and 0.24 respectively). None of the non-catastrophising CSQ scales correlated with scales of the McGill PRS. Contrasting with this, Turner and Clancy (1986) found that an increase in coping via praying and hoping from pre- to post- CBT treatment was associated with decreased pain intensity.

A number of dimensions of coping have been investigated based on empirically-derived CSQ factors. Factor analytic studies of the CSQ have adopted two (Nicholas, 1988; Keefe, Caldwell, Queen, Gil, Martinez, Crisson, Ogden, & Nunley, 1987), three (Rosenstiel and Keefe, 1983; Turner and Clancy, 1986; Hill 1993), five (Tuttle, Shutty & DeGood, 1991; Swartzman, Gwadry, Shapiro, & Teasell, 1994) and six (Robinson, et al., 1997) factor solutions. However, clarity regarding the appropriate structure of the CSQ has been obscured by large diversity in approaches taken in factor analysis. Confirmatory

factor analyses on large samples have suggested both three factor (Lawson, Reesor, Keefe, & Turner, 1990) and six factor (Riley & Robinson, 1997) models. All of the factor analytic studies reported above included the CSQ's catastrophising scale. The studies of Rosenstiel and Keefe (1983), Keefe, et al. (1987), Hill (1993) and Lawson, et al., (1990) also included the pain control and pain reduction items. These studies, and one by Nicholas (1988), analysed the factor structure of the CSQ's *a priori* subscales, whereas the studies of Tuttle, et al. (1991), Swartzman, et al. (1994), Robinson, et al. (1997) and Riley & Robinson (1997) analyzed the CSQ at the item-level.

Rosenstiel and Keefe's (1983) factor analysis of the eight CSQ scales identified three factors, *Cognitive Coping And Suppression, Helplessness,* and *Diverting Attention And Praying*. The reported frequency of use of these strategies was not related to pain history, disability status, or number of surgeries. In total, the three coping factors accounted for 61% of the variance in trait anxiety (measured on the STAI – Trait scale), 37% of average pain level (measured via three 11-point pain ratings), 23% of depression, and 19% of functional capacity (measured on the Functional Capacity Evaluation Scale and a measure of downtime). After controlling for disability status, pain history, previous surgeries, and somatization, the three factors accounted for significant variance in depression (R^2 change=11%), pain intensity (R^2 change=22%), state anxiety (R^2 change=14%), and functional capacity (R^2 change=12%). Specifically, diverting attention and praying was associated with higher average pain and lower functional capacity, helplessness was associated with greater depression and anxiety, and cognitive coping and suppression with poorer functional capacity.

Based on Rosenstiel and Keefe's (1983) three factor model, Keefe, Crisson, Urban & Williams (1990) found that the *Helplessness* factor (consisting of the CSQ's catastrophising and pain control items) accounted for substantial proportions of variance in depression (46%) and global symptoms of psychological distress (50%, measured on the SCL-90), controlling for demographic and medical status variables. Helplessness was associated with greater psychological symptoms and depression. The *Diverting Attention and Praying* factor accounted for only a moderate proportion of variance in pain (measured by the McGill pain questionnaire), and was associated with increased pain. *Cognitive Coping And Suppression* factor was a weak but significant predictor of greater psychological symptoms.

In a heterogeneous pain sample of 152 participants, Geisser, et al. (1994) performed a principal components analysis only on the cognitive coping subscales of the CSQ. They identified two factors, which they labeled "Conscious Cognitive Coping" (CCC; consisting of the Coping Self Statements, Ignoring Sensations, and Reinterpreting Pain subscales) and "Pain Avoidance" (consisting of the Divert Attention and Praying/Hoping subscales). Catastrophising, the two pain-coping self-efficacy scales, and the Increasing Activities, CCC, and Pain Avoidance scales were entered in regression analyses prediciting MPI Affective Distress and Perceived Interference. In first-order analyses, perceived ability to decrease and control pain, catastrophising, and the Pain Avoidance scale were related to increased affective distress on the MPI. Within the Pain Avoidance Scale, only praying/hoping was associated with distress. Pain Avoidance no longer predicted MPI Affective Distress once age, education, McGill total PRI, and BDI scores were covaried. The same first-order correlates, except for ability to control pain, were

related to the MPI Life Interference scale. Pain Avoidance was the only significant predictor in a regression analysis – associated with increased perceived life interference. Other standardised measures of pain-specific coping have also been employed. The CPCI measures eight *a priori* dimensions of behavioural coping deemed to be important as targets of treatment (guarding, resting, asking for assistance, relaxation, task persistence, exercise/stretch, seek support, and coping self-statements). The Cognitive Coping Strategy Inventory (CCSI; Butler, Damarin, Beaulieu, Schwebel, & Thorn, 1989; Rokke & al'Absi, 1992) was developed to assess coping strategies used in acute pain though it has also been used to assess coping with chronic pain. Its seven subscales are labelled *Imaginative Inattention, Imaginative Transformation – Context, Imaginative Transformation – Sensations, Attention Diversion – External, Attention Diversion – Internal, Somatization,* and *Catastrophising*. Most of the research on the CCSI has been done in the acute-pain arena. For example, Rokke and al'Absi (1992) administered the CCSI to undergraduate students to determine the strategies they were most likely to use under normal circumstances. Before subjecting the students to a cold-pressor task, the researchers either allowed the student to choose which strategy they would use, allocated them a strategy that matched their CCSI preferences, or allocated a mismatched strategy. Pain threshold and tolerance was lower for those who used a mismatched strategy.

4.3.2.1 Theoretical Models of Coping: Active and Passive Coping

Katz, et al. (1996) noted that the distinction between emotion-focused and problem-focused coping is problematic when distinguishing between strategies for coping with pain, largely because pain itself is understood as an inherently emotional experience. In terms of theoretically derived models of coping, the pain literature has tended to utilize

the presumably more appropriate active versus passive dimensions (Brown & Nicassio, 1987). According to Brown and Nicassio (1987), passive coping strategies are those which are reliant on external sources for pain control, or which allow other life areas to be adversely effected by pain. Active strategies are those that are used to actively control the pain or to function despite pain. Snow Turek, Norris, and Tan (1996) suggest that the active/passive dimensions display greater predictive validity than the problem focused/emotion focused dimensions in terms of their relationship to outcomes such as positive affect, depression, and distress (eg. Holmes and Stevenson, 1990). Active and passive coping have primarily been measured via the Vanderbilt Pain Management Inventory (Brown and Nicassio, 1987), and an active/passive factor solution of the CSQ (Nicholas, 1988), but the Pain Coping Inventory (PCI; Kraaimaat, Bakker & Evers, 1997) has also been used. The PCI measures passive coping strategies including restricting functioning, avoiding environmental stimulation, and catastrophising, whilst the active scale involves distraction, reinterpreting and transforming pain, and functioning in spite of pain.

To assess the validity of the active and passive coping constructs Brown and Nicassio (1987) conducted Principal Axis Factoring with orthogonal rotation on their 27 item Vanderbilt Pain Management Inventory using a sample of 259 rheumatoid arthritis patients. They confirmed the factorial solution via LISREL on a further 101 rheumatoid arthritis patients. They identified two internally consistent scales reflecting active (alpha=0.71) and passive (alpha= 0.82) coping, which were slightly negatively correlated (r=-0.29), and stable over 6-months (r=.65 and 0.69 respectively). The *passive* scale incorporated such behaviours as calling health care providers, engaging in wish fulfilling

thoughts, and restricting functioning due to pain. It did not incorporate cognitive elements, such as catastrophising and low coping self-efficacy, as does the CSQ and PCI. Snow Turek, et al. (1996) constructed active and passive coping scales from CSQ items based on a factor analysis conducted by Nicholas (1988). The passive coping scale was composed of the CSQ Praying/Hoping and Catastrophising scales. The active coping scale was composed of the remaining CSQ scales. The CSQ and Vanderbilt scales correlated r=.56 for active coping and 0.71 for passive coping.

There is a large literature on determinants of coping styles, which will not be reviewed here except to note that active and passive pain coping has been linked to a number of person variables, including personality and demographic factors. For example, Ramirex-Maestre, Martinez, and Zarazaga (2004) looked at personality factors influencing coping in 96 general chronic pain sufferers, using the Eysenck Personality Inventory and the Vanderbilt Pain Management Inventory. They found a positive relationship between neuroticism, pain intensity, and use of passive coping strategies. Extraversion was related to use of active coping strategies and lower reports of pain.

Coping styles are also likely to be influenced by demographic characteristics. For example, Brown and Nicassio (1987) reported that active coping was associated with more education, and that females tended to engage in more active and passive coping. Mercado, Carrol, Cassidy, and Cote (2000) also found that those with higher education were likely to engage in more active coping, but that females were more likely to engage in active coping only. They reported that passive coping was more prevalent amongst those who were married. Watkins, Shifren, Park, and Morrell (1999) found that older participants were more likely than younger participants to report using passive coping

when dealing with mild pain. In seeming contrast to the previous studies, Ramirex-Maestre, et al. (2004) found that men and elderly participants were more likely to use active coping.

Characteristics of the pain experience have also been linked to the use of active and passive coping. For example, Watkins, et al. (1999) asked 121 individuals with rheumatoid arthritis to complete a modified version of the CSQ according to strategies they use for mild versus severe pain. They found that participants reported using more active coping for mild pain and passive coping for severe pain. Snow Turek, et al. (1996) found that patients with longer pain histories reported greater use of passive coping strategies.

Coping may play a role in the aetiology of chronic pain conditions. Hadjistavropoulos & Craig (1994) compared CSQ scores of individuals with acute pain, chronic pain congruent with an identifiable pathology, and "incongruent" chronic pain. They found that chronic incongruent and acute patients displayed greater passive coping than chronic "congruents". One explanation of these findings was that, although passive coping may be a common response to acute pain, those who go on to have more complex medically-incongruent pain syndromes fail to develop alternative, presumably more functional, ways of coping compared to those whose pain is a reflection of ongoing verifiable pathology.

Research using the Vanderbilt scales appears to suggest that active coping is associated with positive adaptation and passive coping with negative adaptation. For example, Brown and Nicassio (1987) reported that depression and helplessness were associated with lower engagement in active coping behaviours and greater use of passive coping.

Passive coping was associated with greater pain and functional impairment whilst active coping displayed the opposite relationships. Bishop & Warr (2003), also using the Vanderbilt scale, investigated pain, disability and mood amongst 68 breast-cancer patients with chronic pain. Controlling for pain and catastrophising, active coping was associated with less disability and passive coping with greater disability. Active coping was also associated with reduced depression. Mercado, et al. (2000), surveyed 655 people with neck or low-back pain, and found that passive coping was related to illness, depression, and greater pain severity, whereas active coping was negatively associated with depression and illness, and positively related to exercise frequency. Strahl, et al. (2000) found that, in a sample of RA patients, passive coping was associated with physical dysfunction and active coping was associated with greater social interaction, controlling for health status, demographic, and pain history variables.

In contrast, Snow Turek, et al.'s (1996) findings suggest that whereas passive coping is associated with adverse outcomes on both the CSQ and Vanderbilt, active coping may also be associated with adverse adjustment – but only according to the CSQ. They compared the predictive roles of the CSQ and Vanderbilt active and passive scales, controlling for age, gender, SES, disability support status, pain history, and pain severity. For the CSQ, active coping accounted for significant change in R-squared for activity level and depression, and passive coping accounted for significant change in R-squared for depression and psychological symptomatology. Both active and passive coping were associated with greater depression, though passive coping was the better predictor (R-square change= 0.05 for active coping and 0.23 for passive coping). CSQ active coping was associated with reduced activity according to the MPI, and passive coping was

associated with increased psychological symptomatology. Using the Vanderbilt scales, only passive coping was associated with significant R-squared change in psychological symptomatology and depression (it was related positively to both), whereas only active coping was associated with significant R-squared change in MPI Activity – it was related to greater functioning. Unlike Jensen and Karoly (1991), Snow Turek, et al. (1996) did not find an interaction between pain severity and coping strategy usage in the prediction of depression, psychological symptomatology, or activity level – either for the CSQ or Vanderbilt scales.

Madland, Feinmann, and Newman's (2000) findings in 80 patients with facial arthromyalgia did not appear to be promising for either active- or passive- coping according to the CSQ. They found that whilst passive coping, but not active coping, was associated with both depression and anxiety measured on the HADS, the only subscale predictive of anxiety and depression in multivariate analyses was catastrophising. Other studies using the CSQ have not found such dire results for the active-coping scale. Fisher, et al. (2001) found higher reports of passive coping and lower reports of active coping (measured via the CSQ) amongst 26 depressed general chronic pain inpatients compared to non-depressed inpatients.

At least two studies have investigated the potential importance of active and passive coping in long-term prognosis. In a sample of 78 rheumatoid arthritis sufferers, Evers, Kraaimaat, Geenen, Jacobs, and Bijlsma (2003) demonstrated that passive coping at time of diagnosis, but not active coping, (measured by the PCI) predicted functional disability at three-years follow-up but not at five-years. In contrast, demographic variables, neuroticism and extraversion, disease status, pain intensity and active coping at the time

of diagnosis demonstrated no significant relationship with function at either follow-up. Neither form of coping was found to be related to pain intensity at three or five years follow-up. Brown and Nicassio (1987) found that over a shorter interval (6-months), controlling for adaptation at the time coping was measured, active coping predicted lower depression and greater physical activity, whilst passive coping predicted more frequent rheumatoid pain flare-ups, greater depression, and lower physical activity and engagement in ADLs.

A number of authors have found that reduced passive coping is more associated with adaptive functioning than increased active coping (Snow Turek, et al., 1996; Brown and Nicassio, 1987; Smith and Wallston 1992), reflecting Keefe, et al.'s (1987) assertion that "it's not what you do, it's what you don't do". Indeed, the importance of passive, and not active, coping is highlighted in fear-avoidance models where passive, avoidant ways of reacting to pain are said to be associated directly with disability, physical disuse, and depression (Vlaeyen & Linton, 2000). Behavioural models of depression, too, suggest that reduced involvement in pleasant activities – possibly as a result of passive coping – would contribute to the onset of depression (Lewinsohn, 1974). Robinson, et al. (1997) noted that many studies employing the CSQ have failed to find associations between indices of adaptation and theoretically adaptive coping scales such as coping self-statements, distraction, and ignoring or reinterpreting pain sensations. For example, Jensen, Turner, and Romano (1994) found a predominant change in use of passive coping when investigating adaptational outcomes in the context of pre- to post-treatment changes in coping strategy usage. Although this contrasts with findings that active coping increases after cognitive-behavioural treatment for rheumatoid arthritis (Evers,

Kraaimaat, Geenen, Jacobs, & de Jong, 2002) and low-back pain (Nicholas, et al., 1992) – such changes may reflect increased use of active coping due to coping training, rather than any possible role active coping may play in the process of therapeutic change *per se*. Rosenstiel and Keefe (1983) also noted that catastrophising appeared to have a greater impact on adjustment than active use of coping strategies (see also Spanos, Radtke-Bodorik, Ferguson, & Jones, 1979). According to Robinson, et al. (1997), whilst responses to CSQ items reflect respondent's perceptions of coping strategy usage, their actual usage of these strategies may be imperfect, misconceived and inconsistent. That is, respondents who endorse the use of a certain strategy would be unlikely to define the strategy in the same way it would be taught, for example, in a coping skills intervention. Such factors may conceal the predictive validity of coping strategies – especially active strategies, which may demonstrate greater effects when they are used consistently and in an appropriate manner. This may partly account for the lack of findings that adaptive strategies (as opposed to decreased use of maladaptive strategies) are associated with greater adaptive functioning and psychological wellbeing. Rosenstiel and Keefe (1983) stated that the effectiveness and frequency of coping strategy usage, as reported on the CSQ, may differ if participants undergo systematic coping skills training. Alternatively, active coping strategies may indeed be less relevant in the chronic setting, being predominantly effective for acute pain or only mild and transient flare-ups of chronic pain. Rosenstiel and Keefe (1983) noted that prior research into coping with experimental pain demonstrates that coping is associated with lower pain ratings (eg. (Kanfer and Goldfoot 1966; Spanos, Horton, & Chaves, 1975; Rybstein-Blinchik, 1979). They suggested that the relative lack of effect of coping on pain in their findings for the CSQ

strategies suggest that different mechanisms may be involved in coping with acute versus chronic pain.

A number of cross-sectional studies have demonstrated that use of active coping strategies (eg. Snow Turek, et al., 1996) and strategies traditionally seen as active (eg. cognitive coping and suppression in Rosenstiel and Keefe's (1983) and Keefe, et al.'s (1990) studies) are actually related to negative adaptational outcomes. Open-minded researchers must entertain the possibility that use of active coping strategies may indeed generate distress, and/or impair function. Alternatively, these findings may represent an example of the ambiguous direction of causality in cross-sectional research. For example, it is also likely that impaired function, increased pain, and/or emotional distress prompt the use of active coping strategies as an attempt at self-regulation. The strategies themselves may either be ineffective in improving adaptation or may have a beneficial effect that, in cross-sectional studies, is masked by the positively correlated causative effect of distress, pain or functional impairment.

4.3.2.2 Coping With Chronic Pain: Conceptual and Theoretical Issues

The relationship between coping and adaptation remains ambiguous, and it may not be a straight-forward matter of some strategies, or class of strategies, being universally and consistently maladaptive, whilst others are adaptive. Stewart, et al. (2001) stated that the range of strategies used, use of particular combinations of strategies, flexibility in the use of strategies, and the interaction between patterns of strategy use and variables such as pain intensity or appraisal may all account for the outcome of coping efforts. For example, several studies have demonstrated that the efficacy of coping efforts does depend to some extent on pain intensity. The selection of strategies may depend on pain

severity (eg. Estlander and Haerkaepaeae, 1989), and the relationship between coping usage and distress may reduce as pain intensity increases (eg. Brown, Nicassio, & Wallston, 1989; Jensen and Karoly, 1991).

There are also suggestions that coping strategy usage is influenced by appraisal processes, as would also be suggested by Stress and Coping theory. For example, Turner, Clancy and Vitaliano (1987) found that certain beliefs were associated with reported use of coping strategies on the Ways Of Coping checklist. Those who accepted their pain and who did not believe that pain should hold one back in one's life were more likely to report use of problem-solving strategies. A belief that one is able to change one's pain was associated with coping by wishful thinking, and avoidance coping was more likely in those who reportedly believed that their pain would not be resolved within four years. Robinson, et al. (1997) found that those who demonstrated lower perceived life interference were more likely to cope via ignoring sensations ($r = -0.22$), and less likely to cope via distraction and praying ($r = 0.19$ and 0.16 respectively). Brown and Nicassio (1987) reported that active coping was associated with higher internal locus of control and self-efficacy, whilst passive coping was associated with lower internal locus of control, lower general self-efficacy, and higher powerful-other and chance loci of control. Crisson and Keefe (1988), also, found that coping strategies were related to locus-of-control. They found that a chance-locus-of-control was associated with the Helplessness factor of the CSQ and increased reported use of the diverting attention and praying/hoping coping styles.

However, although cognitive-styles may influence coping selection, the relationship between appraisal and coping may not be one-way. Brown and Nicassio's (1987)

exploration of the predictive role of active and passive coping scales suggests that strategy usage may modify appraisal processes over time. Such a notion would not appear to conflict with Stress and Coping theory. Over a six-month interval, controlling for appraisals at the time coping was measured, they found that active coping predicted lower chance locus of control, and greater internal locus of control and general self-efficacy. Passive coping predicted greater powerful-other and chance locus of control, and lower general self-efficacy.

As a final comment on the complexity of findings of pain coping, Robinson, et al. (1997) suggested that effects of coping may be obscured by differential effects on positive versus negative affectivity. That is, some adaptive strategies may increase positive affect rather than decreasing distress. They suggest that because coping strategies tend to load on separate factors, theoretically "adaptive" and "maladaptive" classes of coping strategies represent separate indices that will not necessarily influence the same outcome variables in the same way.

Assessment of pain coping has been criticised on a number of grounds, with a number of authors being critical of measurement of coping via coping scales (eg. Jensen, Turner, Romano & Karoly, 1991; Jensen, Turner, & Romano, 1992). Stone and Kennedy-Moore (1992) suggested that the items within a coping subscale will not necessarily co-vary because coping efforts do not necessarily conform to trait-like patterns. Folkman (1991) stated that because coping efforts vary within individuals, process-oriented approaches are necessarily to capture temporal dynamics and interactions between environmental conditions and coping behaviour. Such portrayals of coping are consistent with suggestions (eg. Lazarus, 2000) that coping efforts should be measured and assessed

using momentary intra-individual methodologies as a means of accounting for variations in individual's coping efforts and the resultant differential functional and emotional outcomes. Such an approach was used in the current study.

4.3.3 Integration of Appraisal and Coping

Stress and Coping theory would appear to make a number of predictions regarding the relationships between pain, appraisals, coping and adaptation. For example, it would predict that pain appraisals and coping would account for adaptational outcomes independently of any direct effect pain may have on adaptational status. In operational terms, this hypothesis would suggest that appraisal and coping variables would account for significant variance in outcomes whilst controlling for pain intensity (eg. Rudy, Kerns & Turk, 1998). Stress and coping theory would also suggest that coping efforts are influenced by cognitive appraisals (eg. Crisson & Keefe, 1988) and that coping and appraisal also exert independent effects on outcome (eg. Jenson & Karoly, 1991). Importantly, it would suggest that these relationships occur on an on-going basis within people, rather than being interacting trait-like factors that distinguish between people (Lazarus, 1993; 2000).

Turner, et al. (2000) noted that although a cognitive-behavioural model of adaptation to chronic pain has been supported by studies examining the separate impact of appraisals and coping on adjustment, few studies have examined the relationships between adjustment, coping, and appraisal in the same study. This still appears to be the case. Furthermore, they stated that although coping and appraisal may interact reciprocally (for example, appraisal may influence the nature and/or impact of coping efforts, and coping may reciprocally influence appraisal processes) it is important to first examine the

independent relationships between adjustment, appraisal, and coping. Turner, et al. suggested that one rationale for this line of enquiry is to establish key goals of targeted psychological interventions for chronic pain. If it can be established that certain beliefs, coping strategies, or appraisals are unrelated to adaptation, whilst others have effects of varying degrees, the efficiency and effectiveness of interventions can be enhanced by modifications on the basis of such empirical findings. Few studies have explicitly addressed these issues in the chronic pain literature, however Jensen and Karoly (1991) and Turner, et al. (2000) are illustrative examples of studies that have done so explicitly. Jensen and Karoly (1991) noted the possible role of pain-intensity as a confound in the relationship between psychological factors and adjustment. Namely, pain intensity may influence both appraisal and adjustment separately, and if it is not co-varied a spurious relationship between appraisal, coping, and adaptation may appear. Indeed, Jensen and Karoly (1991) suggested that pain intensity may interact with psychological factors to influence adaptation, and this was one of the models they tested. They also investigated the possible mediating role of coping in the appraisal-adaptation relationship.

In a sample of 118 former participants in a multidisciplinary pain program with heterogenous pain conditions, Jensen and Karoly (1991) set out to address the following issues: (1) is appraisal of control over pain related to adjustment, and is this relationship moderated by pain intensity?; (2) does coping relate to adjustment, and is this effect moderated by pain intensity?; (3) do control appraisals or the appraisal/pain interaction relate to adjustment once the possible influence of coping strategy usage is controlled? Jensen and Karoly's (1991) measure of control appraisal was a factor score derived from the SOPA's Pain Control scale, the two pain-coping self-efficacy items from the CSQ,

and an item enquiring about belief that the participant had control over the effects of pain on their life. Pain-intensity was also a factor score composed of 101-point NRS ratings of current, average, most and least pain, and how many days per week participants experienced “intolerable pain”. Coping was measured via the six subscales of the CSQ, excluding the catastrophising scale. Factor analysis was also used to derive three indices of adaptation: Activity Level (consisting of three of the activity scales of the MPI), Medication Use and Professional Service Utilisation (assessed via a series of questionnaire items), and Psychological Functioning (consisting of the CES-D and a measure of life-satisfaction).

Jensen and Karoly (1991) found that pain severity accounted for 13% of variance in psychological functioning, and 6% of variance in activity-level.

In hierarchical multiple regression analyses, control appraisals were related to psychological functioning, contributing an additional 11% variance to what was accounted for by pain intensity. In a subsequent analysis this relationship was no longer significant after controlling for coping strategy usage. They suggested that the action of control appraisals may not be directly on psychological well-being, as proposed by learned helplessness theory, but via the application of adaptive coping. In terms of activity-level, Jensen and Karoly (1991) found a significant interaction term with pain intensity, indicating that control appraisals related to function for those with less intense pain but not those with severe pain. Coping did not account for this effect in subsequent analyses. Control appraisals were unrelated to medication usage and medical service utilisation after controlling for pain severity.

In separate hierarchical regression analyses for each coping strategy, Jensen and Karoly (1991) found that ignoring pain, coping self-statements, and increasing activities were related to psychological functioning, accounting for 7%, 10% and 12% respectively, controlling for pain intensity. No strategy demonstrated a direct relationship with activity-level, however ignoring pain, diverting attention, and coping self-statements were associated with better functioning only for people reporting lower pain intensity. Coping was unrelated to medication usage and medical service utilisation after controlling for pain severity.

In a sample of 169 people with heterogenous pain conditions waiting to commence a multidisciplinary pain program Turner, et al. (2000) sought to explore the unique relationships between pain beliefs, catastrophising, coping, and two indices of adaptation: depression and physical disability. They did so by running three hierarchical multiple regression analyses to predict depression and three predicting disability, entering beliefs, catastrophising and coping, respectively, in the last step whilst controlling the other two. Only the results for catastrophising and coping will be discussed here. Turner, et al. (2000) also co-varied age, gender, and pain intensity, in order to reveal the effect of the psychological variables independently of the effect of pain intensity and demographics. The current study follows this same rationale in as much as pain-intensity is controlled in the initial step of all hierarchical analyses.

Turner, et al. (2000) measured depression via the CES-D, disability via the Roland-Morris scale, pain on a single 11-point NRS of average pain over the past fortnight, catastrophising via the CSQ, coping via the CSQ (using six of the original subscales) and the CPCI, and beliefs via the SOPA and PBAPI.

In the prediction of depression, age and gender accounted for 9% of variance, with pain intensity adding a unique 6%. Catastrophising and coping collectively accounted for 43% of variance in depression. When catastrophising was added last it was associated with greater depression, accounting for an additional 19% unique variance. The unique variance attributable to coping was not significant, though active coping demonstrated a significant effect – being associated with reduced distress. This strategy reflected CPCI Coping Self-Statements (eg. telling oneself things could be worse, comparison of one-self to others, trying to see the pain in a more optimistic light), diverting attention, asking for assistance, and increasing behavioural activities. First-order correlations between the basic coping strategies and depression revealed that guarding, and lower ignoring, coping self-statements, behavioural activities, task persistence, and exercising/stretching were associated with greater depression.

In the prediction of disability, pain, age and gender was associated with 8% of variability, all of which was attributable to pain intensity. Catastrophising and coping accounted for 34% of variance. Catastrophising did not contribute independently to the prediction of disability. Interestingly, it did demonstrate a significant first-order relationship, suggesting that any affect of catastrophising on disability may have been due to pain-intensity, demographic, or coping factors. Coping demonstrated the strongest effect, contributing 12% unique variance beyond that accounted for by the other predictors. Specifically, only the Activity Restriction scale demonstrated a significant effect. The first-order correlations of the subscales suggested that disability was related to coping via praying/hoping, guarding, resting, asking for assistance, and less use of ignoring and task persistence.

Collectively, these two studies provide a limited picture of the interactive relationship between pain intensity, appraisals, coping, and psychological and physical adaptation. In terms of appraisal, Jensen and Karoly (1991) demonstrated that the effect of pain control appraisals on distress, whilst independent of pain intensity, appeared to be attributable to coping. In contrast, catastrophising, according to Turner, et al. (2000), had a negative relationship with distress that was independent of pain intensity and coping strategy usage.

As for coping and distress, whereas Jensen and Karoly's (1991) study found that ignoring pain, coping self-statements, and increasing activities (traditionally seen as active coping strategies) were associated with reduced distress, they did not control for the possible confounding influence of appraisal. Indeed, Turner, et al. (2000) found that coping had no significant effect having controlled for pain intensity and appraisal (ie. catastrophising). Interestingly, active coping strategies demonstrated a significant beta-coefficient, and strategies associated with active-coping had significant first-order correlations with distress – suggesting that whilst active coping may ameliorate distress, these effects may be due primarily to reduced catastrophic thinking.

As for function, Jensen and Karoly (1991) found that control appraisal was independently related to function, but only for those with low pain intensity. The effect of catastrophising on function, according to Turner, et al. (2000) was attributable to other factors – possibly pain intensity or coping – that were not statistically disentangled. The possible mediating role of pain intensity on catastrophising was not tested, suggesting that, like control appraisals, catastrophising may influence function for only those with a certain level of pain intensity (c.f. Sullivan, et al.'s (2000) suggestion that catastrophising

only had an impact on exercise performance under conditions of pain, but not in the absence of pain). In Jensen and Karoly's (1991) study, three coping strategies traditionally seen as active strategies were associated with better functioning for those with lower pain intensity. The possible confounding effect of appraisal was not investigated in that study. Turner, et al.'s (2000) study, which included a wider range of coping strategies associated with passive coping, found that such strategies were related to poorer functioning, independently of pain intensity and appraisal. The traditional active strategies were not prominent predictors in this study, possibly because the potential moderating role of pain intensity was not investigated, leaving open the possibility that active coping may have an effect for those with low pain intensity. Also, the lack of effect of active coping may have been attributable to the wider inclusion of passive strategies, or the co-variation of appraisals – either of which may have accounted for the effect of active coping on physical function.

Unfortunately, Turner, et al. (2000) and Jensen & Karoly (1991)'s studies did not address the independent effects of catastrophising and control appraisals in the one study. Furthermore, pain appraisals are not limited to these two constructs – there are a number of appraisal factors that are theoretically important and have demonstrated a significant role in the literature. The unique relationship of a range of pain appraisals to adaptation ought to be addressed, controlling for pain and coping factors. That is one purpose of the current study.

The cross-sectional studies of Turner, et al. (2000) and Jensen & Karoly (1991) fail to reveal anything about the intra-personal dynamics of the appraisal, coping and adaptation variables. Further, these studies are unable to suggest causal relationships – for example,

catastrophising and depression may be related either because catastrophising influences mood, or because in a depressed mood one is more likely to demonstrate catastrophic thinking. In fact, Turner, et al. (2000, p124) acknowledged that "current theories of stress and coping posit dynamic and reciprocal relationships among these variables that change over time", and that "longitudinal research is needed to examine more closely the sequential relationships among [psychological factors], physical disability, and psychological adjustment".

To date, few EMA studies have adequately addressed momentary adaptational status in chronic pain from a stress and coping perspective. That is, few have investigated the within-person processes of appraisal and coping that influence changes in outcomes such as function and distress. The current project has taken such an approach. Similar to the studies of Turner, et al. (2000) and Jensen and Karoly (1991), the current project aims to identify the unique role of appraisal (controlling for pain intensity and coping) and the unique role of coping (controlling for pain intensity and appraisal). Unlike those studies, the current study is concerned not with general adaptation, but with momentary adaptational status. EMA is used to assess these within-person factors, and cross-lag analyses are used to facilitate interpretation of directional (and perhaps causal) relationships (eg. Bateman & Strasser, 1984).

4.4 Intra-personal Mechanisms of Adaptation to Pain

Only a small number of studies, described below, have investigated within-person appraisal and coping in EMA studies of chronic pain (Keefe, et al., 1997; Affleck, Urrows, et al., 1992; Grant, 1998; Catley, 1999). Prior to reviewing these studies, a brief overview of approaches to within-person assessment of appraisal and coping is provided.

4.4.1 Measurement of Appraisal and Coping for EMA Studies

The studies below, with the exception of Catley (1999), involve once-per-day monitoring. All used paper-and-pencil questionnaires. So, rather than developing scales, researchers have tended to use pre-existing appraisal and coping scales adapted for daily diary use. Keefe, et al. (1997) and Grant (1998) measured pain-coping self-efficacy via the two CSQ pain items. Grant (1998) also used the CSQ to measure coping and catastrophising, and the pain self-efficacy scale of the Arthritis Self-Efficacy Scale. To measure coping, Keefe, et al. (1997) and Affleck, Urrows, et al., (1992) used a measure developed by Stone and Neale (1982) for use in daily diary research, the Daily Coping Inventory (DCI). These researchers adapted the scale for use in a chronic pain population (see Affleck, Urrows, et al., 1992). The DCI is a checklist consisting of seven items relating to (a) pain reduction efforts, (b) relaxation, (c) distraction, (d) redefinition, (e) venting emotions, (f) seeking emotional support, and (g) seeking spiritual comfort.

4.4.2 Appraisal, Coping and Psychological Distress

The first study to investigate daily coping and adaptation to chronic pain did not look at within-person effects, but the relationship between summary measures of coping and within-person trends in mood. Affleck, Urrows, et al. (1992) had 75 RA patients monitor their pain (via the RADAR), mood (via POMS scales), and coping (via the Daily Coping Inventory) for 75 consecutive days. First-order analyses identified a number of factors associated with upward trends in positive mood – the number of reports of engaging in a coping strategy, the variety of strategies engaged in, and frequency of coping via seeking emotional support or expressing emotions. Coping via direct action was associated with a downward trend in positive mood. These significant first-order predictors were then

entered into the second step of separate hierarchical regression analyses, controlling for average mood and pain, trend in pain, age, gender, disability (via AIMS), and neuroticism. The authors found that only the diversity of strategies used and the tendency to cope via seeking emotional support were related to upward change in positive mood over the monitoring days.

Keefe, et al. (1997) and Grant (1998) conducted studies investigating the concurrent (same-lag) relationship between coping, appraisal, and emotional adjustment. Keefe, et al. (1997) monitored 53 RA sufferers over 30 days with one entry per day. All analyses were conducted using multi-level modelling with individuals as higher-order (level-2) units of analysis and within-person daily observations as lower-level (level-1) units couched within the level-2 units. This analytic method allows for partitioning of variance into separate within- and between-person components such that within-person predictors may have differential effects at the two levels of analysis (Raudenbush & Bryk, 2002; Snijders & Bosker, 1999; see section 6.1.5). Coping strategies and perceived coping efficacy were entered together into analyses predicting same-day mood, with pain intensity and first-order autocorrelative effects covaried. They reported that pain-coping self-efficacy was related to lower negative mood (beta=-.16) and higher positive mood (beta=.16), and use of pain-reduction efforts (beta=.08) and venting emotions (beta=.06) were related to increased negative mood. Pain reduction efforts were related to reduced positive mood (beta=-.08), whilst distraction (beta=.09) and seeking emotional support (beta=.05) were related to higher positive mood. Pain-coping self-efficacy was the strongest psychological predictor in each within-day analysis. The coping variables and pain-coping self-efficacy accounted for 3.8% of NA and 6.1% of PA.

Grant (1998) investigated a sample of 88 women with daily low-back pain of over 6 months duration. The monitoring schedule involved thirty consecutive days of evening and morning entries. Separate MLM analyses were conducted to predict night-time depressed mood and night-time anxious mood. The morning rating of the night-time outcome variables were covaried in the first step of analyses, appraisals were entered next, and coping was entered into the last step of each analysis. Morning entries consisted of ratings of pain self-efficacy (from the pain-control scale of the Arthritis Self-Efficacy Scale), pain (on a ten-point Numerical Rating Scale), anxiety and depression (measured by the state-form of the State-Trait Personality Inventory). Evening entries consisted of average-daily and current pain (on NRSs), anxiety and depression, catastrophising (the CSQ scale), perceived ability to control pain (the CSQ item), and a number of CSQ coping strategies: distraction, ignoring pain, reinterpreting pain sensations, and praying and hoping. Grant (1998) did not control for pain-intensity, however Grant and her colleagues subsequently reanalysed the data (Grant, Long & Willms, 2002) controlling for change in pain-ratings from morning to evening.

In Grant's (1998) analysis of night-time depressed mood, reinterpreting pain sensations was not included in the analysis because it did not demonstrate a significant first-order relationship with the criterion. Morning depression, appraisals, and coping accounted for 36% of within-person variance in night-time depressed mood, and 53% of total variance. Grant found that morning depressed mood was the strongest predictor, being associated with elevated night-time depressed mood (accounting for 23% of within-person variance in night-time depressed mood). An additional 12% of within-person variance was accounted for by appraisals. The strongest appraisal predictor was catastrophising –

associated with greater night-time depression. Night-time depression was also associated with low pain-coping self-efficacy on the CSQ. The relationship between general pain self-efficacy (measured in the morning) and night-time depressed mood, though significant, was the smallest of all the predictors (standardised co-efficient=0.289). However, the effect was in an unpredicted direction – morning self-efficacy was associated with greater night-time depression. Grant, et al. (2002) reported that this anomalous effect vanished when change in pain intensity from morning to evening was controlled. Grant (1998) found that a further 1% of within-person variance in night-time depression was accounted for by coping strategies once appraisal and morning mood were controlled. Distraction coping and ignoring were associated with lower night-time depression. Coping by praying and hoping was not a significant predictor. Two interaction effects were identified between pain intensity and the appraisal and coping variables. Namely, when the day's average pain was high, use of Ignoring strategies was associated with lower night-time depressed mood, and praying/hoping was associated with greater night-time depressed mood.

Reinterpreting pain sensations was not included in Grant's (1998) analysis of night-time anxious mood because it did not demonstrate a significant first-order relationship with night-time anxiety. Morning anxiety, appraisals, and coping accounted for 29% of the within-person variance in night-time anxiety, and 38% of total variance. Morning anxiety accounted for 18% of within-subject variance in night-time anxiety – it was the strongest predictor and was associated with greater night-time anxiety. Appraisals accounted for an additional 10% of within-person variance, the strongest predictor being catastrophising. High catastrophising and low pain-coping self-efficacy were associated with night-time

anxiety. General pain self-efficacy was not significantly related to night-time anxiety but its effect demonstrated significant variation between subjects, though Grant did not explore this further. Controlling for morning anxiety and appraisals, coping was associated with only a further 1% of within-subject variance. Distraction coping was the only significant predictor, associated with reduced night-time anxiety. Two interactions were found between daily-average pain and the appraisal and coping variables. On days with higher average pain, praying/hoping was associated with higher night-time anxiety. On days with low average pain, use of distraction coping was associated with lower night-time anxiety.

After controlling for changing pain-intensity from morning to evening, Grant, et al. (2002) confirmed many of Grant's (1998) findings – reporting that pain-coping self-efficacy, catastrophising, and distraction coping were related to night-time depressed and anxious mood, and ignoring strategies were also related to night-time depressed mood. Grant and colleagues did not conduct the interaction analyses performed by Grant (1998).

Only one study to date has looked at the impact of appraisal on momentary adaptational status in chronic pain on a *within day* basis. Catley (1999) conducted an EMA study on 45 people with chronic pain – 20 with fibromyalgia and 25 with rheumatoid arthritis – to test a cognitive mediation model of the pain/distress relationship. Monitoring was conducted via questionnaire booklets over a two day period. Entries were made upon awakening and prior to bed, and on six occasions between 8am and 9pm signalled by a wristwatch alarm. Ambulatory monitoring involved ratings of pain (an average of four 7-point scales involving pain intensity, stiffness, joint tenderness/swelling, and fatigue), positive affectivity, and negative affectivity. Affectivity was measured by averaging

ratings on 7-point scales of mood adjectives. Participants also completed one set of standard questionnaires – the MPI Life-Control, Life Interference, and Pain Severity scales, and the BDI.

Catley (1999) set out to test a moderation model whereby perceptions of life-control and life-interference modify the relationship between within-day pain and mood. She reported a positive relationship between pain and negative affectivity, and an interaction whereby the pain/affectivity relationship was stronger for those with low perceived life-control. She also reported a negative relationship between pain and positive affectivity, and an interaction whereby pain was more strongly related to low PA for those with low perceived life control and high perceived life interference.

Keefe, et al.'s, (1997) study is the only one to date to investigate the lagged effects of coping and appraisal factors on adaptation to chronic pain. They conducted lagged-analyses of PA and NA, controlling for previous-day PA and NA respectively (ie. first-order autocorrelation), and same-day pain. They found that pain-coping self-efficacy was associated with neither PA nor NA. This was not inconsistent with Jensen and Karoly's (1991) cross-sectional research demonstrating that pain coping self-efficacy was unrelated to distress once coping was covaried.

Keefe, et al. (1997) found that coping involving pain-reduction efforts, seeking emotional support, and relaxation were associated with greater next-day PA. Seeking spiritual support was related to greater next-day NA. Pain-coping self-efficacy and the coping variables accounted for only 2% of next day PA. The authors did not report proportion of next-day NA accounted for.

The current state of research into momentary adaptation status in chronic pain using models based on Stress and Coping theory appears to be rather sparse and demonstrates a number of shortcomings. Firstly, the scope of appraisal and coping constructs investigated is very limited. In terms of appraisal, Grant (1998) investigated catastrophising, pain-coping self-efficacy and general pain self-efficacy, and Keefe, et al. (1997) has also investigated pain-coping self-efficacy. Catley's (1999) use of perceived life-interference and perceived life control were as between-subjects factors. Examination of coping has been limited to the DCI scales (Keefe, et al., 1997; Affleck, Urrows, et al., 1992), and a subset of CSQ scales (Grant, 1998). Appraisals such as pain expectancy and perceived interference and the theoretically-driven passive and active coping dimensions have been neglected in this research, but will be investigated in the current study.

Secondly, only three studies (Keefe, et al., 1997; Affleck, Urrows, et al., 1992; Grant, et al., 2002) have investigated the independent effects of psychological factors, controlling for the effects of pain intensity. The current study covaries pain intensity in all analyses to facilitate investigation of the unique effect of appraisal and coping.

Thirdly, the separate effects of appraisal and coping have only been demonstrated by Keefe, et al. (1997), who entered both into analyses simultaneously. Grant (1998) removed the effect of appraisals from coping in hierarchical analyses, but did not do the same for appraisal. The current study addresses this shortcoming by conducting hierarchical analyses where appraisal is investigated after controlling for coping, and coping is investigated after controlling for appraisal.

Fourthly, three of the four studies were conducted across days – only Catley's (1999) investigated within-day variations in pain and mood. That study, however, did not

measure the appraisals on a within-person basis. The remaining three studies measured appraisal and coping on a daily-recall basis. Although the likelihood of recall and judgment biases are reduced under such circumstances, it is nonetheless conceivable that such biases are introduced even when the recall period is as short as one day. Whether or not biases exist with within-day recall, such approaches forfeit the true advantage of EMA studies in that they did not collect data about momentary states (Csikszentmihalyi, et al., 1977). The current study was conducted with multiple within-day assessments over a number of days, during which ratings of pain, mood, activity, and appraisal were made on a momentary basis, and ratings of function and coping were made using recall over periods of up to only three hours.

On a related note, all of the studies reported above were paper-and-pencil based. That is, they did not take advantage of the potential methodological advantages of EMA via palm-held computers. As discussed, PDAs have a number of potential advantages over paper-and-pencil methods, including concealment of previous responses to reduce risks of response-set biases and measurement reactivity (cf. Grant (1998) had participants seal questionnaire forms in an adhesive label after completion and mail them at weekly intervals). Also, Stone, et al. (2002) clearly demonstrated the hazards of assuming paper-and-pencil diaries schedules are complied with, even when participants report compliance. PDAs, as used in the current study, reduce the risk of potential methodological problems that may throw doubt on the validity of paper-and-pencil studies such as those described above.

Sixth, only one of the above studies (Keefe, et al., 1997) took advantage of the possibilities offered by repeated within-person assessments to investigate lagged effects.

Cross-lag analyses not only support presumed “carry-over” effects, but lend weight to arguments that the lag1 variable plays a causal role in the lag2 outcome variable (Bateman & Strasser, 1984). The current study takes advantage of lagged analyses. Finally, the only outcomes investigated in the literature reviewed above relate to psychological functioning: depressed mood, anxious mood, PA, NA, and general distress. The current study recognizes the importance of assessing multiple indices of adaptation, and investigates three criterion measures: distress, psychosocial functioning, and activity-level.

4.5 Aims of the Current Study

The aim of the current project is to explore the possible role of a range of appraisal and coping factors in determining momentary adaptational status in a chronic pain sample. Of key interest is whether pain-intensity *per se* is sufficient to account for adjustment, or as hypothesized, whether appraisal and coping demonstrate effects on adjustment beyond the pain/adjustment relationship (see Jensen & Karoly, 1991). This hypothesis is considered significant – it addresses a key issue regarding the importance of psychological factors in understanding adjustment to chronic pain. It is relevant not only for supporting the use of multidisciplinary and holistic approaches to management of chronic pain, but also because it is an example of a more fundamental psychological issue – the importance of cognitive mediation, relational meaning, and self-regulatory processes in adaptation to an ongoing, unavoidable and often unpredictable stressor (Lazarus, 1999; Jensen, Turner, Romano & Karoly, 1991; Burke, Zautra, Davis, Schultz & Reich, 2003).

Also, it is of interest whether coping and adjustment separately influence adjustment, or whether the effects of one account for the other (see Turner, et al., 2000). This too is considered important because "identification of specific… cognitive processes and coping strategies strongly and independently associated with the primary outcomes of interest would suggest the value of targeting those variables for modification in treatment" (Turner, et al., 2000, p116-117). The distinction between appraisal and coping is crucial here because the two have different implications for personal adaptive functioning and therapeutic intervention: coping involves overt and covert behaviours that are under volitional control (Lazarus and Folkman, 1984) whereas appraisals, though they may be amenable to change (eg. Beck, 1967), are understood to be frequently automatic and even beyond awareness until brought to attention (Lazarus & Folkman, 1984).

In the current study, adjustment is defined by three criterion variables: psychological distress, involvement in functional activities, and physical activity level. Previous EMA studies of adjustment to chronic pain have been limited, almost exclusively, to investigations of mood. It was considered that a wider range of adjustment outcomes not only extends findings across important adaptational domains, but allows for the possibility that differential processes operate across indices.

Selection of the specific appraisal and coping constructs to be investigated in the current study (catastrophising, perceived interference, pain expectancy, pain self-efficacy, and passive and active pain coping) was guided by psychological theory and on the basis of their established role in the literature. The individual effects of the specific predictors, though of interest, were not of focal importance in the current study. These appraisal and

coping variables have never been investigated concurrently, thus their unique relative effects are unknown. Further, within-person research into chronic pain that incorporates appraisal and coping variables is sparse, and in the case of predicting physical and social functioning, non-existent. Therefore, there are few empirical precedents to guide predictions in the current study. Even cross-sectional research into certain appraisal and coping variables, such as active coping, appears to remain equivocal as to their role and impact (eg. Snow Turek, et al., 1996). Therefore, the current study approached the individual appraisal and coping variables on an exploratory basis, guided by theoretical predictions and previous findings. In general, it was expected that appraisals and coping strategies construed of as being beneficial, such as self-efficacy and active coping, would be associated with better adjustment, and "negative" appraisal and coping strategies such as catastrophising and passive coping are expected to be detrimental to adjustment. More specific predictions are provided in the introduction to Study Two.

4.5.1 Study 1 - PAMS Development and Validation

Study One was concerned with developing and validating the PAMS for use in Study Two. Study One was composed of two parts, each concerned with different analyses of the same data set. Part A involves the development and validation of the PAMS scales. Each scale was analysed separately. In the case of composite scales (namely, distress, appraisals, coping, and function), data reduction techniques were applied, then the internal validity of scales was assessed. Scale properties were calculated, and the scales were compared to established measures of the same constructs in order to establish convergent validity. In the case of pain intensity and coping, analyses were done to evaluate the predictive validity of the PAMS scales.

In Part B, the predictive validity of the PAMS instrument, as a whole, was assessed. A traditional cross-sectional study was conducted involving a series of hierarchical regression analyses, where PAMS predictor variables (pain, appraisal, and coping) were employed to predict distress, activity-level, and function. As a means of validating PAMS, the results of analyses involving PAMS scales were compared to findings of analyses employing predictors and criterion variables from standard questionnaires such as the MPI, DQ and CSQ. More specific predictions are provided in the next chapter, in the introduction to Study One.

4.5.2 Study 2 – The Independent Role of Pain Appraisals and Coping in Distress, Function and Activity Level

Study Two set out to address the focal research questions. The study was also structured in two parts, involving analyses addressing separate questions. EMA was used to investigate momentary adaptation status. Specifically, the daily lives of 55 people with chronic pain were sampled using PAMS – assessing pain, appraisals, coping, and adaptation up to nine times per day for up to nine days.

In Part A of Study Two, prior to addressing the focal hypotheses, several methodological issues were addressed. Compliance rates were investigated, including exploratory analyses of correlates of compliance. For the purposes of establishing convergent validity the average of momentary ratings for each PAMS scale was compared to standard cross-sectional measures of the same constructs. Also, summary scores of the PAMS scales were compared to a one-week recall version of the PAMS scales (PAMS-R), both as a means of further validating the PAMS scales and to explore the relationship between recalled and momentary scales. Finally, possible reactivity effects were investigated both

in terms of drift in ratings across entries and over monitoring days, and progressive changes in the variability of monitoring ratings between the first and second halves of the monitoring period.

In Part B of Study Two, and in the analyses of reactivity in Part A, EMA data was analysed using multi-level modelling via HLM (Raudenbush, Bryk, Congdon, 2001). Using multi-level modelling the within-person variance in outcome variables was examined separately from between-person variability. Analyses were conducted in a hierarchical fashion analogous to hierarchical multiple regression.

The focal research questions were addressed in Part B of Study Two. The predictive role of pain appraisals were explored – firstly without controlling for coping, and then with coping covaried. The role of coping, prior to and after controlling for pain appraisals, was explored in separate analyses. Analyses were repeated for each of the three outcome indices.

The relationship between variables measured during the same lag were investigated, however cross-lag analyses were of primary concern for all three outcomes. Same-lag analyses were conducted only for the outcomes of distress and activity-level – the function outcome was measured in a retrospective way, making it non-conducive to same-lag analyses.

For the purposes of the current study the term *lag* will be used to refer to a given measurement point, such that *same-lag* refers to an analysis in which both the predictors and the outcome variables were measured during the same assessment point and *cross-lag* refers to when the predictors were measured during the assessment point prior to the entry from which the outcome measure derives. Furthermore, the terms *lag1* and *lag2*

will be used whilst discussing cross-lag analyses. Lag2 refers to the lag, or entry, in which the outcome variables are located. Therefore, a lag2 predictor is in the same-lag as the outcome measure, and was thus measured concurrently with it. In a cross-lag analysis, lag2 variables may also be referred to as being in the *next* or *subsequent* lag in relation to lag1 variables. A lag1 predictor was measured during the entry prior to the outcome measure, up to three hours previously. These variables may be referred to as being in the *prior* or *previous* lag in relation to lag2 variables. In all cross-lag analyses (predicting a criterion at lag2) the predictors of interest are lag1 variables although lag2 covariates are also included. Variables measuring the difference between lags (that is, change from lag1 to lag2) are also included in some analyses. These are referred to as *cross-lag change* variables, and will be further elaborated in Section 6.1.5.

Whilst cross-lag analyses may reveal delayed effects of the predictors (at lag1) on the criterion variables (at lag2), the true value of the cross-lag analyses for the current study is the potential to suggest possible causal effects of predictors on next-lag outcomes (eg. Bateman & Strasser, 1984). It was anticipated that the effects seen in cross-lag analyses would be quite small compared to effects in same-lag analyses (eg. Keefe, et al., 1997). Specific hypotheses for each outcome variable, for both same-lag and cross-lag analyses, are provided in more detail in the introduction to Study Two.

5 STUDY 1 - PAMS DEVELOPMENT AND VALIDATION

Study One involved the development and validation of the Pain Ambulatory Monitoring Survey (PAMS), and the application of this tool in a set of conventional between-person analyses of adjustment to chronic pain. This measure was designed as a comprehensive measure of factors relevant to a stress and coping model of adaptation to chronic pain. Items were included to assess pain intensity, a range of outcomes (activity level, distress, and function) and key appraisal and coping variables that have been tied, theoretically and empirically, to chronic pain adaptation. Importantly, the PAMS represents an attempt to measure well delineated and conceptually clear constructs, guided primarily by Stress and Coping theory, but also other models of adaptation to pain based on social-learning theory, cognitive models of emotional disorders, and behavioural models of depression. The instrument was designed to be conducive to intensive within-day repeated measurements, for use in EMA research. A minimum set of items was employed, and all items were worded to obtain momentary or short-term recall self-reports. The pool of items was devised to measure pain intensity, appraisals (catastrophising, pain self-efficacy, perceived interference, and pain expectancy), coping strategies (including strategies of pacing and activity management, solicitation, rest, relaxation, and medication and alcohol usage), and adaptational outcomes (activity level, function, and psychological distress). Items were either directly adapted from established measures of the respective constructs, or devised to reflect the core content of those measures. Appraisals were investigated, rather than beliefs, on the basis that appraisals were more likely to display fluctuations over timeframes as brief as one to two hours. The appraisal

scales were selected on the basis of theoretical importance and demonstrated predictive utility in the literature.

Part A of Study One concerned the development and validation of the PAMS instrument. Each of the six content areas of the PAMS – *Pain Intensity*, *Appraisal*, *Coping*, *Distress*, *Function,* and *Activity Level* – were investigated separately. Where relevant, each of the multi-item dimensions were subjected to data-reduction analyses to establish factor structure and eliminate redundant items. The internal reliability and descriptive qualities of multi-item scales are also reported.

PAMS scales were compared to standard measures of similar constructs to establish convergent validity. It was hypothesised that the *Pain Intensity* scale would correlate significantly with the McGill *PRI-total*, MPI *Pain Severity*, and SF-36 *Bodily Pain* scales. The predictive validity of the scale was also assessed via correlations with a range of standard measures of function and emotional distress. It was anticipated that the PAMS Pain Intensity scale would be related to higher distress and disability, but that these correlations would be no greater than convergent correlations with other pain measures.

The appraisal items were selected on an *a priori* basis to measure four factors representing pain self-efficacy, catastrophising, pain expectancy, and perceived interference. Because the single-item scale measuring pain expectancy was selected *a priori* on theoretical grounds it was not subjected to factor analysis with the other appraisal items. It was expected that the *Pain Self-Efficacy* scale would correlate significantly with the PSEQ, and the CSQ *Ability to Control Pain* and *Ability to Reduce Pain* items. The *Catastrophising* scale was expected to correlate with the PCS scales, and

the CSQ *Catastrophising* scale. It was anticipated that the PAMS *Perceived Interference* scale would be related to the MPI *Life-Interference* scale. As there is no recall-based measure that is analogous to the PAMS pain expectancy measure, there were no specific predictions about the inter-relationships of the *Pain Expectancy* scale.

PAMS coping items were expected to divide into a two factor, passive and active, coping structure. It was anticipated that the *Passive* scales of the PAMS and CSQ would correlate significantly with each other, and *vice versa* for the *Active* coping scales. It was anticipated that this pattern of inter-relationships would be reflected in the relationship between the PAMS coping scales and the traditional CSQ sub-scales. The predictive validity of the PAMS coping scales was assessed via a series of multiple regression analyses where standard measures of distress and disability were regressed onto the PAMS coping scales. Variance-accounted for by the PAMS scales were compared to separate analyses where six of the CSQ scales were used as predictors, and another set of analyses where the CSQ active- and passive- coping scales were used. It was anticipated that the PAMS and CSQ scales would be associated with comparable amounts of variance in distress and disability.

PAMS distress items were selected to cover positive affect and negative affect and the dimensions of frustration, depression, and anxiety. Although it was expected that factors reflecting these dimensions of affect might emerge, the scale was designed to provide a simple unidimensional outcome measure of psychological distress. It was expected that PAMS *Distress* would correlate with the HADS scales, MPI *Affective Distress*, and SF-36 *Role Functioning – Emotional* and *Mental Health.*

As with the distress scale, the PAMS function items were intended to provide a unidimensional outcome measure of physical, social and personal functioning. It was expected that PAMS *Function* would be related to the DQ, and SF-36 *Physical Functioning*, *Role Functioning – Physical*, *Social Functioning,* and *Vitality*.

It was hypothesised that the single PAMS item measuring physical activity level would also be related to the above measures of function, especially SF-36 *Vitality*.

In Part B of Study One, the PAMS appraisal and coping scales were used to predict adjustment in conventional between-subjects hierarchical regression analyses, comparable to Turner, et al. (2000). Separate analyses were performed for the outcomes of distress, function, and activity-level. Pain intensity was controlled in the first step of each analysis. The unique effects of appraisal and coping were investigated in separate hierarchical analyses by entering each into the last step of their respective analyses.

As a further assessment of validity, the analyses involving the PAMS scales were contrasted with comparable hierarchical regression analyses performed using standard measures, in which functioning (measured by the DQ) and distress (measured by the MPI Affective Distress scale) were predicted. It was anticipated that appraisal and coping scales would account for comparable amounts of variance in the PAMS analyses compared to the standard-measure analyses, and that interpretational differences between PAMS and standard-measure predictors would be negligible. Also, it was expected that the total variance accounted for in PAMS criterion variables would be similar to that of standard measures.

5.1 Method

5.1.1 Participants

One-hundred-and-twenty-four participants (70 female) were recruited from a student sample, community sample, and clinical sample. A pain history criteria used by previous epidemiological studies (eg. Bowsher, Rigge & Sopp, 1991; Andersson, Ejlertsson, Leden & Rosenberg, 1993; Bergman, Herrstrom, Hogstrom, Petersson, Svensson, & Jacobsson, 2001) was adopted as an inclusion criterion: participants were required to have experienced bodily pain, not due to cancer, for three months or longer. Ages for the total sample ranged from 14 years to 78 years (M=42.17, SD = 15.34).

The student sample was recruited from a pool of first-year psychology students seeking course credit for research participation. It consisted of 27 participants (19 males), aged between 18 and 52 years (M=25, SD=10.65).

The community sample was recruited via three newspaper advertisements in community newspapers. In addition, fifteen participants in the community sample had previously attended a physiotherapy-based whiplash clinic run as a research project through the University of Queensland's School of Physiotherapy. These people had originally responded to advertisements in community newspapers requesting volunteers for the whiplash treatment project. As part of that project they indicated they would be willing to be involved in other research projects run through the University. The community sample consisted of 63 participants (24 males), aged between 14 and 76 years (M= 46.16, SD= 13.27).

The clinical sample were recruited from pain-management classes they attended as part of the Royal Brisbane Hospital's Multidisciplinary Pain Management Centre program.

The clinical sample was composed of 34 participants (19 males), aged between 26 and 78 (M= 48.60, SD= 11.84).

Frequency data relating to marital status, education level, employment status, professional background, and source of income can be found in Appendix A, Table A.5, both for the total sample, and broken down according to gender and the three sample sources. Similar frequency data can be found for pain-related variables in Appendix A, Table A.6. Differences between gender and participant-source groups were investigated for all demographic and pain-related variables. Chi-square comparisons were conducted with nominal and ordinal variables. Descriptive statistics for continuous variables, including standardised questionnaires, can be found in Appendix A, Table A.7 (for the whole sample) and Table A.8 (broken down according to sample source and gender). For these variables independent samples *t*-tests were used to compare between genders and *F*-tests to compare between sample sources, with test-wise Bonferroni adjustments for post-hoc comparisons.

There were no significant differences between genders in age ($t(121)=0.731$, p=n.s.). The only gender difference in demographic characteristics was that there appeared to be significantly more tradespeople amongst male participants ($\chi^2(9)=21.46$,p=0.011). In terms of pain characteristics, upper-back (χ^2 (1)=4.663, p=0.031) and arm pain (χ^2 (1)=7.653, p=0.006) appeared to be under-represented amongst men, as was the use of NSAID medications (χ^2 (1)=4.45,p=0.035) and SSRI anti-depressants ($\chi^2(1)=6.003$,p=0.014). Men also appeared to have attended rheumatologists (χ^2 (1)=6.822, p=0.009) and neurosurgeons (χ^2 (1)=4.03, p=.009) significantly less than women. Females scored significantly higher on MPI Pain Severity ($t(118)=-2.09$, p=.039)

and HADS Anxiety (*t* (119)=-2.2, p=.03) than males. The genders did not differ on pain duration (*t*(120)=0.218, p=n.s.) or total number of bodily pain sites (*t*(121)=-1.2, p=n.s.) and radiating pain sites (*t*(121)=-0.26, p=n.s.).

Three sets of chi-square tests were conducted on each nominal and ordinal variable to compare sample sources in a pair-wise manner. Students were more likely than the community sample to have obtained a senior high-school education (χ^2 (5)=18.64,p=.002). They were more likely than the clinical sample to be studying, and less likely to be performing home duties or to be unemployed (χ^2 (8)=50.65,p=<.001). Students were also more likely to be studying than the community sample (χ^2 (8)=48.4,p=<.001). The clinical sample was less likely than the community (χ^2 (1)=7.456, p=.006) or student (χ^2 (1)=13.45,p=<.001) samples to be earning a wage, and more likely than the community (χ^2 (1)=7.36, p=.007) or student (χ^2 (1)=14.07,p=<.001) samples to be receiving an income through disability benefits. The community sample was more likely than the student sample to be receiving disability benefits (χ^2 (1)=4.13,p=.042).

In terms of pain-related variables, there were a number of differences between sample sources. Students were less likely than both the community (χ^2 (5)=22.96, p<.001) and clinical (χ^2 (6)=22.3, p=.001) samples to report that their pain was constant but varied. The community group was more likely than the clinical group to report pain that was usually present with short pain-free periods (χ^2 (5)=13.32, p=<.021). They were more likely than the clinical group to report that their pain was related to a car accident and less likely to report it was related to an occupational accident (χ^2 (7)=19.62, p<.006). Students were also less likely than the community group to report that the pain was related to a car accident, and more likely to report that there was no reason for the onset of pain (χ^2

(7)=16.94, p<.018). Compared to the clinical group, students were more likely to report no clear reason for pain onset, and less likely to report pain of post-surgical origin (χ^2 (7)=22.19, p<.002). In terms of locations of pain, the community group was more likely than both the student (χ^2 (1)=6.93, p=.008) and clinical groups (χ^2 (1)=5.08, p=.024) to report neck pain, and more likely than the clinical group to report head pain (χ^2 (1)=4.57, p=.032).

Students were less likely than both clinical (χ^2 (1)=7.63, p=.001) and community (χ^2 (1)=6.32, p=.012) groups to use narcotic medications. The clinical group was more likely than both groups to use simple analgesics (vs students χ^2 (1)=7.21, p=.006; vs community χ^2 (1)=8.32, p<.004) and anti-convulsant medications (vs students χ^2 (1)=11.02, p<.001; vs community χ^2 (1)=16.92, p<.001). Finally, the community group was more likely than the clinical group to use NSAID medications (χ^2 (1)=5.38, p=.02).

There were noteworthy differences in the groups in terms of usage of professional services. The student group was less likely than the community and clinical groups to have attended a neurologist (vs clinical χ^2 (1)=6.46, p==.011; vs community χ^2 (1)=6.08, p=.014), neurosurgeon (vs clinical χ^2 (1)=13.12, p<.001; vs community χ^2 (1)=14.83, p<.001), occupational therapist (vs clinical χ^2 (1)=28.9, p<.001; vs community χ^2 (1)=6.67, p=.01), orthopedic surgeon (vs clinical χ^2(1)=10.94, p<.001; vs community χ^2 (1)=6.32, p=.012), physiotherapist (vs clinical χ^2 (1)=8.3, p=.004; vs community χ^2 (1)=7.23, p=.007), psychologist (vs clinical χ^2 (1)=20.8, p<.001; vs community χ^2 (1)=4.78, p=.029), or their GP (vs clinical χ^2 (1)=7.67, p=.006; vs community χ^2 (1)=7.71, p=.005). The clinical group was also more likely to have attended an occupational therapist (χ^2 (1)=16.45, p<.001) or psychologist (χ^2 (1)=11.09, p=.001) than the

community group. Finally, the clinical group was more likely than both the student and community samples to have attended an anesthetist (vs student χ^2 (1)=6.76, p=.009; vs community χ^2 (1)=5.51, p=.019), psychiatrist (vs student χ^2 (1)=18.85, p<.001; vs community χ^2 (1)=13.44, p=.001), and pain clinic (vs student χ^2 (1)=32.84, p<.001; vs community χ^2 (1)=26.74, p<.001).

Students were significantly younger than both other samples (F(2,120)=33.753, p<.001), and experienced fewer total sites of pain (F (2,120)=6.844, p=.002), and sites of radiating pain (F (2,120)=3.788, p=.025). They scored lower than both the clinical and community samples on MPI Pain Severity (F(2,118)=12.12, p<.001), MPI Interference (F(2,118)=15.39, p<.001), and the Disability Questionnaire (F(2, 118)=7.894, p=.001). They scored lower than the clinical sample only on PCS Helplessness (F(2,118)=3.991, p=.021), CSQ Increasing Pain Behaviour (F(2,115)=4.8, p=.01), and HADS Depression (F(2,119)=4.876, p=.009). The student sample scored higher than the other two samples on the PSEQ (F(2,118)=9.182, p<.001), and the SF-36 scales Physical Functioning (F(2,118)=14.4, p<.001), Physical Role Functioning (F(2,117)=6.81, p=.002), Bodily Pain (F(2,115)=9.693, p<.001), and Social Functioning (F(2,115)=12.685, p<.001).

5.1.2 Procedure

Participants were given an information sheet about the project, given the opportunity to ask any questions, and asked to sign a consent form (see Appendix F). They were then given a questionnaire package and asked to complete it in their own time. They were asked to complete the whole package in one day. The PAMS, demographics and pain history questionnaire, and McGill pain rating scale, were presented first in the package (in that order), and the order of the remaining questionnaires was varied.

To represent responses from across the waking-day, participants were instructed to complete the PAMS within a certain 105 minute timeframe. These corresponded with the timeframes during which alarms were scheduled to signal during PDA monitoring in Study Two (8:00 to 9:45; 9:45 to 11:30; 11:30 to 13:15; 13:15 to 15:00; 15:00 to 16:45; 16:45 to 18:30; 18:30 to 20:15; 20:15 to 22:00). Each participant's specific timeframe was indicated both on the PAMS and an instruction sheet. To check compliance participants were asked to indicate what time they commenced the PAMS. They also indicated what time they completed the PAMS, enabling the calculation of completion times.

Participants were asked to return completed questionnaires to the investigator via an addressed and stamped envelope provided.

5.1.3 Measures

5.1.3.1 Pain Ambulatory Monitoring Survey (PAMS).

A complete copy of the PAMS can be found in Appendix E.

The PAMS was designed to provide comprehensive assessment of chronic pain using minimal items. It was designed for momentary use: all items ask about what the participant was experiencing at the moment they completed the questionnaire or in the 105 minute period prior to commencing the questionnaire (this time-frame was adopted to correspond with the average interval between entry occasions in Study 2). For example, "Right now the bodily pain I am experiencing is…", "How down do I feel right now?".

The PAMS contains two item formats. The first is what Karoly and Jensen (1987) refer to as a Graphic Rating Scale (GRS) - a ten centimetre line labelled "0%" at the left extreme

and “100%” at the right extreme, with descriptors anchoring the scale at equal intervals along the line. Participants were asked to indicate their response by placing a single vertical mark anywhere along the line. The second type of items were check-box items where a question is followed by up to five options. Participants were asked to endorse relevant items with a tick. The format of these questions was devised to resemble, as closely as possible, the format of questions on the PDAs in Study 2. In total, the PAMS contains 24 GRS items, and 13 check-box questions containing a total of 63 options. The PAMS consists of items relating to five domains: pain intensity, emotional distress, pain appraisals, pain coping strategies, and activity/functioning.

Pain Intensity. The pain intensity domain contained one item (see Table 5.1) – a GRS indicating the degree of physical pain experienced at that moment. Verbal anchors were based upon the fifteen-point verbal-rating scale used by Gracely, McGrath and Dubner (1978).

Emotional Distress. Eight GRS items were included to measure emotional distress (see Table 5.1). A number of these items were sourced from items used in other questionnaires (see Appendix A, Table A.1). An additional item (“I am feeling frustrated at this moment”) was included to gain a more comprehensive assessment of the frustration/irritability spectrum of emotional responses to pain. An emotional components analysis of pain conducted by Wade, et al. (1990) suggested that frustration was the most commonly reported emotion associated with chronic pain, and it was the most consistent predictor of participant’s ratings of pain unpleasantness.

Table 5.1 PAMS Items Measured by GRS

Pain Intensity
"Right now the bodily pain I am experiencing is..."

Emotional Distress
"Right now I feel calm and peaceful"
"How down do I feel right now? "
"I am depressed at this moment "
"How anxious do I feel right now? "
"I am feeling frustrated at this moment"
"How irritable do I feel right now? "
"I feel tense or 'wound up' right now "
"I feel cheerful right now "

Pain Appraisals
"At the moment I can tolerate pain without medication "
"At the moment I am able to cope with the pain without medication "
"I'm capable of controlling the amount of pain I experience (without medication)"
“Right now I feel I’m capable of decreasing the pain without using medication”
"Right now the suffering I experience because of the pain is... "
"Right now I think that having the pain is terrible and I can't stand it anymore "
"Right now I wonder whether something serious may happen because of the pain"
"I expect that in the next 1 hour 45 minutes the pain will be..."
“At this moment I believe I am able to do the things I need to do today”
“I believe I’m capable of engaging in physical activity (eg. work chores, shopping)
At the moment I am accomplishing less than I would like because of the pain "
"Right now I am finding it difficult to perform day-to-day activities because of the pain "
"Right now I feel I'm limited in the kinds of activities I can perform, because of the pain "

Activity-Level
"Prior to beginning the questionnaire/s how physically active was I? "
"What was my highest activity level over the last 1 hour 45 minutes?"

Pain Appraisals. Thirteen GRS items (see Table 5.1) were used to measure pain appraisals from the domains of pain self-efficacy (six items), catastrophising (three items), pain expectancy (one item), and perceived interference (three items). Once again, many of these items were influenced by items from other questionnaires. A comparison between these items can be found in Appendix A, Table A.2.

Items not specifically sourced from other questionnaires were also included in the pain self-efficacy (“At the moment I can tolerate pain without medication”), catastrophising (“Right now the suffering I experience because of the pain is...”), and pain expectancy (“I expect that in the next 1 hour 45 minutes the pain will be...”) scales. Verbal anchors for

the pain expectancy item were identical to those used to rate current pain severity. Verbal anchors for the catastrophising item “Right now the suffering I experience because of the pain is…” were adapted from verbal rating scales used to measure pain unpleasantness (eg. Tursky, Jammer, & Friedman, 1982; Gracely, et al., 1978).

Function. The Function domain of the PAMS consisted of check-box items concerned with activities engaged in and activities avoided in the 105 minutes prior to completion of the questionnaire (see Table 5.2). Items that were derived from pre-existing scales are displayed in Appendix A, Table A.3.

The first set of check-box questions assessed function via five questions comprising a total of 21 check-box options. These enquired about which activities the participant had engaged in during the prior 105 minute period. Sets of options were preceded by one of two questions: “Which of these activities have I done for over 10 MINUTES in total?” or “Which of these activities have I done over the last 1 hour 45 minutes?”.

The second set of check-boxes involved two questions comprising ten check-box options enquiring about which activities have been avoided during the past 105 minute period because of pain or fear of the pain getting worse. These options were preceded by the question “Which of these things have I avoided because of the pain, or fear of it getting worse?”.

Some activity engagement items that were sourced from other questionnaires were reversed and used as activity avoidance items (eg. “Shopping” and “Avoided Shopping”), and visa versa. This was done because it was considered that because a participant indicated that they did not engage in an activity does not necessarily mean they actively avoided that activity.

Table 5.2 PAMS Function Items

Which of these activities have I done for over 10 MINUTES in total (tick as many boxes as you need to)?

- ☐ Housework/chores
- ☐ Yardwork/gardening
- ☐ Work - paid or unpaid
- ☐ A sport

Which of these activities have I done over the last 1 hour 45 minutes (tick as many boxes as you need to)?

- ☐ Bend, kneel or stoop
- ☐ Carry or push an object
- ☐ Lift an object
- ☐ Walked 500 meters
- ☐ Walked a kilometer
- ☐ Climbed 1 flight of steps
- ☐ Climbed several flights

Which of these things have I avoided because of the pain, or fear of it getting worse (tick as many boxes as you need to)?

- ☐ Housework/chores
- ☐ Yardwork/gardening
- ☐ Work (paid or unpaid)
- ☐ Shopping
- ☐ A sport
- ☐ Cooking
- ☐ Visiting
- ☐ Dress or bath myself
- ☐ A hobby
- ☐ Driving

Items not sourced from other scales were also included as activity engagement and avoidance items (eg. “A hobby”, “A sport”, “Watching TV”, “Leant on something”).

Activity-Level. The Activity-Level domain of the PAMS (see Table 5.1) consisted of one GRS item assessing physical activity prior to commencing the questionnaire (“Prior to beginning the questionnaire/s how physically active was I?”).

Pain Coping. Pain coping was assessed via six questions comprising a total of 24 check-box items (see Table 5.3). Four questions related to use of specific coping

behaviours, one question related to activity management strategies, and one question related to solicitation of help from others.

Four questions asked the participant to indicate what things they have done to cope with the pain during the prior 105 minute period ("Which of these things have I tried to help myself cope with the pain?"). Pain coping items were selected to cover the domains of coping assessed by the CSQ, and also to assess substance use (four items), and communication (one item). In addition to items sourced from other questionnaires, additional items were included relating to coping behaviours and relaxation ("Lay down/rested/slept", "Relaxed/breathed deeply"), positive self-statements ("Talk sense to myself", "Use positive thinking"), substance use ("Taken sleeping tablets"), and praying/hoping ("Hope/wish it'd go away").

The fifth question, relating to activity management, asked participants to indicate how they managed their activities during the previous 105 minute period ("In relation to my tasks/activities over the last 1 hour 45 minutes, at times I have:"). Possible response options were: "Avoided doing a task/s"; "Given up during a task/s"; "Persisted despite pain"; "Taken breaks to rest"; "Switched between tasks".

Table 5.3 PAMS Coping Items

Which of these things have I tried to help myself cope with the pain (tick as many boxes as you need to)?

- ☐ Drank alcohol
- ☐ Did an activity/stretched
- ☐ Did something I enjoy
- ☐ Hope/wish it'd go away
- ☐ Ignore the pain
- ☐ Talk sense to myself
- ☐ Think of pleasant things
- ☐ Distract myself from pain
- ☐ Taken pain medication as part of a regular schedule
- ☐ Taken pain medications that were not part of a regular schedule
- ☐ Taken sleeping tablets
- ☐ Lay down/rested/slept
- ☐ Pretend it isn't there
- ☐ Use positive thinking
- ☐ Tell myself it doesn't hurt
- ☐ Relaxed/breathed deeply

In relation to my tasks/activities over the last 1 hour 45 minutes, at times I have: (tick as many boxes as you need to)

- ☐ Avoided doing a task/s
- ☐ Given up during a task/s
- ☐ Persisted despite pain
- ☐ Taken breaks to rest
- ☐ Switched between tasks
- ☐ Refused help from others
- ☐ Sought help from others
- ☐ Accepted their help

A sixth question asked about help-seeking behaviour during the previous 105 minute period (“In relation to my tasks/activities over the last 1 hour 45 minutes, at times I have:”). Possible response options were: “Refused help from others”; “Sought help from others”; “Accepted their help”.

See Appendix A, Table A.4 for a comparison between PAMS items and items sourced from standard coping scales.

All items sourced from other questionnaires were adapted so that they were (a) worded in the first person which, according to Peters, et al. (2000), mimics participant’s internal

dialogue, (b) momentary (eg. “Right now I feel…”) or short-latency recall (In the past 1 hour 45 minutes I have….”), (c) were suited to either the GRS or check-box format, and (d) were of minimum word length to fit on the screen of the PDA in Study Two.

5.1.3.2 Demographics and Pain History Questionnaire

Participants were asked to complete a demographics questionnaire with items regarding age, gender, marital status, education, occupation, and source of income. Pain-related variables were also assessed, including time since onset, bodily locations of pain (eg. Toomey, Gover, & Jones, 1983; Margolis, Tait, & Krause, 1986), onset circumstances, temporal fluctuations in pain, treatments sought, current medication usage, and involvement in litigation. A copy of this questionnaire can be found in Appendix B.

5.1.3.3 McGill Pain Rating Index – Total (PRI-T)

The McGill Pain Rating Index (Melzack, 1975) is composed of twenty lists of adjectives that can be used to describe the experience of pain. The lists reflect three dimensions of pain sensation, based on Melzack and Wall’s (1965) Gate Control Theory of pain. Ten lists reflect the *sensory* dimension, five reflect the *affective* dimension, and one reflects the *evaluative* dimension. The scale also contains four additional *miscellaneous* lists. Participants are instructed to underline words that reflect their pain, but to underline no more than one word per list. Originally, Melzack (1975) described three scales, *Sensory, Affective,* and *Evaluative,* which are calculated by designating each underlined word a rank value according to its order in its list, and then summing the rank values for each list in the respective scales. Melzack also proposed a total score calculated by summing the rank-value of underlined words across all twenty lists.

After conducting a confirmatory factor analytic study across two separate samples Turk, Rudy, and Salovey (1985) recommended that only the *Total* scale of the MPI was valid as a measure of pain experience. They found a high degree of internal consistency for the total scale (alpha=0.84), more so than the other scales (alpha= 0.78, 0.71 and 0.46 for sensory, affective and evaluative scales respectively). Only the MPI *PRI-Total* scale was employed in this study. The current study employed a scoring system devised by Kremer, Atkinson, and Ignelzi (1982) whereby the rank-ordered values summed over all lists are divided by the sum of the maximum possible rank-ordered scores, providing a score between zero and one.

5.1.3.4 Multidimensional Pain Inventory – Part One (MPI-I)

The MPI, originally developed as the West Haven-Yale Multidimensional Pain Inventory (Kerns, et al., 1985), was divided into three parts consisting of 12 *a priori* scales. Part One included scales assessing (1) pain severity and suffering (*Pain Severity*), (2) pain-related life-interference and degree of satisfaction with that level of functioning (*Life-Interference*), (3) appraisal of social support (*Support*), (4) perceived life control (*Life Control*), and (5) *Affective Distress*. Part Two assessed perceptions of the reactions of significant others to the pain condition, and Part Three assessed involvement in various activities of daily living.

Kerns, et al. (1985) developed the scale on a sample of 120 chronic pain patients. Using confirmatory factor analysis with oblique rotation they found support for four scales in Part One. They collapsed a fifth and sixth scale (pain-related life interference versus dissatisfaction with current functioning) into a single scale. Internal reliability for these five scales ranged from alpha=0.7 to 0.9. Two-week test-retest reliabilities ranged from

0.62 to 0.91. All inter-correlations amongst the scales (from 0.0 to 0.58) were lower than the reliability of the individual scales, supporting the discriminant validity of the scales. To assess convergent and divergent validity, Kerns, at al. (1985) entered the MPI scale scores into an exploratory factor analysis with other standard measures. They found that the MPI *Affective Distress* and *Self-Control* scales fell into an affective distress dimension. The MPI *Support* scale and a range of scales from *Parts Two* and *Three* of the MPI fell into a support dimension. MPI *Pain Severity* and *Interference* fell into a third dimension.

5.1.3.5 Pain Self-Efficacy Questionnaire (PSEQ)

The PSEQ (Nicholas, 1988) is a ten-item self-report scale in which participants are asked to rate (on a seven-point scale) how confident they are that they can perform a number of activities (zero being "not at all confident" and six being "completely confident"). The content of the scale reflects self-efficacy beliefs relating to coping with pain (eg. "I can cope with pain without medication"), though it focuses primarily on self-efficacy relating to performing daily activities and functions (eg. "I can still do many of the things I enjoy doing, such as hobbies or leisure activities, despite the pain").

Evidence of the reliability and validity of the PSEQ was presented by Nicholas (1989).

5.1.3.6 Pain Catastrophising Scale (PCS)

The PCS (Sullivan, Bishop, & Pivik, 1995) is a 13-item scale in which participants are asked to indicate on a five point scale (0=not at all, 4= all the time) the frequency with which they experienced a range of pain-related catastrophic thoughts in the prior week. Sullivan and colleagues identified three scales from their original principal components analysis, *rumination*, *magnification*, and *helplessness.* The scales were moderately to

highly correlated (r=-0.3 to –0.5), and ranged in internal validity (alpha=0.87, 0.6 and 0.79 for rumination, magnification and helplessness respectively). Support for this factor structure has been reported in confirmatory factor analytic studies with student (Osman, Barrios, Gutierrez, Kopper, Merrifield, & Grittmann, 1997), community (Osman, Barrios, Kopper, Hauptmann, Jones, & O'Neill, 2000), and sport-participant (Sullivan, et al., 2000) samples. In a confirmatory factor analysis involving one-, two-, and three- factor models of the PCS in separate pain-free, low-back pain and fibromyalgia samples, Van Damme, Crombez, Bijttebier, Goubert, and Van Houdenhove (2002) found that the three factor model was the best fit for all three samples, and was invariant across the three samples and across gender.

Sullivan, Bishop, & Pivik (1995) validated the scale by demonstrating that students classified as catastrophisers according to cut-off scores were more likely to report negative pain-related thoughts, greater distress, and higher pain intensity during and after a cold-pressor task. They reported a six-week test-retest reliability of r=.75 for this student sample. Further, pain patients reported more negative pain-related thoughts, greater distress, and higher pain intensity during and after an aversive electro-diagnostic medical procedure. In a final study, Sullivan and colleagues demonstrated that the average score for the three PCS scales (PCS Total) was correlated with fear of pain, negative affect, trait anxiety, depression, and pain intensity in a sample of students doing a cold-pressor task. Controlling for these other constructs, only the PCS average score significantly predicted pain intensity experienced during the cold-pressor tasks (semipartial r=.29, zero-order r=.46). A ten-week test-retest reliability of 0.7 was found in this student sample.

Studies employ both the PCS subscales and PCS Total (eg. Sullivan, Bishop, & Pivik, 1995), and all four scales will be used in the current study.

5.1.3.7 Coping Strategy Questionnaire (CSQ)

The Coping Strategy Questionnaire (CSQ; Rosenstiel and Keefe 1983) is perhaps the most frequently used measure of strategies used to cope with chronic pain (Stewart, et al., 2001). The original scale is composed of 48 items measured on a seven-point (1= never, 3= sometimes, 7= always) scale indicating frequency-of-use.

Rosenstiel and Keefe (1983) devised seven scales reflected coping strategies (Diverting Attention, Reinterpreting Pain Sensations, Coping Self-Statements, Ignoring Pain Sensations, Praying or Hoping, Increasing Activity Level, and Increasing Pain Behaviours), and an eighth scale, labelled "Catastrophising", was composed of items relating to catastrophic pain cognitions (eg. "It is awful and I feel that it overwhelms me"). The CSQ included two pain coping self-efficacy items, rated along seven-point scales, assessing participants beliefs that they are able to control and decrease pain given their repertoire of coping strategies.

Rosenstiel and Keefe (1983) found adequate internal consistency for seven of their scales (0.85 to 0.71), however "Increasing Pain Behaviour" produced an alpha-reliability of only 0.28 and was rejected from the final scale. With a sample of 30 chronic pain outpatients Stewart, et al. (2001) found alpha-coefficients between .82 and .75 for four scales, and alpha coefficients of 0.49, 0.66, 0.5, and 0.1 for Coping Self-Statements, Praying and Hoping, Increasing Behavioural Activity, and Increasing Pain Behaviour respectively. Test-retest reliabilities between 0.68 and 0.91 were reported for the CSQ sub-scales over a one-day interval (Main and Waddell, 1991). Stewart, et al. (2001) found

one-week test-retest reliabilities between .69 and .40 for seven of the eight scales – the lowest of these being Increasing Pain Behaviour and the next lowest being Diverting Attention (at 0.47). Only the Catastrophising scale fell above 0.7. Neither of the pain control self-efficacy items displayed adequate test-retest properties in this study, both being below 0.4.

The validity of Rosentiel and Keefe's (1983) eight scales has not been well replicated (eg. Main and Waddell, 1991; Lawson, et al., 1990). The current study used seven of the original scales (not including "Increasing Pain Behavior"), and a two factor version of the CSQ reflecting active- and passive- coping dimensions. Based on factor analytic work by (Nicholas, 1988), the passive coping scale is composed of the CSQ Praying/Hoping and Catastrophising scales, whilst the active coping scale was composed of the remaining CSQ scales. Snow Turek, et al. (1996) found alpha reliability coefficients of 0.88 and 0.81, respectively, for the CSQ active and passive coping scales.

5.1.3.8 Medical Outcomes Survey Short-Form 36 (SF-36)

The SF-36 is a 36 item scale designed as part of the Medical Outcomes Study as a brief measure of general health-related outcomes that could be administered to both clinical and general populations (Ware and Sherbourne, 1992). The scale consists of eight scales reflecting (1) limitations in physical activities due to health problems (*Physical Functioning*), (2) limitations in social activities (*Social Functioning*), (3) limitations in usual roles due to physical health (*Role Functioning – Physical),* (4) limitations in usual roles because of emotional problems (*Role Functioning – Emotional*), (5) *General Mental Health*, (6) *Bodily Pain*, (7) *Vitality*, and (8) general perceptions of health (*General Health Perceptions*). A ninth scale, composed of a single item, measures participant's

perception that their health has changed over the previous year (*Health Transition*). These scales and the items they are composed of were adapted from the full MOS scale (Ware and Sherbourne, 1992).

In initial attempts to validate the SF-36 scales on a sample of 1014 health-system consumers, McHorney, Ware, and Raczek (1993) conducted a Principal Components Analysis on the eight scales, revealing a Physical Health factor and a Mental Health factor. The Physical Functioning, Role Functioning – Physical, and Bodily Pain scales were (in that order) most related to the Physical Health Factor (all loadings above 0.77). The Mental Health, Role Functioning – Emotional, and Social Functioning scales were most related (in that order) to the Mental Health factor (all loadings above 0.71). The Social Functioning scale loaded to some degree on the Physical Health factor (loading=0.44), whilst the Vitality and General Health Perceptions scale loaded on both the Physical Health (loadings= 0.59 and 0.68 respectively) and Mental Health (loadings= 0.57 and 0.32 respectively) factors. They then compared the profile of the eight scales across four clinical samples: minor chronic medical conditions, serious chronic medical conditions, psychiatric conditions, and both psychiatric and serious chronic medical conditions. The various scales distinguished between the four groups in anticipated ways, including distinguishing between the severity of medical conditions, the extent of psychiatric symptomatology, and between patients with and without psychiatric illness.

Garratt, Ruta, Abdalla, Buckingham, and Russell (1993) assessed the psychometric properties of the SF-36 on 1787 people with low back pain, excessive uterine bleeding, a possible peptic ulcer, or varicose veins. Item-total correlations between 0.55 and 0.78 were found within each scale, and all items correlated more with their own scale than

with divergent scales. Cronbach's alpha exceeded 0.8 for all scales. They found that the profile of the clinical samples differed from that of the general population sample in predictable ways. In a Swedish sample (n=8930), Sullivan, Karlsson, and Ware (1995) found internal reliabilities between alpha=0.79 and 0.93.

5.1.3.9 Roland and Morris Disability Questionnaire (DQ)

The Roland and Morris Disability Questionnaire (Roland and Morris, 1983) was constructed as an outcome assessment of functional status amongst low-back pain populations. The scale consists of 24 check-box items in which participants are asked to endorse relevant statements about the functional impact of pain. Items were originally selected from the Sickness Impact Profile (Bergner, Bobbitt, Carter, & Gibson, 1981). Roland & Morris (1983) found a same-day test-retest reliability of 0.91 for 20 participants. They found that for 124 participants, average DQ scores increased with higher ratings on a six-point pain rating system. Other studies with longer retest intervals found test-retest reliabilities of 0.88 (one week; Johansson and Lindberg, 1998) and 0.83 (three weeks; Deyo and Centor, 1986), though the authors of the test argue that the measure was designed to be sensitive to changes over time, questioning the use of longer retest intervals (Roland and Fairbank, 2000).

Internal reliabilities between alpha= 0.84 (Jarvikoski, Mellin, and Estlander, 1995) and 0.93 (Hsieh, Phillips, and Adams, 1992) have been reported for the DQ. The DQ has also been shown to correlate with other measures of functional disability, including the Oswestry disability questionnaire (Leclaire, Blier, & Fortin, 1997) and the Sickness Impact Profile (Deyo and Centor, 1986). Reneman, Jorritsma, Schellekens, & Goeken (2002) found that the DQ correlated r= 0.5 with the Oswestry Disability Index (Fairbank,

et al., 1980), and 0.6 with the Quebec Back Pain Disability Scale (Kopec, Esdaile, Abrahamowicz, Abenhaim, Wood-Dauphinee, Lamping and Williams, 1995). They found that the DQ correlated higher than those two questionnaires with a behavioural measure of functional performance (r=-0.52).

Recent adaptations of the DQ have altered the wording for applicability to non-low-back pain conditions, including a version for pain conditions in general (Roland and Fairbank, 2000).

5.1.3.10 Hospital Anxiety and Depression Questionnaire (HADS)

The Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983) consists of separate Anxiety and Depression scales consisting of seven items each. For each item respondents are asked to underline one of four statements to indicate how they have been feeling over the past week. Items were selected to avoid measurement of anxious and depressive symptoms that would overlap with medical symptoms of participants in medical settings. The HADS was chosen for the current study because of its greater interest in affective symptoms, and to avoid complications arising from medical symptoms relating to chronic pain conditions.

In Zigmond & Snaith's (1983) original article, the Depression scale of the HADS correlated r=.70 with clinician ratings of depressive symptoms and was unrelated to clinician ratings of anxiety (r=.08). Depression scale scores appeared to be unrelated to physical illness severity. The HADS's Anxiety scale correlated r=.54 with clinician ratings of anxiety, and was somewhat less related to clinician ratings of depression (r=.19). Internal consistency of the scales was assessed by correlating each item with a composite composed of the other items in its scale. All correlations were significant

($p<.01$) and ranged between 0.76 and 0.41 for the Anxiety scale, and 0.6 to 0.3 for the Depression scale.

5.2 Results – Part A: PAMS Validation

Part A of Study One reports analyses aimed at developing, validating, and describing the PAMS scales. The Pain-Intensity scale is investigated first, followed by the appraisal scales, the coping scales, the Distress scale, the Function scale, and the Activity-Level scale.

5.2.1 Pain Intensity

Descriptive statistics for the PAMS Pain Intensity scale is displayed in Table 5.1

Table 5.1 Descriptive statistics for PAMS Pain Intensity scale

Minimum	2
Maximum	97
Mean	56.09
SD	20.91
Skew	-0.49
Std. Skew	-2.24
Kurtosis	-0.34
Std. Kurtosis	-0.79

Std. Skew= Standardized Skew
Std. Kurt.= Standardized Kurtosis

The convergent validity of the PAMS Pain Intensity scale was evaluated against the McGill PRI–Total, and the MPI and SF-36 pain scales (see Table 5.5). Note that higher SF-36 Bodily Pain scores reflect less pain.

Table 5.5 Correlation between PAMS Pain Intensity and standard pain measures

	PAMS Pain Intensity
SF-36 Bodily Pain	-0.612***
MPI – Pain Severity	0.687***
McGill – Total	0.299**

*** p= <.001 ** p= <.01

The PAMS scale correlated significantly with the SF-36 and MPI scale, comparing to a correlation between the MPI and SF-36 scales of r=-0.734.

The PAMS scale correlated with the McGill PRI-T, though to a much lesser extent. However, it is noted that the SF-36 and MPI pain scales also displayed lower correlations with the McGill PRI-T (r=-0.42 and r=.33, respectively). According to the test described by Williams (1959), PAMS Pain Intensity correlated significantly better with the MPI ($t(114)=4.68$, $p<.001$) and SF-36 ($t(114)=3.64$, $p<.001$) scales than it did with the McGill PRI.

Table 5.6 Correlation between PAMS Pain Intensity and standard measures

Scale		PAMS Pain Intensity
SF-36	Phys. Functioning	-0.456***
	Phys. Role Funct.	-0.462***
	General Health	-0.235*
	Vitality	-0.26**
	Social Functioning	-0.411***
DQ		0.349***
SF-36	Emotional Role Funct.	-0.141
	Mental Health	-0.164
MPI	Affective Distress	0.23*
HADS	Anxiety	0.258**
	Depression	0.352***

*** p= <.001 ** p= <.01 * p= <.05

The predictive validity of the PAMS Pain Severity scale is demonstrated in Table 5.6. In support of its validity, the scale was significantly related to all measures of functional status and a number of measures of distress – the MPI and both HADS scales. It is noted that these correlations assessing concurrent validity were lower than the convergent correlations with the MPI and SF-36 pain scales.

5.2.2 Appraisal

The factor structure of the PAMS Appraisal items was explored via Principal Axis Factoring with oblique (SPSS Oblimin) rotation (see Table 5.7). Oblique rotation was employed because appraisal dimensions were not expected to be orthogonal. Pain Expectancy was intended to remain as a single-item measure of that construct and as such it was not entered into the analysis.

Table 5.7 Principal Axis Factoring of PAMS Appraisal items, using orthogonal (Oblimin) rotation.

	Pattern Matrix		
	1	2	3
Pain Self-Efficacy: Pain tolerance	-0.06	**0.74**	-0.38
Pain Self-Efficacy: Pain coping	-0.11	**0.79**	-0.44
Pain Self-Efficacy: Pain control	0.04	**0.79**	0.03
Pain Self-Efficacy: Ability to decrease pain	0.06	**0.63**	0.26
Pain Self-Efficacy: Ability to perform daily tasks	0.28	0.18	-0.44
Pain Self-Efficacy: Capacity to engage in physical activity	0.40	0.26	-0.37
Catastrophising: Perceived suffering from pain	-0.18	-0.08	**0.53**
Catastrophising: Pain is terrible	-0.08	0.15	**0.71**
Catastrophising: Injury expectancy	-0.02	-0.02	**0.52**
Pain Interference: Doing less	**-0.85**	0.13	0.02
Pain Interference: Difficulty performing tasks	**-0.79**	-0.14	0.08
Pain Interference: Limited in tasks	**-0.84**	0.02	-0.01
VARIANCE ACCOUNTED FOR:	41.92	17.33	10.21

Loadings in bold typeface were considered to load uniquely on a factor

Three factors were identified with eigenvalues over one, and were also suggested by inspection of the scree plot. These factors accounted for a total of 69.5% of total variance. Factor one was correlated r=.23 with factor two, and r=-0.48 with factor three. Factors two and three correlated r=-0.24. An orthogonal rotation revealed an identical pattern of loadings to those seen in Table 5.7. Items with a loading outside the range -0.3 to 0.3, and that diverged from loadings on other factors by at least 0.2 were considered to load uniquely on a factor.

The first factor, labelled *Pain Self-Efficacy*, was composed of the four pain-coping self-efficacy items. The second factor, *Catastrophising*, contained items reflecting perceived suffering due to pain, perceptions that the pain is terrible, and expectation about the likelihood that an injury would occur as a result of pain. The final factor, *Perceived Interference*, contained the three items designed to measure that construct. The two self-efficacy items measuring perceived capacity to engage in daily activities and physical activity did not form a separate factor or load in a simple manner on any of the three factors identified. Further, these items did not form a separate "functional self-efficacy" factor when additional oblique and orthogonal factor analyses were conducted with four factors selected. Thus, these two items were not included in the selected scales.

Except for one item, inspection of corrected item-total-correlations revealed no items that, if removed, increased scale reliability significantly. The corrected item-total-correlation of the *Ability to Decrease Pain* item was *alpha* =0.46, as opposed to the other three items in the *Pain Self-Efficacy* scale, which fell between *alpha* =0.71 and 0.81. Removing the item did not increase the reliability of the scale, but decreased it only

mildly from *alpha*=0.89 to 0.85. For the sake of maintaining minimal item sizes the item was deleted from the Pain Self-Efficacy scale.

Scales were constructed from each of the three factors by unweighted averaging. Descriptive statistics and internal reliability estimates can be found in Table 5.8

Table 5.8 Descriptive statistics for PAMS Appraisal scales

PAMS Factor	Alpha	Min	Max	Mean	SD	Skew	Std. Skew	Kurt.	Std. Kurt
Pain Self-Efficacy	0.89	1.00	94.00	45.95	26.45	0.02	0.10	-1.20	-2.78
Catastrophising	0.66	3.67	83.00	39.88	18.46	0.36	1.65	-0.60	-1.39
Perceived Interference	0.88	12.67	99.67	65.36	20.20	-0.77	-3.53	0.20	0.45
Pain Expectancy		2	96	54.44	21.25	-0.44	-2.02	-0.447	-1.03

Std. Skew= Standardized Skew; Kurt.= Kurtosis; Std. Kurt.= Standardized Kurtosis

All scales demonstrated high levels of internal reliability, except Catastrophising, which demonstrated a moderate but acceptable level.

Correlations between the PAMS appraisal scales and existing scales measuring pain appraisals were calculated (see Table 5.9).

Table 5.9 Correlation of PAMS Appraisal scales and standard cognitive measures

Comparison Scale		PAMS Pain SE	Catas.	Perc. Int.	Pain Exp.
PAMS	Pain Self-Efficacy	-			
	Catastrophising	-0.37***	-		
	Perceived Interference	-0.29**	0.45***	-	
	Pain Expectancy	-0.4***	0.5***	0.38***	-
MPI	Life-Control	0.09	-0.26**	-0.17	-0.16
PSEQ		0.48***	-0.42***	-0.44***	-0.4***
CSQ	Control over Pain	0.25**	-0.10	-0.12	-0.26**
	Ability to Decrease Pain	0.22*	0.03	-0.11	-0.28**
	Catastrophising	-0.29**	0.45***	0.16	0.2*
PCS	Total	-0.3**	0.54***	0.25**	0.23*
	Helplessness	-0.27**	0.52***	0.27**	0.23*
	Rumination	-0.27**	0.42***	0.15	0.21*
	Magnification	-0.16	0.5***	0.2*	0.17
MPI	Life Interference	-0.32***	0.44***	0.6***	0.51***

*** p= <.001 ** p=<.01 * p=<.05
Pain SE= Pain Self-Efficacy; Catas.= Catastrophising; Perc. Int.= Perceived Interference; Pain Exp.= Pain Expectancy

Moderate but adequate relationships were found between the PAMS scales and alternate measures of similar constructs. Comparisons between correlations were made using the method described by Williams (1959). PAMS Pain Self-Efficacy correlated r=.48 with the PSEQ, significantly higher than with any other scale (vs. MPI Life Interference $t(113)=2.36$, p=.02). PAMS Catastrophising correlated r=.54 with the PCS Total scale. Although this appeared higher than correlations with all other cognitive scales testing revealed that it was significantly higher than relationships with all other scales (vs. MPI Life Control, $t(113)=2.99$, p=.003) except MPI Life Interference ($t(113)=1.07$, p=ns) and the PSEQ ($t(113)=1.35$, p=ns). PAMS Perceived Interference correlated r=.6 with MPI Life Interference, which was higher than correlations with all other standardised cognitive scales (vs. PSEQ, $t(113)=2.39$, p=.018). Although no alternate scales were included to measure pain expectancy, the PAMS Pain Expectancy scale demonstrated

some moderate correlations, including r=.51 with MPI Life Interference and r=–0.4 with the PSEQ. PAMS scales displayed significant inter-relationships, between r=–0.29 and r=.5.

Of all the PAMS scales, Pain Self-Efficacy displayed the lowest convergent relationship. Although its relationship to the PSEQ, a known measure of pain self-efficacy, was in the moderate range, the PAMS Catastrophising scale demonstrated a relationship of similar magnitude with that measure. It was considered that the differing item content of the two pain self-efficacy scales may have been responsible for this poor divergent/convergent validity. Namely, the PSEQ appears to focus heavily on self-efficacy as it relates to function and capacity to engage in activities, as opposed to self-efficacy for coping with pain *per se*. To test whether this was the case the PAMS Pain Self-Efficacy scale was correlated with the PSEQ item "I can cope with my pain without medication" (Item 7), which was considered to most reflect the construct of self-efficacy for coping with pain. It was noted that this item had the lowest item-total correlation with the total PSEQ scale for the current sample (r=.39) and correlated below 0.41 with all items except one ("I can still accomplish most of my goals in life, despite the pain"; r=.56). PAMS correlated r=.72 with PSEQ item seven. The other PAMS Appraisal scales correlated between only r=-0.19 and r=-0.3 with PSEQ item seven, which appears to support the convergent validity of the PAMS Pain Self-Efficacy scale as a measure of self-efficacy for coping with pain.

5.2.3 Coping

The factor structure of PAMS coping items was investigated via principal-axis factoring (see Table 5.10). Coping scales were not hypothesised to be orthogonal therefore oblique

rotation (SPSS Oblimin) was used. Seven factors were identified with eigenvalues over one, accounting for 58.19% of shared variance. Inspection of the scree plot suggested a two factor model. A two-factor solution accounted for 26.61% of total shared variance. Variance accounted for by each factor can be found at the bottom of the table. Factors one and two were correlated r= 0.154.

Table 5.10 Principal Axis Factoring of PAMS Coping items

	Pattern Matrix	
	1	2
Drink alcohol	-0.07	**0.37**
Do an activity, or stretch	0.30	-0.20
Think about something I enjoy	**0.49**	0.13
Hope or wish the pain would go away	0.07	**0.52**
Ignore the pain	0.00	0.22
Talk sense to myself	**0.51**	0.22
Think pleasant thoughts	**0.66**	0.04
Distract myself	0.35	0.19
Take PRN pain medication	-0.01	**0.51**
Take a sedative	0.10	**0.44**
Lay down, rest or sleep	0.21	**0.41**
Pretend the pain isn't there	-0.03	0.22
Use positive thinking	**0.59**	0.06
Tell myself the pain doesn't hurt	0.07	**0.42**
Relax or breathe deeply	**0.50**	0.09
Avoid activity	0.02	**0.49**
Give up doing activities	0.04	0.30
Persist with activities despite pain	0.24	-0.10
Take regular breaks between activities	**0.47**	-0.05
Switch between activities	**0.46**	-0.03
Refuse help with doing activities	-0.09	0.20
Seek help with doing activities	0.21	0.28
Accept help with doing activities	**0.43**	0.02
VARIANCE ACCOUNTED FOR:	16.9%	9.71%

Items with bold loadings were considered to load uniquely on the respective factor

An item was considered to load uniquely on a factor if it obtained a loading outside the range –0.3 to 0.3, and the loadings across factors differed by a range of at least 0.2. Items

fulfilling these criteria appear in bold in Table 5.10. Scales were constructed by summing items loading uniquely for each of the two-factors. Internal reliabilities measured according to coefficient alpha were 0.75 for the eight items in the first factor, and 0.64 for the seven items in the second factor. Inspection of item-total correlations and adjustments to alpha revealed no items that could be beneficially deleted from the scales. Descriptive statistics can be found in Table 5.11

Table 5.11 Descriptive statistics for PAMS coping scales

	Factor 1	2
Minimum	0	0
Maximum	8	7
Mean	3.5	2.04
SD	2.35	1.69
Skew	0.19	0.67
Std. Skew	0.87	3.09
Kurtosis	-0.99	-0.01
Std. Kurtosis	-2.29	-0.03

Std. Skew= Standardized Skew
Std. Kurt.= Standardized Kurtosis

Square-root and squared transformations were performed on factor two, with a standardised skew above 3.0, however kurtosis became unacceptably elevated. Thus, the untransformed scale was used in subsequent analyses.

Inspection of item content suggested that factor one represented active-coping strategies and factor two represented passive-coping strategies and scales were labelled Active- and Passive- Coping, respectively.

Convergent and divergent validity was assessed by comparing the PAMS scales with the CSQ two-factor (active and passive) model and six of the original CSQ coping scales (not

including the catastrophising scale and the pain-control items). Correlations can be found in Table 5.12.

Table 5.12 Correlation between PAMS and CSQ coping scales

	PAMS Scale	
CSQ Scale	Active	Passive
Active	0.398***	0.073
Passive	0.071	0.329***
Divert Attention	0.129	0.015
Reinterpret Pain Sensations	0.14	0.22*
Ignore	0.149	-0.036
Pray/Hope	0.444***	0.008
Coping Self-Statements	0.071	-0.076
Increase Behavioural Activity	0.095	0.002

*** p= <.001 ** p= <.01 * p= <.05

The PAMS coping scales were significantly and positively correlated (r=.28, p<.01). Active Coping appeared to be related to CSQ Active Coping, but not CSQ Passive Coping. Amongst the CSQ subscales, PAMS Active coping was related to only CSQ Praying-and-Hoping. PAMS Passive coping was related to CSQ Passive Coping, but not CSQ Active Coping. Passive Coping appeared to be unrelated to the original CSQ coping subscales, except for a small correlation with CSQ Reinterpret-Pain-Sensations.

A series of multiple regression analyses were conducted to investigate the predictive validity of the PAMS coping scales. Analyses were also conducted for the CSQ passive and active scales, and six of the standard CSQ scales (not including the self-efficacy items and catastrophising scale) to assess comparative predictive validity. Thus, three analyses were conducted for each of the two criterion measures – the HADS depression scale, and the Disability Questionnaire. Results can be found in Table 5.13.

For the HADS Depression scale the CSQ six-scale version provided superior prediction. Both the PAMS and two-factor version of the CSQ provided significant prediction, accounting for comparable proportions of variance.

Table 5.13 Regression analyses assessing the predictive validity of PAMS scales compared to CSQ scales

Predictor	R-square	Scale	Beta
HADS - Depression			
CSQ – 2 factors	0.083*	Active	-0.191**
		Passive	0.25*
CSQ – 6 scales	0.163*	Divert Attention	0.159 n.s.
		Reinterpret Pain Sensations	0.064 n.s.
		Ignore	-0.383*
		Pray/Hope	0.059 n.s.
		Coping Self-Statements	-0.225**
		Increase Behavioural Activity	-0.086 n.s.
PAMS	0.078*	Active	0.02 n.s.
		Passive	0.273*
Disability Questionnaire			
CSQ – 2 factors	0.067**	Active	0.119 n.s.
		Passive	0.21**
CSQ – 6 scales	0.083 n.s.		
PAMS	0.197***	Active	0.257*
		Passive	0.295*

*** p= <.001 ** p= <.01 * p= <.05

The PAMS proved to be the better predictor of the Disability Questionnaire, predicting 19.7% of variability. The CSQ passive/active coping scales accounted for a notably smaller but still significant amount of variance, whilst the six CSQ subscales were not significant.

5.2.4 Distress

The two PAMS items measuring Calmness and Cheerfulness were inverted to ease interpretation. Descriptive data can be found in Table 5.14.

Table 5.14 Descriptive statistics for PAMS Distress items

PAMS Items	Mean	SD	Min.	Max.	Skew	Std. Skew	Kurtosis	Std. Kurt.
Cheerful (Inverted)	51.02	22.74	6	97	0.21	0.96	-0.56	-1.30
Calm (Inverted)	46.11	20.06	3	93	0.07	0.31	-0.42	-0.98
Down	35.01	21.47	1	90	0.35	1.60	-0.92	-2.11
Depressed	36.02	24.17	0	82	0.11	0.51	-1.43	-3.31
Anxious	31.73	22.00	1	97	0.63	2.90	-0.46	-1.07
Frustrated	47.72	25.62	0	93	-0.25	-1.13	-0.94	-2.18
Irritable	35.71	22.59	1	95	0.44	2.02	-0.54	-1.24
Tense	44.57	23.22	1	99	-0.22	-1.01	-0.85	-1.96

Std. Skew= Standardized Skew; Kurt.= Kurtosis; Std. Kurt.= Standardized Kurtosis

Factor analysis was conducted on PAMS distress items using principal axis factoring. One factor with an eigenvalue above one was identified, accounting for 63.56% of variance. Factor loadings can be found in Table 5.15. Factor two accounted for only 9.18% of additional variance. Only factor one was retained.

Table 5.15 Factor loadings of PAMS distress items

	Factor Loading
Cheerful (Inverted)	0.72
Calm (Inverted)	0.66
Down	0.67
Depressed	0.80
Anxious	0.80
Frustrated	0.76
Irritable	0.83
Tense	0.86

Descriptive statistics for the PAMS Distress scale can be found in Table 5.16. The scale displayed a high degree of internal consistency (alpha=0.92). There were no items that increased alpha reliability when deleted.

Table 5.16 Descriptive statistics for PAMS Distress scale

Minimum	6.75
Maximum	88
Mean	40.96
SD	18.12
Skew	0.11
Std. Skew	0.51
Kurtosis	-0.65
Std. Kurtosis	-1.50

Std. Skew= Standardized Skew
Std. Kurt.= Standardized Kurtosis

Convergent validity of the PAMS Distress scale was assessed via correlation with a range of standard measures of psychological distress (see Table 5.17).

For the purpose of comparison, the inter-correlations amongst the standard measures are included.

Table 5.17 Correlation of PAMS Distress scale with standard measures of distress

	PAMS Distress	MPI Affective Distress	HADS Anxiety	Depress.	SF-36 Role Funct – Emotion.	Mental Health
MPI – Affective Distress	0.67	-				
HADS – Anxiety	0.62	0.67	-			
HADS - Depression	0.57	0.55	0.59	-		
SF-36 Role Function - Emotional	-0.52	-0.51	-0.55	-0.52	-	
SF-36 Mental Health	-0.63	-0.61	-0.71	-0.64	0.61	-

All correlations p= <.001
Depress.= Depression; Role Funct.= Role Functioning

The PAMS scale correlated significantly with all standard measures of distress. These correlations were in a comparable range to the intercorrelations amongst the comparison measures.

Table 5.18 Communalities of PAMS Function items

	Communality
Avoid Housework/Chores	***0.40***
Avoid Yardwork/Gardening	***0.49***
Avoid Work (paid or unpaid)	***0.42***
Avoid Shopping	***0.50***
Avoid Sport	***0.56***
Avoid Cooking	***0.36***
Avoid Visiting	***0.31***
Avoid Dressing Self/Bathing	0.26
Avoid Hobby	***0.36***
Avoid Driving	0.29
Work (paid or unpaid)	***0.31***
Housework/Chores	0.22
Yardwork/Gardening	0.29
A Sport	0.19
Bend/Kneel/Stoop	***0.44***
Carry An Object	***0.38***
Lift An Object	***0.47***
Walk 500 Meters	0.28
Walk A Kilometre	0.21
Climb A Flight Of Steps	***0.31***
Climb Several Flights Of Steps	0.22

Items in bold-face loaded over 0.3 and were adopted in the PAMS Function scale.

5.2.5 Function

Factor analysis was conducted on the PAMS activity and avoidance checklists using principal axis factoring. To assess which items were most convergent for constructing a single scale measuring function, items with communalities over 0.3 were included in subsequent analyses (see Table 5.18). This method was selected because the function scale was intended as a gross measure of function and there was no reason to assume an underlying factor structure. It was considered that factor analysis *per se* would not reveal theoretically important latent dimensions, but would merely reveal which activities people tended to do at the same time regardless of whether they were functional or

dysfunctional. This conclusion was confirmed when PAMS items were submitted to factor analysis with Varimax rotation. No inherent meaning appeared to be conveyed by the factor solutions other than the practicalities of which activities tend to co-occur in daily life (for example, doing yardwork tends to co-occur with lifting and carrying objects, thus revealing a yardwork/lifting factor).

Descriptive statistics for a scale constructed from the 13 selected items can be found in Table 5.19. This scale displayed an adequate degree of internal consistency (alpha=0.71). Inspection of item-total correlations revealed that one item ("Work (paid or unpaid)") correlated only r=.081 with the total scale. Removal of this item did not appear to increase internal validity significantly, thus the item was retained. It was considered that because the function scale was intended as a gross measure of function, and items were not selected on the basis of factor structure, it was not surprising that certain items had low item-total correlations. Further, it was considered important to retain that item for the sake of content validity.

Table 5.19 Descriptive statistics for PAMS Function scale

Minimum	0
Maximum	100
Mean	57.88
SD	21.63
Skew	-0.42
Std. Skew	-1.95
Kurtosis	-0.17
Std. Kurtosis	-0.39

Std. Skew= Standardized Skew
Std. Kurt.= Standardized Kurtosis

To assess convergent validity the PAMS Function scale was correlated with a range of outcome measures related to function, including the PAMS GRS rating of physical activity (see Table 5.50).

Table 5.50 Correlation of PAMS Function scale with function outcome measures

	PAMS Function
SF36 - Physical Function	0.638***
SF36 - Physical Role Function	0.574***
SF36 - General Health	0.322***
SF36 - Vitality	0.457***
SF36 - Social Function	0.575***
Disability Questionnaire	-0.593***
PAMS - Activity-level	0.235*

*** p= <.001 ** p= <.01 * p= <.05

All correlations with outcome measures were significant and in the range of r=.32 and 0.638. The correlation with PAMS activity-level was significant but small, indicating that the two PAMS measures represent related but distinct measures of physical functioning.

5.2.6 Activity Level

Descriptive Statistics for the single-item PAMS Activity Level measure can be found in Table 5.51.

Table 5.51 Descriptive statistics for PAMS Activity Level scale

Minimum	2
Maximum	89
Mean	37.53
SD	18.87
Skew	0.059
Std. Skew	0.27
Kurtosis	-0.613
Std. Kurtosis	-1.42

Std. Skew= Standardized Skew
Std. Kurt.= Standardized Kurtosis

The concurrent validity of the PAMS Activity-Level scale was assessed via correlation with outcome measures of function (see Table 5.52). The SF-36 Vitality scale demonstrated the highest correlation with PAMS Activity Level, and significant relationships were also found with SF-36 Physical Functioning, and the DQ. Convergent relationships were of only low to moderate magnitudes.

Table 5.52 Inter-correlation of PAMS Activity-Level scale with standard measures of function

	PAMS Activity Level
SF36 - Physical Function	0.239**
SF36 - Physical Role Function	0.15
SF36 - General Health	0.052
SF36 - Vitality	0.35***
SF36 - Social Function	-0.01
Disability Questionnaire	-0.201*

*** p= <.001 ** p= <.01 * p= <.05

5.3 Discussion – Part A

The purpose of Part A of Study One was to develop and validate the Pain Ambulatory Monitoring Survey (PAMS). Each of the six domains – pain intensity, pain appraisals, coping, distress, function, and activity-level – were investigated separately.

5.3.1 Pain Intensity

The PAMS Pain-Intensity measure demonstrated adequate convergent and concurrent validity. Convergent validity was demonstrated by significant and moderate correlations with two established measures of pain intensity from the SF-36 and the MPI. The PAMS scale correlated only mildly with the McGill PRI-Total, reflecting the lower correlations the SF-36 and MPI also shared with that scale.

Concurrent validity of the PAMS Pain-Intensity scale was also supported by correlations with existing measures of function and psychological distress – constructs that are presumably related to pain intensity. PAMS Pain Intensity demonstrated significant mild/moderate correlations with the DQ, five scales of the SF-36, MPI Affective Distress, and the Depression and Anxiety scales of the HADS. In support of divergent validity, all correlations with these function- and distress- scales were notably lower than correlations between PAMS Pain Intensity and the SF-36 and MPI measures of pain intensity.

5.3.2 Appraisal

All appraisal items except pain-expectancy (which was retained as a separate scale for theoretical reasons) were subjected to factor analysis. Three non-orthogonal dimensions of appraisal were established, which clearly distinguished between distinct appraisal constructs – pain control self-efficacy, catastrophising, and perceived interference. In confirmation of the reliability of these scales, all three demonstrated high to very high internal consistency.

The four PAMS appraisal scales were mildly/moderately correlated. Catastrophising demonstrated moderate correlations with both Pain Expectancy and Perceived Interference. This may reflect the shared “primary appraisal” nature of these constructs. However, correlations were not such that any multicollinearity could be considered. Amongst the appraisal scales, Pain Self-Efficacy and Perceived Interference demonstrated excellent internal reliability, and the Catastrophising scale was adequate. Convergent validity appeared to be adequately supported for the Catastrophising and Perceived Interference scales. Catastrophising was most strongly correlated with similar scales – CSQ Catastrophising, the three PCS scales, and the PCS Total score. Perceived

interference was most strongly related to the MPI Life Interference scale. Divergent validity was supported for PAMS Perceived Interference – its relationship to MPI Life Interference was significantly larger than relationships with any other cognitive scale. The divergent validity of the PAMS Catastrophising scale was not as strong. Its relationships with two divergent scales (PSEQ and MPI Life Interference) were not significantly different from its convergent relationship with CSQ Catastrophising or the PCS Total score. This may reflect the breadth of the PSEQ scale as a general measure of pain appraisals, and the similarity of the catastrophising and perceived interference constructs as measures of primary appraisal.

PAMS Pain Self-Efficacy was also most strongly, and exclusively, related with a measure of pain self-efficacy, the PSEQ, supporting the scale's divergent validity. However, thie relationship was not strong, and the scale's correlations with the two CSQ pain-coping self-efficacy scales were mild – no stronger than correlations demonstrated with non-construct specific scales. Thus, analyses of the convergent validity of the Self-Efficacy scale throw some question on the content measured by this scale. Further analysis revealed that the PAMS Pain Self-Efficacy scale was strongly correlated with a specific item from the PSEQ reflecting perceived ability to control pain without the use of medication. Thus, it appears that the PAMS Pain Self-Efficacy scale may reflect self-efficacy for an internal-locus of pain control. It would appear that, given its moderate correlations with the range of PAMS scales, the PSEQ is a broader-spectrum measure of pain appraisal, incorporating perceptions of life control, pain control, and capacity to function. For the purposes of validating the PAMS Pain Self-Efficacy scale, a measure of internal locus of pain-control may have been more suitable.

5.3.3 Coping

Two non-orthogonal factors were extracted from factor-analysis of coping items. This was consistent with two-factor models of coping suggested in the general coping literature (eg. Folkman & Lazarus, 1980) and the chronic pain literature (eg. Brown & Nicassio, 1987). Face-validity of the two scales suggested active-coping and passive-coping dimensions. Both scales demonstrated adequate internal consistency.

The two factors demonstrated convergent and divergent validity, with the Active-Coping scale correlating with the active coping scale of the CSQ but not the passive scale, and visa versa for the PAMS Passive-Coping scale. Though significant, the convergent correlations were somewhat lower than convergent correlations found between the Vanderbilt and CSQ passive- and active- coping scales (Snow Turek, et al., 1996). The PAMS coping scales demonstrated ambiguous relationships with the CSQ subscales, with the Passive-Coping scale demonstrating a small but significant correlation with CSQ Reinterpreting Pain Sensations (traditionally seen as an active coping strategy) and the Active-Coping scale demonstrating a small but significant relationship with CSQ Praying/Hoping (traditionally seen as a passive coping strategy).

It may be that the CSQ passive-coping scale is not a good comparison against which to validate the PAMS Passive-Coping scale. Firstly, the CSQ's content appears lacking in terms of a number of passive-coping strategies on which the PAMS scale focuses, namely medication and substance-use, activity avoidance, help-seeking, and laying/resting. Further, the PAMS Passive-Coping scale does not include catastrophic thinking, whilst catastrophising is predominant in the CSQ's passive-coping scale (Snow Turek, et al., 1996). Nonetheless, it is surprising that the PAMS Active-Coping scale did not

demonstrate a greater relationship with the CSQ active-coping subscales. A scale such as the Vanderbilt (Brown & Nicassio, 1987) may have been a more suitable choice for cross-validation purposes.

A series of regression analyses were conducted to assess the predictive validity of the two PAMS coping scales. Their success in predicting distress (via the HADS Depression scale) and function (via the Disability Questionnaire) was compared to the predictive validity of the CSQ. Two formats of the CSQ were utilized in separate analyses: six of the original coping subscales, and Nicholas' (1988) two-factor model. The two factor model was utilized because it was considered that this factor structure would provide a clearer comparison with the two dimensions measured by the PAMS coping scales (although this factor structure includes the CSQ's catastrophising scale).

In predicting depression, the CSQ provided superior prediction. However, variability accounted for by the PAMS scales was significant, and comparable to that accounted for by Nicholas's (1988) two-factor version of the CSQ.

It is noted that both versions of the CSQ involved far larger item pools than the PAMS scales – thereby allowing a wider measure of the coping constructs – and the six factor version also contained three times the scales of the PAMS. On these bases it is perhaps unsurprising that the CSQ demonstrated greater prediction of distress. The two-factor version incorporated the CSQ catastrophising scale in its passive coping factor. One might expect that this would allow that scale superior prediction of distress (eg. Madland, et al., 2000; Rosenstiel & Keefe, 1983), though this was not borne out.

When predicting disability the PAMS scales provided superior prediction, accounting for three times the variance accounted for by the most predictive version of the CSQ – the

version consisting of Nicholas's (1988) two-factors. Interestingly, the original scales of the CSQ did not demonstrate significant prediction. The superior prediction by PAMS coping scales is likely to be due to PAMS's inclusion of passive coping strategies directly related to function, such as laying/resting, activity avoidance, and help-seeking.

5.3.4 Distress

Factor analysis identified a single distress factor, which was highly internally consistent. This scale incorporated items reflecting positive affectivity, and negative affectivity from the domains of frustration, anxiety and depression. The convergent validity of the scale was supported by moderate/high correlations with a range of measures of distress and emotional functioning, from the MPI, HADS, and SF-36. These correlations were comparable to intercorrelations found amongst those criterion measures.

5.3.5 Function

A range of items were subjected to factor analysis to create a measure of functioning. A single measure of functioning was devised by inspection of communalities. The items selected reflected activities of every-day life that were engaged in, or that were avoided either because of pain or fear that the activity might provoke pain. The scale demonstrated adequate internal consistency, and acceptable convergent validity compared to a range of outcome measures from the SF-36 and DQ.

5.3.6 Activity-Level

A single item reflecting activity level was utilized. It demonstrated a significant low/moderate correlation with the SF-36 Vitality scale, which was expected to be the measure of function most likely to be related to activity-level. The activity level measure

also demonstrated significant relationships with other measures of function from the SF-36 and DQ, supporting its validity. Because the PAMS items were all momentary, and measures used for cross-validation were all recall-based, it was anticipated that this might reflect in lower convergent correlations. As such, it was not surprising that although PAMS Activity-Level demonstrated significant correlations with related constructs, these correlations were nonetheless in the low/moderate range.

5.4 Results – Part B: Between-person Analyses of Coping and Appraisal

In Part B of Study Two, the PAMS scales were employed in a conventional cross-sectional study comparable to those conducted by Turner, et al. (2000). To test the predictive validity of the PAMS scales against alternate standard measures an additional set of regression analyses were conducted in which MPI Affective Distress and the DQ were employed as criterion variables and other standard scales from the MPI, CSQ and PSEQ were employed as predictors. The results of these analyses were compared to findings from the PAMS scales. In each analysis in Part B the unique contribution of appraisal and coping, controlling for pain intensity, was assessed by entering pain intensity in the first step of a hierarchical analysis, followed by appraisal and coping variables in steps two and three.

Table 5.53 Unique prediction of PAMS Distress by PAMS Appraisal

Step	R Square	R Square Change	Predictors	Beta	partial corr.	part corr.
1. Pain Intensity	.139***		Pain Intensity	.37***	.37	.37
2. Coping	.249***	.11***	Pain Intensity	.37***	.39	.36
			Passive Coping	.34***	.36	.33
			Active Coping	-.11	-.12	-.1
3. Appraisal	.361***	.112**	Pain Intensity	.25*	.19	.16
			Passive Coping	.24**	.25	.21
			Active Coping	-.06	-.07	-.05
			Perceived Interference	-.04	-.04	-.03
			Pain Expectancy	-.15	-.12	-.1
			Pain Self-Efficacy	-.04	-.05	-.04
			Catastrophising	.42***	.37	.32

*** p= <.001 ** p= <.01 * p= <.05
Corr.= Correlation

Scales were checked for normality, and untransformed scales were used in each case. Variables were also checked for linearity and homoscedasticity, and the data was deemed adequate. All analyses were performed with pair-wise deletion for missing values.

For the purpose of the current project, which was largely exploratory in nature, alpha values equal to or less than .05 were considered significant.

5.4.1 PAMS Distress

Two hierarchical regression analyses were conducted with PAMS Distress as criterion. In the first analysis, conducted to investigate the independent role of appraisal, PAMS Pain Intensity was entered at step one, PAMS coping scales were entered at step two, and the PAMS appraisal scales were entered in the last step (see Table 5.53). The second analysis was conducted to investigate the role of coping in distress, and was identical to the first analysis except that appraisals were entered second and coping was entered last (see Table 5.54).

Table 5.54 Unique prediction of PAMS Distress by PAMS Coping

Step	R Square	R Square Change	Predictors	Beta	partial corr.	part corr.
1. Pain Intensity	.139***		Pain Intensity	.37***	.37	.37
2. Appraisal	.317***	.178***	Pain Intensity	.2	.16	.13
			Perceived Interference	.03	.03	.02
			Pain Expectancy	-.18	-.14	-.12
			Pain Self-Efficacy	-.08	-.09	-.07
			Catastrophising	.47***	.41	.37
3. Coping	.361***	.044*	Pain Intensity	.25*	.19	.16
			Perceived Interference	-.04	-.04	-.03
			Pain Expectancy	-.15	-.12	-.1
			Pain Self-Efficacy	-.04	-.05	-.04
			Catastrophising	.42***	.37	.32
			Passive Coping	.24**	.25	.21
			Active Coping	-.06	-.07	-.05

*** p= <.001 ** p= <.01 * p= <.05
Corr.= Correlation

Thirty-six percent of variance in distress was accounted for by pain intensity, coping, and appraisal, with 13.9% attributable to pain-intensity in step one, and 22.2% attributable to coping and appraisal. Pain-intensity maintained its association with distress at the third step, being associated with greater distress. Appraisal was associated with 11.2% variance not attributable to pain-intensity or coping. Amongst the appraisal predictors catastrophising was the only significant variable, associated with greater distress. Coping was associated with 4.4% unique variance in distress, with passive coping being related to increased distress. Catastrophising was the strongest of the significant predictors.

5.4.2 PAMS Function

In an initial hierarchical regression analysis PAMS Function was predicted from PAMS Pain Intensity at step one, the PAMS coping scales at step two, and PAMS appraisal scales at step three (see Table 5.55). The second and third steps were reversed in a second analysis investigating the unique contribution of coping to functioning (see Table 5.56).

Table 5.55 Unique prediction of PAMS Function by PAMS Appraisal

Step	R Square	R Square Change	Predictors	Beta	partial corr.	part corr.
1. Pain Intensity	.07**		Pain Intensity	-.26**	-.26	-.26
2. Coping	.189***	.118***	Pain Intensity	-.23**	-.25	-.23
			Passive Coping	-.34***	-.34	-.33
			Active Coping	-.02	-.02	-.02
3. Appraisal	.27***	.082*	Pain Intensity	.02	.01	.01
			Passive Coping	-.21*	-.21	-.18
			Active Coping	-.02	-.02	-.02
			Perceived Interference	-.19	-.18	-.15
			Pain Expectancy	-.09	-.07	-.06
			Pain Self-Efficacy	.12	.13	.11
			Catastrophising	-.14	-.12	-.1

*** p= <.001 ** p= <.01 * p= <.05
Corr.= Correlation

Twenty-seven percent of PAMS Function was accounted for by pain-intensity and the PAMS appraisal and coping scales. In step one, 7% of variance was associated with pain-intensity. Pain was associated with lower functioning both in step one and when coping was added to the model, but retained no association when appraisals were entered. Twenty-percent of variance was associated with the appraisal and coping variables, 8.2% of which was unique to appraisals. Coping was not significantly associated with any unique variance in function. However, whilst appraisals accounted for unique variance in function but coping did not, the only significant predictor was passive coping, being related to reduced functioning. Perceived interference was associated with decreased function in step two of the second analysis, but this effect vanished when coping was entered in step three.

Table 5.56 Unique prediction of PAMS Function by PAMS Coping

Step	R Square	R Square Change	Predictors	Beta	partial corr.	part corr.
1. Pain Intensity	.07**		Pain Intensity	-.26**	-.26	-.26
2. Appraisal	.232***	.162***	Pain Intensity	.04	.03	.02
			Perceived Interference	-.27**	-.25	-.23
			Pain Expectancy	-.05	-.04	-.04
			Pain Self-Efficacy	.17	.17	.15
			Catastrophising	-.17	-.15	-.13
3. Coping	.27***	.038 ns	Pain Intensity	.02	.01	.01
			Perceived Interference	-.19	-.18	-.15
			Pain Expectancy	-.09	-.07	-.06
			Pain Self-Efficacy	.13	.13	.11
			Catastrophising	-.14	-.12	-.1
			Passive Coping	-.21*	-.21	-.18
			Active Coping	-.02	-.02	-.02

*** p= <.001 ** p= <.01 * p= <.05
Corr.= Correlation

5.4.3 PAMS Activity-Level

A hierarchical multiple regression analysis was performed to investigate the unique contribution of appraisal factors to the prediction of activity-level, with pain-intensity entered in the first step, coping in the second step, and appraisal in the third step (see Table 5.57). The effect of coping was investigated in a second analysis in which appraisal was entered in the second step, and coping in the third step (see Table 5.58).

Table 5.57 Unique prediction of PAMS Activity-Level by PAMS Appraisal

Step	R Square	R Square Change	Predictors	Beta	partial corr.	part corr.
1. Pain Intensity	.014 ns		Pain Intensity	-.12	-.12	-.12
2. Coping	.083*	.069*	Pain Intensity	-.13	-.13	-.13
			Passive Coping	-.26**	-.25	-.25
			Active Coping	.15	.14	.14
3. Appraisal	.104 ns	.021 ns	Pain Intensity	.01	.01	.01
			Passive Coping	-.21*	-.19	-.18
			Active Coping	.14	.14	.13
			Perceived Interference	-.07	-.06	-.05
			Pain Expectancy	-.08	-.06	-.05
			Pain Self-Efficacy	.07	.06	.06
			Catastrophising	-.07	-.05	-.05

*** p= <.001 ** p= <.01 * p= <.05
Corr.= Correlation

A total of 10.4% of variance was accounted for in PAMS Activity-level. Pain-intensity was not significantly associated with any variance in activity-level. Whilst 9% variance in activity-level was associated with appraisal and coping, neither appraisal nor coping was significantly associated with any unique variance. Table 5.57 demonstrates that coping accounted for a significant portion of variance that was not related to pain-intensity, but Table 5.58 reveals that this variance could not be considered independent of appraisals. Passive coping was the only predictor that appeared to have an impact on activity-level, associated with decreased activity.

Table 5.58 Unique prediction of PAMS Activity-Level by PAMS Coping

Step	R Square	R Square Change	Predictors	Beta	partial corr.	part corr.
1. Pain Intensity	.014 ns		Pain Intensity	-.12	-.12	-.12
2. Appraisal	.064 ns	.05 ns	Pain Intensity	.08	.05	.05
			Perceived Interference	-.1	-.09	-.09
			Pain Expectancy	-.07	-.05	-.05
			Pain Self-Efficacy	.09	.08	.08
			Catastrophising	-.13	-.11	-.1
3. Coping	.104 ns	.041 ns	Pain Intensity	.01	.01	.01
			Perceived Interference	-.07	-.06	-.05
			Pain Expectancy	-.08	-.06	-.05
			Pain Self-Efficacy	.07	.08	.08
			Catastrophising	-.07	-.05	-.05
			Passive Coping	-.21*	-.19	-.18
			Active Coping	.14	.14	.13

*** p= <.001 ** p= <.01 * p= <.05
Corr.= Correlation

5.4.4 MPI Affective Distress

Two hierarchical multiple regression analyses were conducted with the MPI Affective Distress scale as criterion. The first was to assess the unique impact of appraisal on distress, and the second to assess the unique impact of coping. In the first analysis, the MPI Pain Severity scale was entered first, followed by the CSQ coping scales in the second step, and a range of standard measures of appraisals (namely, CSQ Catastrophising, MPI Life Interference, and the PSEQ) in the third step (see Table 5.59). In the second analysis, the order of entry for the coping scales and appraisal scales was reversed (see Table 5.60).

Table 5.59 Unique prediction of MPI Affective Distress by Appraisal

Step	R Square	R Square Change	Predictors		Beta	partial corr.	part corr.
1. Pain Intensity	0.072**		MPI	Pain Severity	0.27**	0.27	0.27
2. Coping	0.152**	0.08ns	MPI	Pain Severity	0.33	0.33	0.32
			CSQ	Divert Attention	-0.14	-0.11	-0.11
				Reinterpret Pain Sensation	0.03	0.03	0.03
				Ignoring Sensations	0.20	0.15	0.14
				Praying or Hoping	0.23*	0.21	0.19
				Coping Self Statements	-0.25*	-0.19	-0.18
				Increased Beh. Activities	-0.05	-0.04	-0.04
3. Appraisal	0.304***	0.151***	MPI	Pain Severity	0.04	0.03	0.03
			CSQ	Divert Attention	-0.19	-0.17	-0.14
				Reinterpret Pain Sensation	-0.01	-0.01	-0.01
				Ignoring Sensations	0.27*	0.21	0.18
				Praying or Hoping	0.10	0.09	0.08
				Coping Self Statements	-0.11	-0.08	-0.07
				Increased Beh. Activities	-0.04	-0.04	-0.03
			MPI	Life Interference	0.21	0.15	0.13
			PSEQ		-0.08	-0.06	-0.05
			CSQ	Catastrophising	0.36***	0.33	0.29

*** p= <.001 ** p= <.01 * p= <.05
Corr.= Correlation

A total of 30.4% variance was explained in MPI Affective Distress. In step-one, pain-severity was associated with 7.2% variance in distress. Whilst it was a significant predictor in step-one, it became non-significant when either coping or appraisal variables were added to the model. Appraisal and coping variables were associated with 23.2% variance in distress. Whilst appraisals were associated with significant unique variance (15.1%), coping was not. In the third step, the CSQ strategy Ignoring Sensations and CSQ Catastrophising were both related to increased pain, with catastrophising being the stronger predictor.

Table 5.60 Unique prediction of MPI Affective Distress by Coping

Step	R Square	R Square Change	Predictors		Beta	partial corr.	part corr.
1. Pain Intensity	.072**		MPI	Pain Severity	0.27**	0.27	0.27
2. Appraisal	.227***	.155***	MPI	Pain Severity	0.01	0.00	0.00
			MPI	Life Interference	0.23	0.16	0.14
			PSEQ		-0.06	-0.04	-0.04
			CSQ	Catastrophising	0.31***	0.29	0.27
3. Coping	.304***	.077ns	MPI	Pain Severity	0.04	0.03	0.03
			MPI	Life Interference	0.21	0.15	0.13
			PSEQ		-0.08	-0.06	-0.05
			CSQ	Catastrophising	0.36***	0.33	0.29
			CSQ	Divert Attention	-0.19	-0.17	-0.14
				Reinterpret Pain Sensation	-0.01	-0.01	-0.01
				Ignoring Sensations	0.27*	0.21	0.18
				Praying or Hoping	0.10	0.09	0.08
				Coping Self Statements	-0.11	-0.08	-0.07
				Increased Beh. Activities	-0.04	-0.04	-0.03

*** p= <.001 ** p= <.01 * p= <.05
Corr.= Correlation

5.4.5 DQ

Two hierarchical regression analyses were conducted with the DQ as criterion. In the first, intended to assess the unique role of appraisals in disability, pain severity was entered in the first step, followed by coping strategies in step two and appraisals in step three (see Table 5.61). In the second analysis the order of entry for the appraisal and coping variables was reversed (see Table 5.62).

Table 5.61 Unique prediction of the DQ by Appraisal

Step	R Square	R Square Change	Predictors		Beta	partial corr.	part corr.
1. Pain Intensity	0.204***		MPI	Pain Severity	0.45***	0.45	0.45
2. Coping	0.274***	0.07ns	MPI	Pain Severity	0.44***	0.45	0.43
			CSQ	Divert Attention	-0.01	-0.01	0.00
				Reinterpret Pain Sensation	0.16	0.15	0.13
				Ignoring Sensations	-0.04	-0.03	-0.03
				Praying or Hoping	0.13	0.13	0.11
				Coping Self Statements	-0.20	-0.16	-0.14
				Increased Beh. Activities	0.14	0.13	0.11
3. Appraisal	0.489***	0.215***	MPI	Pain Severity	0.02	0.02	0.01
			CSQ	Divert Attention	-0.06	-0.07	-0.05
				Reinterpret Pain Sensation	0.15	0.17	0.12
				Ignoring Sensations	-0.09	-0.09	-0.06
				Praying or Hoping	0.10	0.11	0.08
				Coping Self Statements	-0.05	-0.04	-0.03
				Increased Beh. Activities	0.13	0.14	0.10
			MPI	Life Interference	0.49***	0.39	0.30
			PSEQ		-0.25*	-0.22	-0.16
			CSQ	Catastrophising	-0.14	-0.16	-0.11

*** p= <.001 ** p= <.01 * p= <.05
Corr.= Correlation

Almost 50% of the variance in the DQ was accounted for by pain severity and the appraisal and coping scales. Pain severity was initially related to increased disability, accounting for 20.4% of variability. It retained this relationship when coping was added to the model, but not when appraisals were included. A total of 28.5% variance was attributable to appraisal and coping, though only appraisal appeared to account for a significant amount of unique variance (21.5%). In the final step, perceptions of life interference were related to greater disability and pain self-efficacy was related to lower disability. Perceived life interference was the stronger of the two predictors.

Table 5.62 Unique prediction of the DQ by Coping

Step	R Square	R Square Change	Predictors		Beta	partial corr.	part corr.
1. Pain Intensity	0.204***		MPI	Pain Severity	0.45***	0.45	0.45
2. Appraisal	0.448***	0.244***	MPI	Pain Severity	0.01	0.01	0.01
			MPI	Life Interference	0.50***	0.39	0.32
			PSEQ		-0.25*	-0.23	-0.18
			CSQ	Catastrophising	-0.09	-0.10	-0.08
3. Coping	0.489***	0.041ns	MPI	Pain Severity	0.02	0.02	0.01
			MPI	Life Interference	0.49***	0.39	0.30
			PSEQ		-0.25*	-0.22	-0.16
			CSQ	Catastrophising	-0.14	-0.16	-0.11
			CSQ	Divert Attention	-0.06	-0.07	-0.05
				Reinterpret Pain Sensation	0.15	0.17	0.12
				Ignoring Sensations	-0.09	-0.09	-0.06
				Praying or Hoping	0.10	0.11	0.08
				Coping Self Statements	-0.05	-0.04	-0.03
				Increased Beh. Activities	0.13	0.14	0.10

*** p= <.001 ** p= <.01 * p= <.05
Corr.= Correlation

5.5 Discussion – Part B

In Part B of Study One, a series of hierarchical regression analyses were conducted to predict the PAMS Function, Activity-level and Distress scales. The unique effects of appraisal and coping were evaluated in separate analyses by entering each into the last step of the hierarchy. Mirroring Turner, et al.'s (2000) approach, the potential confounding effect of pain-intensity was controlled in all analyses by entering it at the first step of each analysis. Analogous analyses were conducted using standard measures of similar constructs – scales from the MPI, CSQ, DQ and PSEQ were employed to measure distress, functional status, appraisals, and coping strategies. These analyses of standard scales were done as a means of further validating the PAMS scales. Of interest was whether the analyses involving PAMS scales demonstrated a comparable pattern of findings to those found in analyses involving standard measures.

5.5.1 PAMS Analysis of Appraisal and Coping

The current study is the first to investigate the concurrent effect of such a representative variety of appraisal and coping variables on distress, function, and activity-level whilst controlling for pain-intensity.

In terms of distress, the current study found independent effects of both appraisal and coping, supporting a Stress and Coping model but contrasting with Turner, et al.'s (2000) finding that only appraisals were independently related to depression. For function, the current study only supported an independent role of appraisal, which again differed from Turner, et al.'s (2000) finding that coping but not appraisal (measured only as catastrophising) was independently related to disability. The current study found that neither coping nor appraisal were independently related to activity-level. The only significant predictor was passive coping, suggesting that people who tend to cope in passive ways are likely to be less physically active. This somewhat intuitive finding is well supported in the literature (eg Brown & Nicassio, 1987; Strahl, et al., 2000). Given that 10% of variance was accounted for by appraisal and coping factors, but neither appraisal nor coping played independent roles in determining activity-level, it may be that interactions between pain, appraisal, and coping factors play a key role in determining the differences between people in their physical activity levels. Jensen and Karoly's (1991) findings of interactions between pain intensity and psychological factors are consistent with this possibility.

Results for the analyses of distress were consistent with Turner, et al.'s (2000), Robinson, et al. (1997), and Geisser, et al.'s (1994) findings that catastrophising was an important predictor of distress even after controlling for a range of appraisal variables and coping

strategies. As anticipated, those who reported greater catastrophising were likely to be more distressed.

That other appraisal predictors appeared to be unrelated to distress (when entered with catastophising and coping variables) was interesting, especially considering other cross-sectional studies that have demonstrated a role for such appraisal variables as pain self-efficacy (eg. Strahl, et al., 2000) and perceived interference (eg. Rudy, et al., 1988; Catley, 1999). Previous findings relating to the relationship between passive coping and distress (eg. Brown & Nicassio, 1987; Snow-Turek, et al., 1996) were supported by the current analyses, though unlike previous studies no beneficial effect was found for active coping (cf. Brown & Nicassio, 1987; Mercado, et al., 2000).

Passive coping was the only significant individual predictor of function and activity-level in the current study, though collectively coping was not associated with significant unique variance. As expected, those who reported greater use of passive strategies tended to report poorer functioning and lower activity levels. Such an effect is well supported in the literature (eg. Strahl, et al., 2000).

The current study found that appraisal variables appeared to play no role in predicting function or activity-level when entered simultaneously with active and passive coping. It would appear to be the first study to have done such analyses and established such a finding. Findings from the current study that pain self-efficacy was unrelated to function contrasts with literature (eg. Buckelew, et al., 1995) that supports the role of this construct and theoretical expectations on the basis of Social Learning Theory. That catastrophising appeared to play no role in differentiating people on the basis of functional status was supportive of studies such as Turner, et al. (2000) and Geisser, et al.

(1994). The relationship between perceived interference and function has been neglected in the literature, so the lack of current findings to support the construct is noteworthy. It is noted that, considering the number of variables investigated, the analyses reported above may have had inadequate power to reveal effects for certain predictors.

5.5.2 Comparison of Findings from Standard Measures

Analyses of PAMS Distress, Function and Activity-Level scales were compared to analyses of distress and function measured via standard scales. Of interest was the proportion of variance accounted for in outcomes measures, proportion of variance uniquely attributable to appraisal and coping, and the individual predictors identified as important.

Somewhat more variance was accounted for in PAMS Distress than MPI Affective Distress. The literature has reported R-square values closer to those found for the PAMS scale when predicting distress from similar sets of predictors – Jensen & Karoly (1991) and Geisser, et al. (1994) reported R-squares of 34% and 38%, though Turner, et al. (2000) obtained greater prediction than was obtained in the current analyses, with an R-square of 51% with coping, appraisal, pain, and demographic predictors. PAMS Distress may be a more internally consistent measure than the MPI scale, thereby potentially more sensitive. Kerns, et al. (1985) reported an alpha reliability of 0.73 for the MPI scale compared to 0.92 for the PAMS scale. In addition, the item-content of PAMS Distress appears to cover a wider range of affective states than the MPI.

Significantly more variance was accounted for in the DQ than PAMS Function and Activity-Level. By contrast, when predicting functional disability from similar sets of predictors Jensen & Karoly (1991) reported an R^2 lower than was found in the current

study (20%), whilst Turner, et al. (2000) and Geisser, et al. (1994) reported values between those found here – 42% and 41% respectively.

One explanation for the poorer prediction of the PAMS scales than the DQ may be that the DQ appears to be a more internally-consistent measure than PAMS Function (eg. Jarvikoski, et al., 1995), and may also be more reliable than the PAMS Activity-Level scale. The conservative findings for PAMS scales compared to the DQ may also be related to their specificity and momentary nature. PAMS Function was designed as a measure of hour-to-hour functioning, and measures involvement in and avoidance of specific behaviors. The content of the DQ appears to be somewhat more diverse, and less behaviourally specific, perhaps making it a more liberal criterion to predict. The PAMS scales are also momentary indices, thereby providing temporally and contextually specific measures whereas the item content of the DQ is more generalised. Considering the full range of potential determinants of hour-to-hour functioning and activity-level (eg. time of day and day of week, prioritizing of tasks, procedural obstructions to completing certain tasks) which are likely to be "averaged over" when measuring function on gross recall-based measures, it is perhaps unsurprising that less variance was explained in the PAMS scale. Finally, function is measured in PAMS by having participants recall their functioning in the hours immediately prior to completing the monitoring entry. The PAMS pain and appraisal variables, on the other hand, are measured at the moment of the monitoring entry. Therefore, part of the poorer prediction of PAMS Function may have been because of the "back-to-front" temporal sequencing of these variables. Perhaps if function were assessed in the time-frame following assessment of predictors (as is done in Study 2) prediction of this criterion would improve.

The amount of explained variance in distress that was attributable to appraisal and coping variables was comparable between the analyses of PAMS Distress and MPI Affective Distress (23% versus 22%, respectively). In the literate, proportions of variance attributable to appraisal and coping have been as low as 8% (Geisser, et al.,1994), and as high as 43% (Turner, et al., 2000), though Jensen & Karoly (1991) reported a similar proportion to that found in the current study – 20%. However, findings for the MPI scale were not entirely consistent with findings for PAMS in that no significant independent relationship was found between coping and distress. Although both analyses of distress pointed to the importance of catastrophising as a factor that promotes distress, interpretational differences between the analyses became more apparent when it came to the role of coping strategies. Analyses of the MPI distress scale revealed that distress was greater amongst those who tended to ignore the pain – contrasting with the effect of passive coping observed in the PAMS analysis. There were noteworthy differences in the sets of predictors that may account for the differing interpretations – whereas passive coping appears to be more adequately assessed in the PAMS model (including strategies such as activity avoidance, help-seeking, and medication usage), the original CSQ scales are more focused on cognitive strategies and strategies traditionally seen as active.

The finding in the MPI analyses regarding ignoring sensations does not appear to have a precedent in the literature. Jensen and Karoly (1991) found that ignoring sensations was related to distress, though that study found an effect in the opposite (negative) direction. Robinson, et al. (1997) found that Praying/Hoping was related to increased distress, however no such effect was found in the current analyses. Jensen and Karoly (1991) also

found effects for coping self-statements and increased behavioural activities that were not found in the current study.

The proportions of variance attributable to sets of predictors appeared to differ notably between the PAMS and standard-measure analyses of function and activity, though findings for PAMS Activity-Level appeared to be more divergent from PAMS Function than PAMS Function was from the DQ. This may suggest substantive differences – different processes may operate in the prediction of activity-level than function or disability. Less variance was attributable to appraisal and coping in the PAMS Function (20%) analyses and, especially, the PAMS Activity-Level (9%) analyses, compared to the DQ (28%). However, values similar to each of these have been reported in the literature – Jensen & Karoly (1991) reported 14% of variance was attributable to appraisal and coping factors, Geisser, et al. (1994) reported 8%, and Turner, et al. (2000) reported 34%. Despite these differences between the PAMS and DQ analyses, the interpretation of the PAMS Function and DQ analyses was similar – pain was related to disability, and appraisals contributed uniquely to disability however coping did not. In contrast, neither pain, appraisal, nor coping appeared to contribute uniquely to the prediction of PAMS Activity-Level.

In terms of the predictors themselves, noteworthy differences were apparent. Whereas PAMS Passive-Coping was the only significant predictor of function and activity-level in the PAMS analyses, perceived interference and pain self-efficacy were the only significant predictors for the DQ. Differences in scale-content may account for the differential pattern of predictors. Namely, passive coping strategies – assessed by PAMS but not the CSQ – may account for the effect of appraisals such as self-efficacy and

perceived interference, potentially explaining why these factors were important in the analysis of the DQ but not in analyses of PAMS Function or Activity-Level. That is, low pain self-efficacy and high perceptions of interference may promote passive coping, and passive coping *per se* may be more proximally related to functional impairment.

Analyses of the DQ provided some interesting findings that are supported by the literature – such as the relationship between pain self-efficacy and disability (Buckelew, et al., 1995) – and previously unreported, such as the relationship between perceived interference and function. The current study did not support a role for CSQ coping strategies in predicting function, contrasting with studies such as Robinson, et al. (1997) who found that ignoring sensations and coping self-statements were related to increased function. Interestingly, Jensen and Karoly (1991) found the same effect for those predictors, and for diverting attention – though only for individuals with less intense pain. This leaves open the possibility that if interactions between CSQ coping strategies and pain-intensity were investigated in the current study an effect may have been found.

In general the PAMS scales provided more conservative prediction than the standard measures. This may be related to the narrow conceptual focus PAMS scales were designed to have. PAMS scales were developed to reflect specific constructs, thus, for example, PAMS Pain Self-Efficacy appears to be a narrower measure of pain self-efficacy that the PSEQ.

Other noteworthy differences between the PAMS predictors and standard predictors may account for differences in predictive strength. Firstly, a larger number of predictors were included in the standard-measures models. Specifically, all six CSQ coping subscales were included to provide a comprehensive coverage of coping domains. The active and

passive dimensions of the CSQ could have been used, except that CSQ Catastrophising (which is incorporated in the CSQ passive-coping scale) was maintained as a separate predictor for the sake of comparison with PAMS Catastrophising. Additionally, the fact that coping was disaggregated in the standard-measures model and aggregated in the PAMS model may have allowed for specific coping-effects that were missed in the PAMS model. The standard measures involve greater item-pools that the PAMS scales and, in cases such as the PSEQ, are likely to cover wider construct-domains than their respective PAMS scales.

In Part B of Study Two, PAMS was applied in a standard cross-sectional questionnaire-based study investigating the unique effect of appraisal and coping factors in predicting adaptation to chronic pain. No previous study has investigated this set of predictors simultaneously, and the relationship between certain predictors and outcomes (such as the relationship between perceived interference and functioning) has also been neglected. Whilst the current study reinforced some established findings, such as the importance of appraisal styles (especially catastrophising) in distress and the effect of passive coping on functioning and distress, other findings conflicted with established literature and with the analyses conducted in the current study that employed standard questionnaires. Some of these differences may be attributable to the specific set of predictors and criterion measures employed. For example, the PAMS criterion variables may differ from the standard measures in terms of internal consistency, and the PAMS predictors differ from standard scales in their momentary nature and narrow conceptual focus. Also, a wider range of coping scales were used in the analyses involving standard questionnaires, though passive coping appears to have been more adequately assessed in the PAMS

analyses. Reassuringly, although there were some differences between the PAMS and standard measure analyses in the total proportions of variance accounted for and the proportions attributable to psychological factors, similar analyses in the literature appear to provide an adequate precedent for the findings of the PAMS analyses.

6 STUDY 2 – THE INDEPENDENT ROLE OF PAIN APPRAISALS AND COPING IN DISTRESS, FUNCTION AND ACTIVITY LEVEL

The purpose of Study Two was to investigate whether appraisal and coping were related, within-people, to momentary adaptational status in a chronic pain population. Analyses relevant to these focal questions are reported in Part B of Study Two.

Specifically, Study Two aimed to address two questions previously raised only in the cross-sectional literature (Jensen & Karoly, 1991; Turner, et al., 2000). The first question concerned whether the effects of appraisal and coping were independent of the relationship between pain-intensity and adjustment. Jensen and Karoly (1991) stated that when investigating the effect of psychological variables on adjustment, pain-intensity may act as a confounding "third variable", and its effect should therefore be controlled. The second question was whether the effect of appraisal on adjustment is independent of coping, and visa versa for coping. Turner, et al. (2000) make the point that identifying independent roles of coping and appraisal is important not only on theoretical grounds, but for defining and refining therapeutic approaches to managing chronic pain. Despite this, few cross-sectional or EMA studies have investigated the relative effect of appraisals and coping in the same study (cf. Grant, 1998; Keefe, et al., 1997; Turner, et al., 2000).

These hypotheses were guided by Stress and Coping theory (Lazarus & Folkman, 1984), and on the basis of this heuristic model it was predicted that both appraisals and coping would have independent effects on adjustment to chronic pain, and these effects would not be attributable to pain-intensity. These predictions are supported by a limited body of

research in the EMA literature. Keefe, et al. (1997) and Grant, et al. (2002) demonstrated that certain appraisal variables were related to same-day mood and that these effects were independent of both pain intensity and coping strategies. Similarly, studies by Grant and colleagues, Keefe and colleagues, and Affleck, Urrows, et al. (1992) demonstrated that coping strategies were related to same-day mood and that those effects were independent of the effects of pain-intensity. Keefe and colleagues' and Grant and colleagues' work also demonstrated that these effects of coping were not due to appraisal, although only a limited range of possible appraisal variables were investigated (pain coping self-efficacy in both studies and catastrophising and general pain self-efficacy in Grant and colleagues' study). In the only study reporting cross-lag analyses, Keefe and colleagues reported that coping accounted for a small but significant amount of variance in next-day mood that was not attributable to pain-coping self-efficacy or pain intensity. However, pain-coping self-efficacy was not related to next-day mood when entered simultaneously with pain-intensity and coping efforts.

It is recognized that although more complex models could be tested regarding the relationship between coping, appraisal, and adjustment (eg. Jensen & Karoly, 1991; Catley, 1999) it was not the aim of this study to do so. As an early study in the field of within-person stress-and-coping models of chronic pain, the aim was merely to establish the independent roles of appraisals and coping in a within-person context.

The current study involves analyses of three separate outcome measures, thus acknowledging the multidimensional nature of adjustment and the need to assess it via multiple outcomes. Adjustment was assessed in terms of emotional and physical functioning. Emotional functioning was operationalised as *Distress* – an empirically

developed index reflecting non-clinical affect, composed of measures of positive affect and negative emotions from the domains of depressed mood, anxiety and anger/frustration. Physical functioning was operationalised as two separate outcome variables: *Function* (an empirically derived measure of engagement in and avoidance of functional activities) and *Activity Level*.

Same-lag analyses were conducted for the distress and activity-level outcomes, however because function was measured by asking participants to recall their function in the between-lag interval it was not considered appropriate to assess same-lag effects for that outcome. However, of specific interest to the current study was whether appraisal and coping had an effect on adjustment across time-lags – that is, are psychological predictors measured at one point in time associated with adjustment in subsequent hours. Cross-lag analyses were conducted for all three outcome measures. It was anticipated that larger effects would be found in same-lag than cross-lag analyses – for example Keefe, et al., (1997) accounted for 6.1% of PA in same-lag analyses but only 2% in cross-lag analyses. However, cross-lag analyses were not conducted to look for carry-over effects of the predictors, but rather to investigate the causal-direction of observed effects (see Bateman & Strasser, 1984). Same-lag analyses do not allow for such speculation. Keefe, et al. (1997) also employed cross-lag analyses with the rationale that "stronger causal inferences may be drawn from… findings of lagged, or carry-over, effects of one day's coping on the next day's pain and mood" (p40).

A full outline of specific hypotheses for each outcome variable is provided below, for both the same-lag and cross-lag analyses. In the absence of clearer theoretical predictions and relevant empirical findings, identical hypotheses were tested for each measure of

adaptation and for both same-lag and cross-lag analyses. Thus, where catastrophising, for example, was presumed to be detrimental to mood it was expected that it would also be detrimental to physical/social functioning. However, it was nonetheless suspected that differential findings may result between outcome measures or across time-lags, either in terms of the focal hypotheses or the effects of specific predictors.

The instrument used to conduct multiple daily assessments of these constructs, PAMS, was developed and validated in Study One. Amongst the specific psychological predictors included in PAMS were four measures of pain appraisal (catastrophising, pain self-efficacy, pain expectancy, and perceived interference) and two classes of pain coping strategy (active and passive coping). The predictors investigated were broadly guided by a Stress and Coping framework (Lazarus & Folkman, 1984), but were also selected as a representative sample of important appraisal and coping constructs, or – as Tennen and Affleck (1996) quoted from Casablanca – a "round up [of the] usual suspects" (p155). Each predictor has demonstrated an important relationship with adjustment in prior empirical research, and they are suggested by a number of theoretical models.

Although the specific effects of the appraisal and coping factors were not the focal issue in the current study, they were nonetheless of interest. Beck's (1967) cognitive theory of emotional disorders suggests that catastrophising will be positively related to distress, and such an effect was confirmed in Grant's (1998) across-day EMA study (see section 4.4.2). Cross-sectional studies suggest that the relationship between catastrophising and distress is independent of coping (eg. Turner, et al., 2000; Geisser, et al., 1994). A cross-sectional relationship between catastrophising and function has also been supported (eg. Robinson, et al., 1997), but other studies leave open the possibility that coping accounts

for that effect (eg. Turner, et al., 2000; Geisser, et al., 1994). Regression analyses in Study One consistently linked catastrophising to distress but not functioning, when controlling for both pain intensity and coping strategies.

Perceived interference has been strongly linked to distress in studies by Rudy, et al. (1988), Jacob, et al. (1993), Maxwell, et al. (1989) and Catley (1999). According to these authors, the reduced experience of positive reinforcement implied by perceived pain-related life-interference ties the construct to depression according to Lewinsohn's (1974) behavioral model of depression. Regression analyses in Study One linked perceived interference (measured by the MPI) to impaired functioning – measured by both the DQ and the PAMS Function scale – but not to distress. However, differences in perceptions of life interference did not distinguish between people of differing adaptational status when PAMS factors were analysed.

Pain self-efficacy (or, perceptions of ability to control or cope with pain) is linked directly to distress according to Seligman's (1972) Learned Helplessness theory of depression and Locus of Control Theory (eg. Smith, 1970; Calhoun, et al., 1974), and to adjustment via its effect on coping strategy usage according to Social Learning Theory (eg. Bandura, 1986; Jenson and Karoly, 1991). EMA studies suggest that pain coping self-efficacy and general pain self-efficacy are related to reduced distress (eg. Grant, 1998). Keefe, et al. (1997) demonstrated that whereas the effect of pain control self-efficacy on emotional functioning does not appear to be due to pain-intensity or coping strategy usage in same-lag analyses, the same cannot be said for cross-day lagged analyses. Cross-sectional findings by Jensen and Karoly (1991) support Keefe, et al.'s cross-lag analyses and are consistent with a Social Learning Theory interpretation – the

effect of pain coping self-efficacy on distress was attributable to coping. Cross-sectional studies have also linked pain self-efficacy to functioning (eg. Strong, et al., 1990; Buckelew, et al., 1995; Strahl, et al., 2000). Regression analyses in Study One linked pain self-efficacy (as measured by the PSEQ) to improved function, controlling for pain-intensity and coping strategies. However, no effect of pain self-efficacy on distress was observed in either analysis of the PAMS Distress or MPI Affective Distress scales.

A number of studies have linked pain expectancy to performance in laboratory exercises, according to expectancy theory (Dolce, et al., 1986; Turk, 1992). Whilst high pain expectancies have been linked to reduced performance (eg. Lackner, et al., 1996; Crombez, et al., 1996), behavioural avoidance has also been linked to pain expectancies that under-predict subsequent pain (Murphy, et al., 1997). Whilst pain expectancy has not been strongly linked to distress, Murphy, et al. (1997) reported that high pain expectancies during task performance were associated with anxiety. Unfortunately, analyses in Study One provided no support for the role of pain expectancies in predicting distress or function.

Passive coping has been consistently linked to both impaired emotional and physical/social functioning (eg. Brown & Nicassio, 1987; Bishop and Warr, 2003; Strahl, et al., 2000; Snow Turek, et al., 2000). Active-coping has been linked to improved emotional and physical/social functioning (eg. Brown & Nicassio, 1987; Bishop and Warr, 2003), but has also been linked to impaired functioning (Snow Turek, et al., 2000). In Study One, passive coping was linked to greater distress, poorer functioning, and lower activity-levels. Active-coping did not appear to be associated with any of the three adaptational indices.

Thus, it would be expected on the basis of theory and prior research that certain appraisal and coping variables will be associated with greater distress and impairment in function and activity-engagement (eg. catastrophising, perceived interference, pain expectancy, passive coping), whereas others will be associated with the opposite effects (eg. pain self-efficacy and active coping). However, the appraisal and coping factors outlined above have never been investigated simultaneously prior to the cross-sectional regression analyses in Study One. As such there is little precedent for hypotheses about their unique effects. Thus, in Study Two the relative within-person effect of each appraisal and coping factor on the three indices of adjustment was approached on an exploratory basis and no specific predictions were made.

Separate analyses were conducted for each of the three criterion variables, and results are presented first for Distress, then Function, and finally Activity Levels. For each outcome measure, same-lag analyses were conducted followed by cross-lag analyses – except for Function, for which the measurement protocol was not conductive to same-lag analyses. The focal hypotheses concerned whether appraisals and coping are independently related to adjustment, so to rule out the possibility that the effects of appraisal and coping were attributable to extraneous variables certain potential confounding variables were covaried. Pain intensity and time-of-day during the same lag as the outcome measure were covaried in all analyses. Pain intensity in the same-lag as the predictors (lag1) was also covaried in cross-lag analyses to remove the possible influence it may have had on the criterion at lag2. Other more procedural covariates are described in the Data Structure and Analyses subsection of the Method section (Section 6.1.5).

Methodological analyses were conducted prior to focal analyses, in Part A of Study Two. It was anticipated, based on prior EMA studies with chronic pain populations (eg. Feldman, et al., 1999; Stone, et al., 2003, Keefe, et al., 1997), that the percentage compliance rate for the current study would be high. However, it is noted that almost all prior studies (cf. Grant, 1998) offered monetary incentives for compliance whereas the current study did not. This may have impacted negatively on compliance in the current study.

It was anticipated that summary scores of the PAMS scales would be correlated with standard measures of their respective constructs and with respective scales of the PAMS-R – a one-week recall version of PAMS. However, it was also anticipated, based on prior empirical findings (eg. Lousberg, et al., 1997; Peters, et al., 2000), that reduced correlations would be found because of discrepancies in method – summary scales of momentary ratings are likely to diverge somewhat from recall-based measures. Thus, it was anticipated that summary PAMS scales would demonstrate higher convergent relationships with the PAMS-R scales (with which they presumably share measure-related variance but not method-related variance) than the standard questionnaires.

It was anticipated, based on prior findings of EMA studies in chronic pain populations, that reactivity effects would not be prominent (eg. von Baeyer, 1994; Peters, et al., 2000; Cruise, et al., 1996). However, the possibility of reactivity was not ruled out, either in terms of drift in mean-levels of ratings (eg. Stone, et al., 2003) or changes in variability in ratings (eg. Csikszentmihalyi & Larson, 1987) across the monitoring period.

The following focal hypotheses were made about the prediction of within-person adaptation (for distress and activity-level only) from appraisal and coping:

A. It was hypothesised that both coping and appraisals would contribute to the prediction of same-lag adaptation beyond what was accounted for by pain and time-of-day. This was assessed via comparison of a full model involving both the control variables and either coping or appraisal to a restricted model including only the control variables.

B. It was hypothesised that the effect of coping on adaptation would be independent of appraisal, and would therefore remain significant after the addition of appraisal to the model. Similarly, it was hypothesised that the effect of appraisal would be independent of and largely uninfluenced by coping.

Regarding the possible cross-lag relationship between appraisal and adaptation (for distress, function, and activity-level):

C. It was anticipated that, after the effect of covariates was accounted for, appraisals (lag1) would be associated with adaptation in subsequent hours (lag2). For the purpose of testing this hypothesis a full model composed of appraisal and control variables was compared to a restricted model containing only the control variables.

D. It was hypothesised that coping behaviours engaged in between the time of the appraisals and measurement of the adaptation outcome (that is, lag2 coping) would not fully account for the effect of the appraisals, and that the effect of the appraisals would be largely unchanged by the addition of lag2 coping to the model.

Regarding the possible cross-lag relationship between coping and adaptation (for distress, function, and activity-level):

E. It was anticipated that, after the effect of covariates was accounted for, coping behaviours (at lag1) would be associated with subsequent adaptation (lag2). For the

purpose of testing this hypothesis a full model composed of coping and control variables was compared to a restricted model containing only the control variables.

F. It was hypothesised that appraisals measured in the period between measurement of coping and subsequent adaptation (lag1 appraisals) would not fully account for the effect of coping on subsequent adaptation (at lag2), and that the effect of coping would be largely unchanged by the addition of lag1 appraisals to the model.

A set of analyses was conducted to clarify the effect of specific coping behaviours on subsequent adaptation. The dichotomously coded items constituting the coping scales were included as separate predictors, but only for coping scales that were found to be significant predictors of the outcome measure in prior analyses. Their effect on lag2 adaptation was assessed controlling for the covariates in the control model. There were no specific hypotheses regarding these analyses, though it was expected that specific coping behaviours would demonstrate a relationship with subsequent adaptation.

A final set of cross-lag analyses were concerned with the relative predictive importance of lag1 appraisal and coping in predicting subsequent adaptation. Lag1 appraisal and coping variables found to predict the outcome measure in prior analyses were included simultaneously in a model for comparison of effects.

6.1 Method

6.1.1 Participants

Subjects were literate English-speakers who lived within two-hours travelling time of the University of Queensland. Those with severe medical or psychiatric conditions for whom participation may have caused added stress were not asked to participate, though no participants were deemed to meet this exclusion criterion.

Prior to becoming involved in the project, participants were told they would be given an opportunity to receive comprehensive feedback about their monitoring data if they indicated that they were willing to have their PDA-output labelled for identification. All participants signed a consent form indicating that they wished to receive feedback. A description of the content of feedback forms and an example of such a form can be found in Appendix G. After subjects were given feedback, their output file was de-identified to ensure confidentiality. No monetary incentive was offered for participation.

Fifty-five participants (67% female) were recruited who had experienced bodily pain, not due to cancer, for three months or longer. Twenty-eight of these were recruited from the sample used in the pilot study (the "old" cohort) – five from the student sample, 17 from the community sample, and six from the clinical sample. Seventeen participants from the "new" cohort were from a student sample, three were from a clinical sample, and five were recruited from the community. Questionnaire booklets were completed by only 48 of the 55 participants.

Ages for the total sample ranged from 17 years to 74 years (M=39.1, SD=17.7). Frequency data relating to marital status, education level, employment status, professional background, and source of income can be found in Appendix C, Table C.1 (for the total sample and broken down according to gender, cohort, and the three sample sources). Descriptive statistics for continuous variables, including standardized questionnaires, can be found in Appendix C, Table C.3 (for the whole sample) and Table C.5 (broken down according to sample source and gender). Descriptive data for the PAMS-R questionnaire, and for summary scales (average scores and standard deviations of the full dataset) of the PAMS monitoring can be found in Appendix C, Table C.4 (for

the whole sample) and Table C.6 (for PAMS-R scores broken down according to gender, cohort, and sample source).

Participants predominantly reported being married (39.6%) or single (37.5%). Thirty-nine percent of participants reported having some form of tertiary education, followed by 31.9% with a senior high-school education, and 19% with a junior high-school education. Thirty-six percent of participants reported being involved in some form of work (Full- or part-time, casual, or voluntary), with the largest proportion of workers doing part-time work (35%). Twenty-three percent described themselves as students, 17% as unemployed, and 12% as retired. In terms of sources of income, the largest group (37.5%) described their primary source of income as wages/salary, followed by 27% on a disability pension, 18.7% living on a partner's income, and 12.5% on savings or investments. No participants reported supporting themselves via worker's compensation payments. Almost nineteen percent of participants described their profession as a machine operator or driver, manual worker, or tradesperson. Equal numbers of participants (12.5%) described themselves as a manager/administrator, paraprofessional, or as being in sales/personal services. The next largest professional group was administrative assistants (10.4%).

The vast majority of participants (93%) described their pain as being "Always present with varied intensity". In terms of factors associated with the onset of pain, the largest group indicated that they knew of no clear reason for their pain onset (31%). Twenty-five percent indicated that it was related to work, and 12.5% indicated that it was after a non-work accident (at home or in a car). The most frequently reported locations of pain were lower back (56% of participants), neck and upper leg (each 42%), and head (31%).

Narcotic- and simple- analgesics were the most common form of medication reported (each 39.6%), followed by anti-depressants (27%, including SSRI, tricyclic, and others), and NSAIDs (16.6%). Consultations with medical and allied-health professionals for the pain problem was most frequently reported for GPs (81%), and physiotherapists (70.8%). Almost 42% of participants reported attending a pain clinic. Sixteen percent of participants indicated that they had previously been involved in some form of litigation for their pain condition (worker's compensation, third-party compensation, or other), all of whom indicated that they had been successful in that action. One participant indicated that he was involved in a worker's compensation claim at the time of the study, and one indicated he was involved in some other form of litigation.

Differences between genders, participant-sources, and old versus new participants ("cohort") were investigated for all demographic and pain-related variables. Chi-square comparisons were conducted for nominal and ordinal variables. Sample sources were compared on categorical variables via three sets of pair-wise chi-square tests. T-tests and F-tests were conducted to compare continuous variables. In the case of sample source, test-wise Bonferroni adjustments were used for post-hoc comparisons.

As might be expected, the student sample appeared to differ from the other two samples on a number of demographic variables, whereas the community and clinical samples did not appear to differ significantly. Students were younger than the other two groups $F(2,45)=37.832$, $p<.001$. Participants with more than a senior high-school education were more prevalent in the community, $\chi^2(5)=14.67$, $p=.012$, and clinical, $\chi^2(5)=13.139$, $p=.022$, samples than the student sample. Students were also more likely to be single than those from the community sample, $\chi^2(5)=20.23$, $p<.001$. They were more likely than both

the community, χ^2 (1)=4.659, p=0.31, and clinical, χ^2 (1)=8.29, p=.004, samples to report earning an income from a wage or salary.

Students also appeared to differ along a number of pain-related dimensions. Students reported shorter pain histories, *F*(2,43)=4.06, p=.024, and fewer sites of regular pain, *F*(2,45)=5.8, p=.006, than the community sample, but not the clinical sample. Compared to the clinical sample, but not the community sample, students demonstrated lower bodily pain on the SF-36, *F*(2,45)=4.41, p=.018, and lower levels of minimum weekly pain on the PAMS-R , *F*(2,45)=5.027, p=.011, greater pain self-efficacy on the PSEQ *F*(2,45)=3.279, p=.047, and greater tendency to cope via Ignoring Sensations on the CSQ, *F*(2,45)=3.821, p=.029. Students were less likely than the community group to report pain in the upper legs, χ^2 (1)=7.84, p=.005. Students were less likely to report experiencing constant pain than both the community, χ^2 (5)=26.7, p<.001, and clinical, χ^2 (5)=11.274, p=.046, samples. Use of narcotic analgesics, χ^2 (1)=5.44, p=.02, was less prevalent in the student group than the clinical group. Students were less likely than both community and clinical groups to have visited a range of health professionals, with fewer students attending orthopedic surgeons, χ^2 (1)=3.28, p=.07, and rheumatologists, χ^2 (1)=9.38, p=.002, than the community group. They were less likely than both groups to have attended a pain clinic (community χ^2 (1)=5.39, p=.02; clinical χ^2 (1)=18.756, p<.001).

Students also differed in functional status. They reported fewer depressive symptoms on the HADS than both community and clinical samples, *F*(2,45)=6.092, p=.005, and higher Physical Functioning on the SF-36, *F*(2,45)=13.477, p<.001. Compared to the clinical group, but not the community sample, students demonstrated less disability on the DQ,

(2,45)=5.091, p=.01, and more improvement and/or stability in their one-year health status according to SF-36 Health Transition, $F(2,45)=4.1$, p=.023. According to the PAMS-R, students demonstrated lower levels of minimum weekly activity $F(2,45)=5.96$, p=.005, and higher levels of maximum weekly activity, $F(2,45)=6.1$, p=.005, than the clinical but not the community samples.

The community and clinical groups appeared to be more similar in terms of pain-related factors, although the community group was less likely to have attended a pain clinic, χ^2 (1)=6.261, p=.012. The clinical group reported greater use of medications on a regular basis on the PAMS-R than the student or community groups, $F(2,45)=13.477$, p<.001. Males and females were very similar in terms of demographic variables, with the only significance difference being in occupation – women were less likely to describe themselves as a tradesperson or manual laborer χ^2 (9)=18.056, p=.035.

On pain-related and adaptation variables some gender differences were apparent. Females were less likely to have attended a chiropractor, χ^2 (1)=3.927, p=.048, or occupational therapist, χ^2 (1)=3.927, p=.048. When recalling how "down" their mood was when their mood was at its best (on the PAMS-R), males' minimum "down" mood was worse (that is, they were more "down") than females, $t(46)=2.79$, p=.008. Males also reported lower average use of *prn* medication (medication taken as required) on the PAMS-R, $t(43)=-3.039$, p=.004.

The cohort groups also appeared to differ in a number of ways. Participants from the new cohort were younger in age $t(46)=2.52$, p=.015. The new cohort consisted of significantly fewer people who had attended an orthopedic surgeon, χ^2 (1)=4.9, p=.027, or psychologist χ^2(1)=6.97, p=.008. They reported shorter pain histories $t(44)=2.12$, p=.039,

fewer sites of regular pain $t(46)=2.08$, p=.043, and lower levels of reported minimum pain according to the PAMS-R $t(46)=2.781$, p=.008.

6.1.2 Procedure

Data collection was conducted via Casio E-11 palm-held computers. These PDAs operate on the Windows CE platform, weigh 6.6oz, and have a 3.1 by 2.4 inch grey-scale screen. They use "pen-based navigation" rather than a keyboard, allowing for a flexible and user-friendly interface.

The experimenter delivered the PDA to participant's homes, at which time he explained the use of the PDA and helped the participant complete one example entry. Participants were given "trouble-shooting" information, a spare set of batteries, an instruction booklet for use of the PDA (see Appendix H), and a power-cord and recharging "cradle". All participants read an information sheet about the project and signed a consent form (see Appendix I). In addition, subjects were asked to sign a "Computer Responsibility Form" on which they consented to liability for lost or damaged computers (see Appendix J). All participants signed this form, however no computers were lost or damaged.

Participants were asked to begin the project on the following day, however they were free to commence monitoring on the day the PDA was delivered as its alarms had already been programmed to begin sounding. Similarly, participants were only asked to monitor for one week, however they were free to continue responding to alarms on the eighth day until the experimenter was able to collect the PDA. Thus, participants were able to conduct monitoring on up to nine days.

Data was collected in subjects' natural environment at a frequency of eight times per day.

Waking hours, between 8 am and 10 pm, were broken into eight 105 minute blocks. Alarm signals were programmed to occur at a random time once during each block with the one stipulation that no two signals would occur within 30 minutes. Feedback indicated that on occasions the PDA skipped an alarm for one block, and this may have been because two alarms had been programmed for within 30 minutes of each other.

In a pilot project the EMA monitoring protocol was tested on four participants with chronic pain. Pilot-study participants were given one minute to respond to alarms before the PDA switched itself off. They carried the PDA for one week, completing a version of PAMS in early development. Participants left no entries incomplete. A 74% compliance rate was obtained (ie. percentage of alarms opened), with 23% of alarms timing-out and only 3% being dismissed. Feedback indicated that participants often missed an entry because alarms were not loud enough and did not ring for long enough. Because the alarms were already set at maximum volume, the amount of time given to participants to respond to alarms was extended for the project *per se*.

For the project, alarms were programmed to sound repeatedly for one minute, and then once per minute for 10 minutes. A visual display indicated how much time had elapsed since the alarm began to ring. After 10 minutes the PDA automatically switched itself of (or, “Timed-out”). An alarm sound was selected that was not considered irritating, but which should have been sufficient to attract attention.

When participants responded they were given the option to *Open*, *Postpone*, or *Dismiss* the alarm. They were asked to dismiss as few alarms as possible, and only when their circumstances were such that opening the alarm would be unsafe for the participant or the PDA, or if it would be impossible for them to complete the PDA within the maximum

postponement period (such as if they were driving). If the *postpone* option was selected, participants were given the options to postpone the alarm for one, five, ten or fifteen minutes. The length of time between the onset of the alarm and selection of the *postpone* option was taken into consideration so that participants were not offered postponement periods that would put their entry more than 20 minutes after the initial onset of the alarm.

If participants did not operate the PDA for one minute whilst completing an entry, the PDA was programmed to emit a beep to attract the participant's attention. The PDA beeped each minute, and switched itself off after four minutes.

PDAs were rendered inoperable between alarms so, for example, the participants could not use the PDA as a personal organizer or make an unsolicited entry. Likewise, during entries no other functions on the PDA were operable.

Participants were asked to complete a questionnaire booklet on the eighth day.

6.1.3 EMA Survey

When an alarm was responded to with the "Open" option the PDA commenced the PAMS monitoring program – an electronic version of the scales developed in Study One. A complete copy of the PAMS protocol can be found in Appendix K. One item was presented per screen. Participants were unable to return to previous items and were unable to commence the next item unless they had responded to the current item. Questions were presented at the top of each screen, with the response system below. Four types of screen were presented:

a) Message screens: occasional message screens appeared, analogous to instructions between sets of questions on a paper-an-pencil questionnaire. For example,

participants were reminded to answer questions according to their state at the time of the alarms, or to answer questions regarding the period between alarms.

The remaining screen-types depended on the response format of the question being asked.

b) Sliding-scale: Instead of manual GRS scales for continuous items, respondents used a stylus-pen to slide a bar along a line corresponding to 0-100 ratings. They were given feedback about what percentage number they had selected. Descriptors were anchored to ranges on the rating scale, and these descriptors were given at the bottom of the screen. For example, when asked “How calm and peaceful were you feeling?” a rating between 0 and 20 returned a descriptor of “Not at all”.

c) Check-box: For the majority of dichotomous items, participants simply used the stylus-pen to endorse a check-box situated next to each item. Once endorsed, a tick-mark appeared in the check box. One, none, or any combination of check-boxes could be selected.

d) Option-box: For one item relating to the nature of any medication use, participants were given a forced-choice of only one of three options.

6.1.4 Measures

Participants completed a questionnaire booklet at the end of the monitoring week, including a feedback form about the project, the PAMS-R, and the demographics and pain-history questionnaire administered in Study One. A complete copy of the PAMS-R and project feedback-form can be found in Appendix L. Participants also completed the McGill PRI, CSQ, MPI-Part One, PCS, SF-36, DQ, PSEQ, and HADS.

6.1.4.1 Pain Ambulatory Monitoring Survey – Recall Version (PAMS-R)

To compare between momentary- and recalled- reports, and to assist in assessing the PAMS scales, a paper-and-pencil version of the PAMS scale was developed in which items were worded in a one-week recall format. For some scales (such as pain, activity-level, and certain mood items) participants were asked to indicate their average, maximum, and minimum state during the week. When summary-scales were calculated for the Distress scale, only the "average" item of these ratings was used.

Because of the item's momentary nature, the Pain Expectancy item was not included on the PAMS-R scale.

Dichotomous items on the PAMS (related to the coping and function scales) were converted into seven-point likert scales similar to the CSQ.

6.1.5 Data Structure and Analysis

6.1.5.1 Structure of the Data Set

Only fully completed entries were included in the dataset. Approximately six entries were excluded because participants abandoned the entry part-way through.

The data set was modified to allow for cross-lag analyses. Lag2 variables were entered on the same row as corresponding lag1 entries by copying predictor and criterion variables from the next adjacent row. Thus, each row in the data set of momentary recordings consisted of a dyad of lag1 and lag2 values, the latter being copied from the following row.

The full data set was used for analyses of compliance, reactivity, and convergent validity.

For focal analyses of distress, functioning and activity-level, a reduced dataset was employed. Namely, rows were deleted in which the lag1 entry in each dyad was made more than three hours prior to the lag2 entry (three hours being the maximum time between adjacent alarms during data-collection). Hence, no rows of data were maintained where a comparison between lag1 and lag2 was comparing between morning and evening or between evening on one day and morning on the subsequent day. The resultant average gap between entries was 104.4 minutes (SD 37.8), with a minimum of 31.68 minutes and a maximum of three hours. Fifty percent of entries were separated by between one and two hours.

To ensure greater comparability between same-lag and cross-lag analyses the outcome variable was derived from the lag2 data set for both types of analyses (as opposed to predicting adaptation from the lag1 dataset for same-lag analyses and from the lag2 dataset for cross-lag analyses).

Two participants had made no entries within three hours of each other, and were deleted from all subsequent analyses, leaving 53 participants. A total of 1363 data-points (that is, 1363 lag1/lag2 dyads) remained, averaging 25.7 data-points per person (SD 12.01), with a maximum of 46. Entries were made over a total of 333 monitoring days, averaging 6.28 days per person (SD 2.16), with a maximum of eight and a minimum of one. On average, participants made 4.12 entries per day (SD 1.94), with a maximum average of nine and a minimum of one. See section 6.2.1 for an analysis of compliance rates for the full dataset.

6.1.5.2 Multi-Level Modelling and the Random Intercept Model

Schwartz and Stone (1998) described three types of questions addressed by EMA research. The questions addressed in the current study resembled the second of these –

"Do situational characteristics (within-person factors) predict fluctuations among assessments" or "How [do] changes from one assessment to another in predictors relate to changes in outcome measures?" (p7). In terms of statistical analysis, Schwartz and Stone recommended the use of *multilevel modelling* (MLM) for analyses of EMA data. MLM is suitable for hierarchically structured data where units at one level are clustered within higher order units. Variance in the outcome variable can thus be partitioned into that which is attributable to variation between higher-order units and that which is attributable to variation within higher-order units (Snijders & Bosker, 1999). In cases such as the current project, two hierarchical levels are investigated, with individuals as the level-2 unit of analysis and measurement occasions clustered within individuals as the level-1 unit of analysis. Thus, variance in dependent measures is partitioned into between- and within-subject variance. The *variance-components model* includes no predictors, and demonstrates the partitioning of variance into between- and within-subject components. Total variance is calculated as the sum of the between- and within- person variance. Inspection of this model is important for establishing the utility of a multi-level model – conventional analyses may be more appropriate if the vast majority of variance in the dependent measure is between-subjects. Because the current project was concerned with within-person predictors of within-person outcomes, the focus of analyses will be on within-person variance accounted-for. Further, it was not expected that between-person variation would be accounted for because the predictor variables were centred around individual means, thereby removing mean differences between individuals. The rationale for this variable transformation will be elaborated below.

Like conventional regression models, multilevel models include an intercept, a set of predictors with corresponding coefficients, and a residual term. However, in repeated-measures models of multi-level analyses (such as EMA data) intercepts are allowed to vary between people. As such, a separate intercept is calculated for each individual. The intercept term is thereby composed of an average intercept (representing the average score on the outcome measure) and a person-dependent deviation from the average (Raudenbush & Bryk, 2002).

For the type of questions addressed by the current study Schwartz and Stone (1998) recommend treating the mean scores of each individual as a random effect – what Snijders and Bosker (1999) refer to as a *random intercept model*. The aim of the current project, and of much EMA research, is to generalize findings from the specific individuals included in the study to populations as a whole. Thus, the intercept terms are treated as *random effects* – they are viewed as a sample from a larger population and parameters are calculated estimating the mean and variance of the "true" intercept (Schwartz & Stone, 1998).

Because the repeatedly-measured scores of individuals in an EMA project come from within the same individual they share variance and are thus non-independent. Whereas this would be a problem in conventional analyses treating each observation as independent, the issue is circumvented in random intercept models because the person-specific intercepts account for all between-person differences (Schwartz & Stone, 1998). The random-intercept model assumes that person-specific intercepts are uncorrelated with the predictors included in the model. For this reason, Schwartz & Stone (1998) recommend centring scores on predictors around each person’s mean (ie. subtracting the

individual's mean on that predictor from the score at each time-point). This method removes all between-person variance from the predictor, and the intercept can be treated as a random effect without concern for biased estimates of within-person effects. Although values of the intercept, *per se*, were not of primary concern in the current project, an additional benefit of person-centring predictors is that it allows for clear interpretation of intercept terms. Namely, intercepts represent the mean score on the criterion for that individual when all predictors are at their average value. Similarly, when person-centred predictors are used, slopes are interpreted as the effect of a predictor on the criterion when all other predictors are at their mean value (Raudenbush & Bryk, 2002). Except for dichotomous variables (which were left uncentred) all variables were person-centred in the current project.

Predictors can be introduced at level-1 (ie. pertaining to the measurement occasions) and level-2 (ie. pertaining to the individual) of a two-level multi-level model, though in the current study only level-1 predictors were of interest. In MLM, slopes representing the effect of level-1 predictors can also be treated as fixed or random (Snijders & Bosker, 1999), however in random-intercept models – as used in the current study – slopes are fixed. In this case, coefficients pertaining to the average slope between the predictors and the criterion are estimated (Snijders & Bosker, 1999). These slopes were of primary interest in the current study, permitting it to answer the kind of within-person questions described by Schwartz and Stone (1998), above. The ratio of a slope parameter to its standard error provides a *t*-statistic that can be used to test the null hypothesis that the population value of the coefficient is zero (Schwartz & Stone, 1998). Coefficients were standardised in the current study by multiplying the coefficient by the ratio of the

standard deviation of the predictor to the standard deviation of the criterion (see Snijders and Bosker, 1999). This was done because no variables, except dichotomous variables, were measured on an inherently meaningful scale. Where relevant, the unstandardised coefficients of dichotomous variables are reported in text. The interested reader can convert standardized coefficients back to raw units using the standard deviation reported in Table D.7 of Appendix D (for the reduced three-hour data set).

A number of methods are available for estimating the parameters of a multilevel model (Raudenbush & Bryk, 2002). Full-maximum likelihood-estimation was used in the current study.

To test the significance of changes in variance-accounted for by groups of variables added to a restricted model (analogous to R-squared change in hierarchical multiple regression) the deviance test was used. Using full-maximum likelihood-estimation this test can be used to assess change-in-fit when fixed parameters are added to a model, where the restricted model is nested within the full model (Schwartz & Stone, 1998). This test is based on the ratio of the log-likelihood estimate of the full model to that of the nested-model, producing a test statistic with chi-square distribution and degrees of freedom equal to the number of parameters added to the nested model (Raudenbush & Bryk, 2002).

Focal analyses and analyses of reactivity were conducted using MLM via the statistical program HLM for Windows version 5.05 (Raudenbush, Bryk & Congdon, 2001).

For HLM, separate databases are used for the level-1 and level-2 data. The level-1 database was set-up with each row consisting of one monitoring (lag1/lag2) dyad. Measurement occasions were ordered chronologically in ascending order, with entries

nested within individuals. The first column designated the subject ID to whom that measurement occasion belonged, thus allowing HLM to link the level-1 data-points to corresponding units (ie. persons) within the level-2 data.

6.1.5.3 Covariates

Covariates included in the analyses differed for same-lag and cross-lag analyses. In both types of analysis pain and time-of-day were covaried. Time-of-day was dummy-coded as evening versus working-hours, with pre-working hours as a reference category. This method was used to allow for potential differential effects of evening and morning, as opposed to measuring time-of-day on a linear scale.

In the case of cross-lag analyses, the criterion variable at lag1 was covaried as a means of controlling for first-order autocorrelation effects (Keefe, et al., 1997). This approach serves to rule out the possibility that the cross-lagged effects of appraisals and coping are only by virtue of their effect on the criterion-variable at lag1.

In certain cross-lag analyses lag1-to-lag2 change scores for the focal predictor variables were covaried. These scores were calculated by subtracting the lag1 scores from the lag2 scores, providing a measure of change in the predictor across lags. Change-scores were included to remove possible effects associated with regression to the mean. That is, when a lag1 score is high the corresponding lag2 score is likely to be lower, and visa versa for low lag1 scores. Thus, change scores tend to be negatively correlated with lag1 scores. If this effect is not statistically controlled it may obscure the effect of the lag1 variable, with cross-lag change variables acting as suppressor variables. Co-varying these scores may facilitate greater interpretability of the lag1 scores, revealing their impact on the lag2 criterion by removing the effect of systematic changes over lags. Affleck, et al. (1994)

and Brissette and Cohen (2002) followed a similar rationale in their cross-lag analyses, though they covaried the actual next-lag scores rather than the change scores. Affleck, et al. (1994) acknowledged that their approach was statistically conservative, possibly underestimating the predictive importance of the lag1 predictor, but was nonetheless prudent for isolating unique effects on the lag2 criterion.

Lag2 pain and lag2 time-of day were covaried in same-lag analyses of distress and activity level (where the criterion variables, also, were located in the lag2 data set). In cross-lag analyses of distress and activity-level, lag2 pain and time-of-day were covaried, as well as pain at lag1 and the criterion variable at lag1. In most cross-lag analyses, cross-lag change variables were included for the focal predictors in order to facilitate interpretation of effects.

By virtue of the way in which function was measured (ie. asking participants to recall their between-lag activities and activity-avoidance) same-lag analyses were not considered viable for that outcome measure, and a different set of covariates was used for cross-lag analyses. Analyses of function covaried lag1 but not lag2 pain, lag1 time-of-day, and lag1 function. Lag2 pain and lag2 time-of-day were not considered appropriate covariates because although they were recorded concurrently with ratings of function, they purportedly "occurred" after the time reported function was supposed to have taken place. Nevertheless, the potential importance of covariates at both lags was assessed empirically prior to dismissing them from further analyses (see Section 6.4.2.1). Cross-lag change variables for predictors were also employed in most analyses of function.

Variables were inspected for linearity, and no noteworthy deviations were found. Homoscedasticity amongst the level-one variables across level-two units (that is, between

people) and in predictor variables over levels of criterion variables was also assessed, and the data was found to be adequate.

Squared-transformations of lag1 and lag2 Function were performed to reduce significant skew. The squared-values of these variables were used in all analyses. Inspection of variable distributions revealed that no other variable would benefit from transformation. There was no missing data in the level-one data set. Although participants made differing numbers of entries and made entries at different times, such a data structure at level-two presents no problems for multi-level analysis (Snijders and Bosker, 1999).

For the purpose of the current project, which was largely exploratory in nature, alpha values equal to or less than .05 were considered significant.

6.2 Results – Part A: Compliance, Convergent Validity, and Analysis of Reactivity

Part A of Study Two is concerned with issues relating to use of the EMA methodology – compliance rate, convergent validity with conventional questionnaire measures, and the possibility of measurement reactivity. All analyses were performed with pair-wise deletion for missing values.

6.2.1 Compliance

A total of 2019 entries were obtained. Participants provided an average of 36.7 entries (SD=15.7), with a minimum of four and a maximum of 62 entries per person. Entries were made over between one and nine days, though one participant monitored on 14 days because he completed an additional week after his PDA malfunctioned. Participants completed em\ntries on an average of 6.85 days (SD=2.29), with a total of 377 monitoring days over all subjects. On average, 7.11 entries were made per day (SD=1.64), with a maximum of nine and a minimum of two.

There was an average gap of 271 minutes between entries (SD=258), with a minimum of 31.7 and a maximum of 1406 minutes.

6.2.1.1 Alarms

The alarms delivered by the PDA and participants' responses to them were analysed from alarm-files stored on the PDAs (see Table 6.1). Such files were not generated for two participants for unknown reasons, and they were not included in these analyses. For the remaining 53 participants, a total of 3018 alarms were signalled over 377 monitoring days, averaging 8 alarms per person per day, including voluntary midnight alarms. A 65% compliance rate was obtained – 1962 alarms were opened, averaging 5.2 entries per person per day. Three-quarters of participants opened more than thirty alarms, with half of the participants opening at least forty-two.

Approximately six percent of the total alarms were dismissed, and 28.5% timed-out. No entries were postponed. Twenty alarms (0.66% of the total) were not completed due to technical problems, probably lack of battery power.

When not including voluntary midnight alarms a slightly higher compliance rate – 70.1% – was obtained. Of the 2687 alarms that were sounded (averaging 7.12 per day), 1886 alarms were opened (averaging 5 per day). Of the non-midnight alarms, 24.6% timed-out and 4.6% were dismissed.

Compliance was further assessed by excluding midnight alarms and investigating only the first seven days of monitoring – commencing from both the first day monitoring was commenced and from the first day participants were expected to commence monitoring. It was expected that such indices would provide a more accurate indication of compliance given that participants were only asked to perform seven days of monitoring and were

only expected to commence monitoring on the morning of the day after the PDA was delivered. A compliance rate of 71.6% was found for the first seven days of monitoring commencing from the day of the first entry, and a 69.3% compliance rate was found for the seven days commencing from the day after the device was delivered.

Table 6.1 Alarms and response to alarms (total, and without including midnight alarms)

						Percentiles			
	Sum	Min	Max	Mean	SD	25	50	75	% of total
Total Days	377	2	12	7.11	1.89	7	8	8	
Alarms	3018	8	85	56.94	15.86	52	61	67	
Open	1962	4	64	37.02	15.58	30.5	42	48	65%
Dismiss	175	0	33	3.30	5.11	0	2	5	5.8%
Time-out	861	0	38	16.25	9.52	8.5	16	23.5	28.52%
Error	20	0	4	0.38	0.77	0	0	1	0.66%
				Without inclusion of voluntary midnight alarms					
Alarms	2687	7	77	50.70	14.17	46	55	60	
Open	1886	4	57	35.58	14.74	29	41	46	70.2%
Dismiss	123	0	27	2.32	4.24	0	1	3.5	4.6%
Time-out	662	0	33	12.49	8.69	5	13	18.5	24.6%
Error	16	0	4	0.30	0.72	0	0	0	0.59%

Figure 6.1 displays the average per-person distribution of opened alarms over nine days of monitoring. The non-parametric Friedman Test was used to test for differences between monitoring-days in response rate. A significant difference was found, $\chi^2(8)=128.79$, $p<.001$. Post-hoc pair-wise Wilcoxon Signed Rank tests were conducted to look for specific differences. Testing indicated that entries rose from the first to second day, falling again by the third day, and then remaining constant until a progressive reduction over the seventh, eighth and ninth days of monitoring. Specifically, more entries were made on the second day of monitoring than any other day (for day two versus day three, the next highest day, $Z=-2.8$, $p=.005$). Day nine demonstrated fewer entries than all other days (day nine versus day eight $Z=-4.49$, $p<.001$), and day eight had fewer entries than all preceding days (day eight versus day seven $Z=-3.63$, $p<.001$).

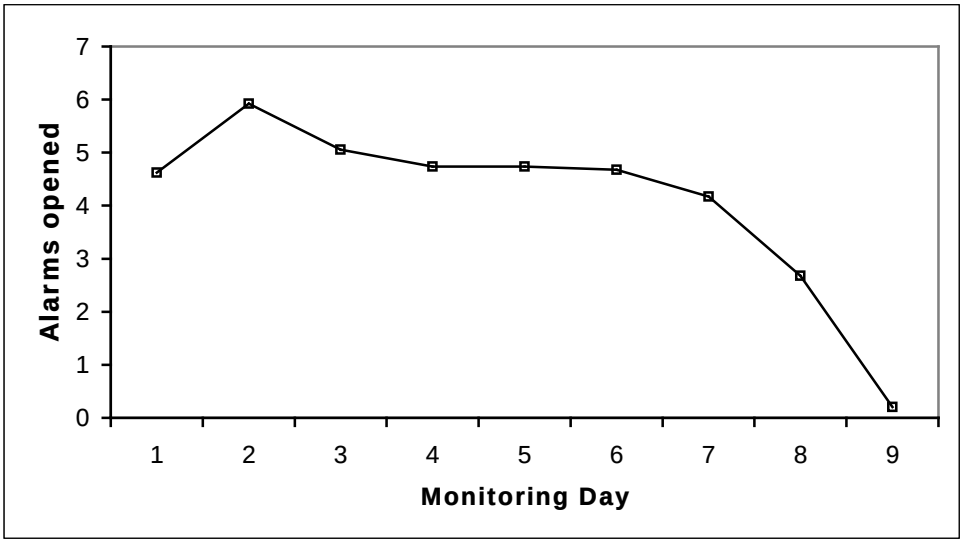


Figure 6.2. Alarms opened over monitoring days one to nine

Entries appeared to begin to drop-off by day seven, which demonstrated significantly fewer entries compared to the two highest days, day two $Z=-3.95$, $p<.001$, and day three $Z=-2.24$, $p=.025$.

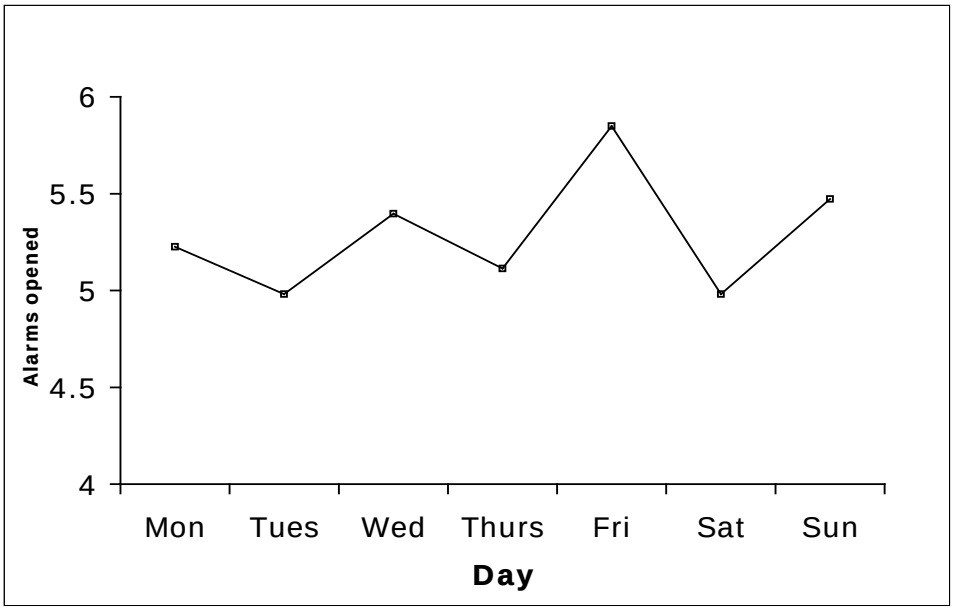


Figure 6.3. Alarms opened over weekdays

Figure 6.2 displays the average per-person distribution of opened alarms over days of the week. The Friedman Test revealed no significant difference, χ^2 (6)=6.62, p=.358. Analyses revealed that monitoring days varied systematically with day-of-the-week, (χ^2 (78)=716.56, p<.001). Table 6.2 suggests that more people commenced monitoring on a Sunday than on any other day of the week.

Table 6.2 Frequency of entries over monitoring days and week-days.

	Monitoring Day								
Weekday	1	2	3	4	5	6	7	8	9
Mon	31	94	19	21	39	29	26	15	
Tues	25	42	86	22	17	40	27	12	
Wed	26	32	35	86	24	17	39	21	6
Thurs	46	31	26	35	81	22	18	25	
Fri	23	78	29	31	35	77	23	12	3
Sat	19	25	63	19	33	40	62	17	
Sun	77	24	19	48	27	28	23	43	5

Figure 6.3 displays the average per-person distribution of opened alarms over the nine time-slots. In this figure, time-slot zero represents the voluntary midnight alarms. According to the Friedman Test a significant difference existed, χ^2 (8)=86.05, p<.001. Post-hoc pair-wise Wilcoxon Signed Rank tests revealed that people were less likely to respond to the voluntary midnight alarm, but were equally responsive during all other timeslots. That is, fewer alarms were opened at time-slot zero than all other timeslots (for time zero versus time four, the next lowest ranking timeslot, Z=-5.27, p<.001). No other significant differences were found.

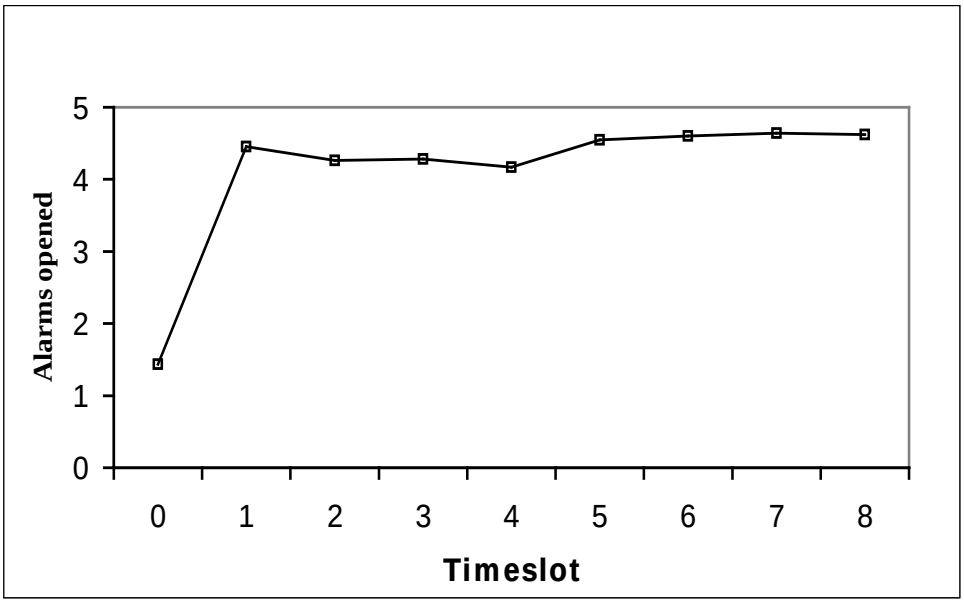


Figure 6.4. Alarms opened over daily timeslots (timeslot 0 represents the voluntary midnight entry)

A number of correlates of response-rates were found (see Appendix D, Table D.1 for full details). Older age was related to fewer opened alarms ($r=-0.37$, $p<.01$). People who worked (on either a full-time, part-time, casual or voluntary basis) were likely to open more alarms ($r=.29$, $p<.05$). The proportion of timed-out alarms was lower for people who reported experiencing constant pain ($r=-0.32$, $p<.05$) and people who were more disabled according to the DQ ($p=-0.32$, $p<.05$).

Participants were asked to indicate why they believed they dismissed alarms and allowed alarms to time-out. Correlates of these attributions were also inspected (for full details see Appendix D, Tables D.2 to D.5).

The three most frequently reported reasons for dismissing responses (each endorsed by 18% of participants) was that their location was not safe to use the PDA and that it would either have been either impossible or inconvenient to open the alarm at the time it rang

(see Table 6.3). A lower proportion of participants indicated that it would have been either impossible or inconvenient to respond to the alarm for at-least 30 minutes after it sounded, or that they were too exhausted to respond to the alarm. Reassuringly, the least frequent reasons for dismissing entries was that the participant was either too distressed or in too much pain to make an entry.

Table 6.3 Attributions for dismissed entries

	Endorsement Rate (%)
Location was not safe for the PDA	18
Physically impossible for at-least 30mins	10
Physically impossible at that time	18
Inconvenient for at-least 30 mins	10
Inconvenient at that time	18
Physically exhausted	10
Psychologically distressed eg. tense, stressed, down	6
Pain was too bad	4
Other	16

* p<.05 ** p<.01 *** p<.001
No participants endorsed the item "I just couldn't be bothered".

People who completed a larger number of monitoring days were more likely to indicate that they dismissed entries because the location was not safe for the PDA ($t(48)=-2.52$, $p=.015$) and because it would have been inconvenient to make an entry for at least 30 minutes ($t(48)=-2.19$, $p=.033$). People who reported that they dismissed entries because they were distressed displayed a greater tendency to dismiss entries ($t(46)=5.63$, $p<.001$), and were likely to make fewer entries ($t(48)=6.1$, $p<.001$) over fewer entry days ($t(48)=6.84$, $p<.001$). Those who indicated that they dismissed alarms because it would have been inconvenient to make an entry at the time it sounded were likely to report higher average functioning ($t(48)=-2.21$, $p=.032$) and activity-levels ($t(48)=-2.13$, $p=.038$) in their PAMS monitoring. People who indicated that they dismissed entries

because their pain was too bad at the time of the alarm were likely to report higher bodily pain according to the SF-36 ($t(48)=2.32$, $p<.025$).

The most frequently reported reasons for missing (timed-out) alarms – in order of endorsement rate – was that the PDA was not in the room and so the alarm was not heard, the participant was out and not carrying the PDA, the PDA was in the room but the alarm was not loud enough, and their location was not safe to use the PDA (see Table 6.4). The least frequent reason for missing an alarm was that the person was in too much pain, or they were too distressed or exhausted.

Those who did report that they missed alarms because they were too distressed were likely to dismiss a greater proportion of alarms ($t(46)=3.15$, $p=.003$), but were no more likely to miss alarms ($t(46)=2.48$, p=ns). These participants were likely to make fewer entries ($t(48)=2.17$, $p=.035$) over fewer days ($t(48)=2.96$, $p=.005$), and were likely to be more distressed according to the MPI ($t(48)=-2.02$, $p=.049$) and more anxious according to the HADS ($t(48)=-3.01$, $p=.004$). Those who reported that they missed entries because the PDA did not ring for long enough (16% of participants) were likely to have had the PDA for more days ($t(486)=-2.16$, $p=.035$) but were not more likely to have made entries on more days ($t(48)=-.753$, p=ns). These people were likely to report experiencing less pain on the MPI ($t(48)=2.26$, $p=.028$). People who reported experiencing lower pain, according to both the MPI and the SF-36 (but not according to average PAMS scores) were more likely to report that they missed alarms because it would have been inconvenient to make an entry at the time of the alarm ($t(48)=2.4$, $p=.021$ for MPI; $t(48)=-2.31$, $p=.025$ for SF-36), or because the PDA was not in the room with them and they did not hear the alarm ($t(48)=2.88$, $p=.006$ for MPI; $t(48)=-2.55$, $p=.014$ for SF-36).

Table 6.4 Attributions for missed entries

	Endorsement Rate (%)
Location was not safe for the PDA	24
Physically impossible at that time	10
Inconvenient at that time	20
Physically exhausted	8
Psychologically distressed eg. tense, stressed, down	8
Pain was too bad	4
PDA in the room & not loud enough	36
PDA not in the room & didn't hear it	42
Out & not carrying the PDA	40
Did not ring for long enough	16
Other	16

* p<.05 ** p<.01 *** p<.001
The items "I just couldn't be bothered" and "It was too embarrassing to answer it, so I ignored it" were not endorsed

6.2.2 Convergent Validity of PAMS

It was anticipated that the average of PAMS scales would be correlated significantly with related scales, measured via standard questionnaires. A full table of correlations between average scores from PAMS monitoring (except Pain Expectancy, for which there were no comparison measures) and standard measures can be found in Appendix D, Table D.6.

Table 6.5 Relationship between standard questionnaires and average ratings on the PAMS Pain Intensity scale

Scale		PAMS Pain-Intensity
McGill	PRI	0.37**
MPI	Pain Severity	0.56***
SF36	Bodily Pain	-0.58***

* p<.05 ** p<.01 *** p<.001

As anticipated, PAMS Pain Intensity demonstrated a significant relationship in the moderate range with both MPI Pain Severity and SF-36 Bodily pain (r=.56, p<.001, and

r=-.58, p<.001 respectively). It was somewhat less related to the McGill PRI scale (r=.37, p<.01).

PAMS Distress was highly related to MPI Affective Distress, and moderately/highly related to all other measures of distress (see Table 6.5).

Table 6.5 Relationship between standard questionnaires and average ratings on the PAMS Distress scale

Scale		PAMS Distress
HADS	Anxiety	0.69***
	Depression	0.62***
MPI	Affective Distress	0.85***
SF-36	Mental Health	-0.7***
	Emotional Role Funct	-0.44**

* p<.05 ** p<.01 *** p<.001

Convergent correlations for the PAMS appraisal scales can be found in Table 6.6. As anticipated, PAMS Pain Self-Efficacy demonstrated a significant relationship with the PSEQ, and was unrelated to all non-domain measures. However, the correlation with the PSEQ was in the low/moderate range. Further, other PAMS appraisal scales obtained correlations with the PSEQ that were comparable to that obtained by PAMS Pain Self-Efficacy.

Table 6.6 Relationship between standard questionnaires and average ratings on the PAMS appraisal scales

		PAMS Appraisal		
Scale		Pain Self Efficacy	Perceived Interference	Catastrophising
MPI	Interference	-0.17	0.72***	0.39**
	Life-Control	0.22	-0.18	-0.33*
PCS	Total	-.114	.267	.585**
	Rumination	-0.16	0.27	0.51***
	Magnification	-0.15	0.27	0.58***
	Helplessness	-0.17	0.31*	0.61***
PSEQ		0.34*	-0.43**	-0.32*
CSQ	Catastrophising	-0.24	0.28	0.56***
	Control over Pain	0.13	-0.13	-0.29*
	Ability to Dec. Pain	0.23	0.01	-0.11

* p<.05 ** p<.01 *** p<.001

PAMS Catastrophising was significantly related to each of the standard measures anticipated, namely the three scales of the PCS, the PCS Total, and CSQ Catastrophising. These correlations were in the high/moderate range. PAMS Catastrophising demonstrated significant correlations with three measures of divergent constructs. Testing suggested that, although apparently lower, the relationships with these scales were not significantly divergent from the correlations between PAMS Catastrophising and PCS Total (for MPI Life Control $t(42)=1.51$, p=ns; MPI Life Interference $t(42)=1.72$, p=ns; and CSQ Control Over Pain $t(42)=1.43$, p=ns) or CSQ Catastrophising (for MPI Life Control $t(42)=1.13$, p=ns; MPI Life Interference $t(42)=1.42$, p=ns; and CSQ Control Over Pain $t(42)=1.39$, p=ns).

As anticipated, PAMS Perceived Interference was strongly related to MPI Life Interference, and this correlation significantly exceeded the highest non-domain specific correlation (vs. PSEQ $t(42)=3.94$, $p<.001$).

Table 6.7 Relationship between CSQ scales and average ratings on the PAMS coping scales

	PAMS Coping	
CSQ Scale	Passive	Active
Passive	0.31*	0.24
Active	0.16	0.33*
Divert Attention	0.3*	0.57***
Rein. Pain Sens.	0.10	0.33*
Ignoring Sensations	0.20	0.02
Praying or Hoping	0.29*	0.3*
Coping Self Statements	-0.11	0.14
Increased Beh. Act.	0.13	0.4**

* p<.05 ** p<.01 *** p<.001

Convergent correlations for both PAMS coping scales can be found in Table 6.7. Comparisons with the CSQ Passive and Active Coping scales supported the convergent

and divergent validity of the PAMS coping scales. PAMS Passive Coping was significantly correlated with the CSQ Passive Coping scale, but not CSQ Active Coping whereas the opposite was true for PAMS Active Coping. However, convergent relationships were not strong (r=.31 and .41 respectively). PAMS Passive Coping demonstrated a low/moderate correlation with CSQ Praying/Hoping, which is traditionally seen as a passive coping strategy. However, this relationship was no stronger than the relationship between Praying/Hoping and PAMS Active Coping ($t(41)=0.04$, p=ns).

PAMS Active Coping demonstrated a number of significant relationships with CSQ coping subscales, with the highest being in the high/moderate range with CSQ Divert Attention. However, this relationship was not significantly greater than the significant relationship between Divert Attention and PAMS Passive Coping ($t(41)=1.98$, p=ns).

Table 6.8 Relationship between standard questionnaires and average ratings on PAMS Function and Activity-Level

Scale		PAMS scale Function	Activity
SF-36	Physical Funct	0.46**	-0.07
	Physical Role Funct	0.28*	-0.09
	General Health	0.36*	-0.06
	Vitality	0.15	-0.02
	Social Funct	0.46**	-0.03
	Health Transition	-0.15	0.28*
DQ		-0.69***	-0.04

* p<.05 ** p<.01 *** p<.001

Convergent correlations for both PAMS Function and Activity-Level scales are presented in Table 6.8.

PAMS Functioning demonstrated significant low to moderate correlations with a number of SF-36 measures of health and physical functioning, and a high/moderate correlation with the DQ.

Amongst the standard measures of function, PAMS Activity-Level was only related to SF-36 Health Transition, though this correlation was in the low/moderate range.

6.2.2.1 Relationship Between Average PAMS Scales and PAMS-R Scales

To assess the relationship between data collected via repeated momentary assessment and the kind of recalled data typical of standard questionnaire-based studies, the average PAMS values were compared to a one-week recall version (PAMS-R) of the PAMS scales (see Table 6.9). Pain expectancy was not measured in the PAMS-R, so was not included in these analyses.

Table 6.9 Correlation between PAMS-R and average PAMS scales

	PAMS scale								
PAMS-R Scale	Pain-Intensity	Distress	Self Efficacy	Catas.	Perc. Interfere	Passive Coping	Active Coping	Function	Activity-Level
Average Pain	0.67***	0.4**	-0.27	0.51***	0.47**	0.13	0.27	-0.23	0.22
Distress	0.29*	0.86***	-0.13	0.47**	0.37**	0.33*	0.07	-0.14	-0.01
Self Efficacy	-0.34*	-0.06	0.73***	-0.27	-0.3*	-0.28	-0.32*	0.39**	-0.05
Catastrophising	0.38**	0.6***	-0.21	0.85***	0.4**	0.28	0.20	-0.15	0.11
Perc. Interference	0.44**	0.44**	-0.28*	0.47**	0.81***	0.31*	0.36*	-0.33*	0.05
Passive Coping	0.17	0.35*	-0.15	0.16	0.18	0.62***	0.17	-0.23	-0.03
Active Coping	0.32*	0.03	-0.26	0.18	0.34*	0.49***	0.68***	-0.20	0.05
Function	-0.26	-0.26	0.38**	-0.42**	-0.51***	-0.43**	-0.4**	0.68***	0.13
Average Activity	0.14	-0.07	0.01	0.02	-0.14	-0.15	-0.03	0.35*	0.57***

* p<.05 ** p<.01 *** p<.001

The magnitude of correlations between momentary-scales and their recalled versions was consistently greater than relationships with any other scale, though for PAMS Pain Intensity and Passive Coping these differences were not always significant. The relationship between PAMS Pain Intensity was greater than with all other PAMS-R scales (vs PAMS-R Catastrophising $t(38)=2.62$, p=0.013) except Perceived Interference ($t(38)=1.96$, p=ns). The relationship between PAMS Passive Coping and PAMS-R Passive Coping was not significantly greater than between PAMS Passive Coping and

PAMS-R Function (t(38)=0.83, p=ns), Active Coping (t(38)=1.11, p=ns), Perceived Interference (t(38)=1.72, p=ns), Self-Efficacy (t(38)=1.59, p=ns), or Catastrophising (t(38)=1.94, p=ns).

Likewise, the magnitude of relationships between recall-based scales and their momentary counterparts were greater than with other momentary scales, though not significantly so for the Passive, Active and Function scales. PAMS-R Passive Coping demonstrated a significant relationship with PAMS Distress, and this was not significantly different to the relationship between the two passive coping scales (t(38)=1.53, p=ns). PAMS-R Active Coping was significantly associated with PAMS Passive Coping and Perceived Interference, and these relationships were not significantly less than between the active coping scales (t(38)=1.21, p=ns; t(38)=1.88, p=ns respectively). Of the five significant relationships between PAMS-R Function and PAMS scales other than function (vs Perceived Interference t(38)=1.11, p=ns; Passive Coping t(38)=1.22, p=ns; Self-Efficacy t(38)=1.95, p=ns; Active Coping t(38)=1.89, p=ns; and Catastrophising t(38)=2.1, p=042) only the relationship with Catastrophising was significantly lower than the relationship between the two function scales.

Table 6.10 Accuracy and direction of errors in recall of continuously-measured PAMS scales (PAMS-R score minus PAMS average score)

	Overestimations	Accuracy: M (SD)		
	N (%)	Total	Overestimations	Underestimations
Pain	44 (88%)	11.11 (12.34)	13.1 (11.79)	-3.56 (1.91)
Distress	36 (72%)	5.85 (8.94)	9.74 (6.82)	-4.18 (5.07)
Self-Efficacy	15 (30%)	-8.84 (19.21)	11.54 (14.14)	-17.57 (13.69)
Catastrophising	39 (78%)	7.62 (11.24)	11.17 (9.9)	-4.96 (4.82)
Perceived Interference	41 (82%)	9.68 (14.67)	13.47 (13.02)	-7.63 (7.61)
Activity-level	44 (88%)	12.31 (12.32)	15.29 (9.68)	-9.58 (5.28)

The accuracy of recall was assessed for PAMS scales measured as continuous variables by subtracting PAMS average-scores from their respective PAMS-R scores (see Table 6.10). On PAMS-R the majority of participants (between 72% and 88%) overestimated their weekly pain, distress, catastrophising, pain-related interference, and activity-levels, and underestimated their self-efficacy (70%) compared to average weekly ratings. Chi-square tests demonstrated that the difference in frequency between over-estimators and under-estimators was significant for all variables ($p<.005$). On average, those who overestimated tended to be out by 12.4% on the measurement scales (ranging from 9.7% for Distress to 15.3% for Activity-Level) and those who underestimated tended to be out by 8% (ranging from 3.6% for pain to 17.6% for self-efficacy).

6.2.3 Reactivity

6.2.3.1 Drift In Mean Levels

Reactivity to monitoring was assessed for pain-intensity, distress, function, and activity-level. Three-level hierarchical linear modelling was used, with monitoring-entry at level one (a within-day level), day at level two (an across-day level), and person at level three. For each outcome variable three separate analyses were conducted investigating a variance-components model, a model investigating drift across entries, and a model investigating drift across days.

Table 6.11 Reactivity to Pain-Intensity Measures; unstandardized coefficient (S.E.)

	Model		
	1	2	3
Predictor	Var. Components	Monitoring entry	Monitoring day
Intercept	45.05 (2.09)***	44.15 (2.22) ***	43.94 (2.22) ***
Entry		0.05 (0.04) ns	
Day			0.37 (0.24) ns
		Variance	
Between-Person	218.85 (46.54%)	218.38	220.29
Between-Day	69.32 (14.73%)	68.58	68.3
Within-Day	182.18 (38.73%)	182.23	182.22

* p<.05 ** p<.01 *** p<.001
Percentage of total variance in the variance components model is in brackets

Analyses of Pain-Intensity (see Table 6.11) revealed non-significant effects for entry-number and monitoring-day.

Inspection of the variance-components model revealed that the majority of variance in pain intensity (53.46%) was within person, with 72.4% of within-person variance being within-days.

Table 6.12 Reactivity to Distress Measures; unstandardized coefficient (S.E.)

	Model		
	1	2	3
Predictor	Var. Components	Monitoring entry	Monitoring day
Intercept	37.45 (2.03) ***	38.14 (2.13) ***	36.83 (2.13) ***
Entry		-0.04 (0.04) ns	
Day			0.21 (0.22) ns
		Variance	
Between-Person	208.02 (51.65%)	207.27	207.89
Between-Day	62.72 (15.57%)	63.16	62.42
Within-Day	132.03 (32.78%)	131.86	132.05

* p<.05 ** p<.01 *** p<.001
Percentage of total variance in the variance components model is in brackets

Analyses of Distress (see Table 6.12) revealed non-significant effects for both entry-number and monitoring-day.

Within-person variance accounted for 48.35% of variance in distress, with 67.8% of that variance being within-days.

Table 6.13 Reactivity to Function Measures; unstandardized coefficient (S.E.)

	Model		
	1	2	3
Predictor	Var. Components	Monitoring entry	Monitoring day
Intercept	61.03 (2.05)***	60.8 (2.16) ***	60.5 (2.15) ***
Entry		0.01 (0.03) ns	
Day			0.18 (0.23) ns
		Variance	
Between-Person	212.02 (47.63%)	212.19	211
Between-Day	55.26 (12.41%)	55.27	55.22
Within-Day	177.82 (39.95%)	177.81	177.8

* p<.05 ** p<.01 *** p<.001
Percentage of total variance in the variance components model is in brackets

Analyses of Function (see Table 6.13) revealed non-significant effects for entry-number and monitoring-day.

The majority of variance in Function was within-person (52.37%), with the majority of that variance (76.3%) being within-day.

Table 6.14 Reactivity to Activity-level measures, including co-variation of day-of-the-week; unstandardized coefficient (S.E.)

	Model			
	1	2	3	4
Fixed Effect	Var. Components	Monitoring entry	Monitoring day	Mon. day (week day)
Intercept	34.9 (1.58) ***	33.72 (1.74) ***	33.21 (1.72) ***	34.25 (1.75) ***
Entry		0.06 (0.04) ns		
Day			0.56 (0.22) *	0.59 (0.22) **
Weekend				-3.59 (1.08) ***
		Variance		
Between-Person	119.63 (25.36%)	120.83	120.36	121.73
Between-Day	29.12 (6.17%)	27.98	27.42	23.71
Within-Day	322.83 (68.46%)	322.95	322.74	322.79

* p<.05 ** p<.01 *** p<.001
Percentage of total variance in the variance components model is in brackets

Analyses of activity-level (see Table 6.14) revealed a significant effect of monitoring-day, but not entry-number. Monitoring days were associated with a progressive increase in activity-level, with each day associated with an average increase of 0.56 percentage points in activity level ratings. Monitoring day accounted for 5.8% of between-day

variance, and 0.22% of total variance in activity-level. Because monitoring days varied systematically with day-of-the-week (see Table 6.2), it was considered that the effect of monitoring day on drift in activity-level ratings may have been confounded by week-day effects. An additional analysis covarying a week-day effect (a dichotomous variable reflecting weekdays versus weekend) revealed independent effects of weekday and monitoring day, with the effect of monitoring day largely unchanged compared to the previous analysis. Weekends were associated with an average decrease in activity level of 3.59 percentage points, accounting for an additional 12.77% between-day variance and 6.88% total variance to that accounted for by monitoring day. Two alternative analyses were conducted where day-of-the-week was entered as six dummy-coded day-of-the-week variables, and as a single linear function from Monday to Sunday. In both analyses the interpretation of the monitoring day effect remained unchanged.

The majority of variance in Activity-Level (74.63%) was within-person, and of this the vast majority was within-days (91.73%).

To summarise, activity-level ratings appeared to drift upwards over monitoring days, and this effect was not attributable to day-of-the-week. These findings provide evidence of a reactivity effect in participants' ratings of their activity-level.

6.2.3.2 Drift In Variability

As a further assessment of reactivity effects, change in variability over the monitoring period was assessed by calculating standard-deviations of pain, distress, activity and function for the first 50% of entries versus the second 50% (see Table 6.15). Only participants with more than ten entries who had participated for four or more days were included in this analysis (n=47).

Table 6.15 Standard deviations for first and second half of entries

	Half of monitoring	
	First	Second
Pain	14.37	13.24
Distress	12.61	10.96
Activity	18.39	16.05
Functioning	13.04	13.11

Paired-sample t-tests were used to compare across halves of the monitoring period. Significant differences were found for distress $t(46)=2.68$, p=.01, and activity $t(46)=2.88$, p=.006, but not pain $t(46)=1.97$, p=ns, or function $t(46)=-.08$, p=ns, suggesting that over the course of monitoring participants tended to provide less diverse ratings of their distress and activity-levels. These findings suggest that reactivity may have influenced participants' ratings of activity-level and distress.

6.3 Discussion – Part A

6.3.1 Compliance

Part A of Study Two began with an investigation of compliance and exploratory analyses of the factors associated with compliance. In EMA studies with chronic pain patients, compliance rates between 76% (for adolescents with sickle cell disease; Gil, et al., 2003) and 97.6% (for women with RA; Keefe, et al., 1997) have been reported, though most compliance rates appeared to fall in the early nineties (eg. Feldman, et al., 1999; Stone, et al., 2003; Catley, 1999). It is noted that all of these studies provided monetary incentives for compliance whereas the current study did not.

A somewhat lower compliance rate of 71.6% was found in the current study for the first seven days of monitoring, not including voluntary midnight alarms. Participants made an average of five entries per day out of the eight "compulsory" 8am to 10pm alarms. Fifty-

percent of participants completed a total of at least 42 entries (including midnight alarms), and 25% completed at least 48 entries.

Like Peters, et al., (2000), it was found that a minority of unopened alarms were voluntarily dismissed – only 4.6% of 8am-10pm alarms. The majority of unopened alarms (24.6% of total alarms) "timed out" after the designated 10 minutes. According to participants' attributions for timed-out alarms, the most common reason was that the alarm on the PDA was not loud enough. It is also possible that the lack of a monetary incentive for participation or compliance may have detracted from compliance.

Analyses revealed equal compliance over the daily alarm timeslots, except for lower compliance with the voluntary midnight alarm. Day-of-the-week did not appear to have an impact on compliance. Participants appeared to make the most entries on the second day of monitoring, and entry-rates appeared to remain stable until the seventh day, after which it continued to wane. The second day may have had more entries than the first because many participants commenced monitoring part-way through the day their PDA was delivered (their "first" day according to analyses), whereas the day after that was strictly the first day they were scheduled to commence monitoring.

Compliance was better amongst younger participants and those involved in some form of work. Also, participants who reported experiencing constant pain and were more disabled were less likely to allow the PDA to time-out. These people may have spent more time in the one location with the PDA nearby. Consistent with this, people reporting more pain were less likely to report the reason for missing alarms as being because the PDA was not in the room or because it did not ring for long enough.

Few people reported that they missed or dismissed alarms because they were too distressed to make an entry. Those who did report this were less compliant than other participants. Those who reportedly missed alarms because of distress did indeed appear to be more distressed than others.

Finally, it was interesting to observe that people who were more compliant with monitoring were more likely to report their reasons as being those for which they were instructed to dismiss entries – the location was not safe for the PDA and/or it would have been inconvenient to make an entry for at least 30 minutes.

6.3.2 Convergence

The convergence between summary scores of PAMS monitoring and recall-based paper-and-pencil questionnaires was also investigated in Part-A of Study Two. On one hand, it was anticipated that scores from the average PAMS scales would diverge from standard measures because of variance due to method – that is, summary scores from the momentary PAMS ratings would presumably provide a more accurate reflection of weekly states than recall-based measures. However, it was hoped that the summary PAMS scales would demonstrate some degree of convergence with the standard scales as a means of supporting convergent validity. To potentially disentangle variance due to differing measures and variance due to method, both standard questionnaires and a one-week recall-based version of the PAMS scales (PAMS-R) were compared to the average of momentary ratings. It was considered that the PAMS summary scores and PAMS-R scales would share a greater amount of measure-variance, and differences between the two would presumably reflect method variance.

All correlations between PAMS scales and their respective PAMS-R scales were of higher magnitude than correlations with divergent PAMS-R scales, though testing revealed significant overlap with other PAMS-R scales for the Pain Intensity and Passive Coping scales. Average PAMS scales appeared to demonstrate comparable or superior convergent validity compared to available data from similar comparisons in other studies. The PAMS Pain Intensity scale correlated r=.67 with the PAMS-R scale. This was somewhat higher than correlations with standard pain scales (r=.56 and –0.58 with the MPI and SF-36 pain scales, respectively). Such convergent scores compared favourably to a correlation between momentary and recalled MPI pain severity scales of only r=.4 reported by Peters, et al. (2000). Catley (1999) reported a momentary/recall convergence more similar to the current study (r=.65), whereas Lousberg, et al. (1997) reported a somewhat higher convergence of r=.75.

The PAMS Distress scale correlated r=.86 with the PAMS-R scale, which was comparable to the excellent convergence with the MPI Affective Distress scale (r=.85). A number of other studies reported convergence between momentary and recalled measures of distress, but none were comparable to that reported here. In fact, momentary and recall versions of the MPI Affective Distress scale have demonstrated smaller (r=.42; Peters, et al., 2000) to non-significant (r=.2; Lousberg, et al.,1997) correlations. Catley (1999) reported correlations of r=.5 and –0.39 between the BDI and momentary measures of NA and PA, respectively.

PAMS Pain Self-Efficacy correlated r=.73 with the PAMS-R scale, but correlated significantly only with the PSEQ, at r=.34. PAMS Perceived Interference, on the other hand, correlated r=.81 with the PAMS-R scale and r=.72 with MPI Life Interference. This

compares well to the lower momentary/recall correlations of r=.34 (Peters, et al., 2000) and r=.6 (Lousberg, et al., 1997) reported for this scale. PAMS Catastrophising correlated r=.85 with the PAMS-R, and between r=.51 (PCS Rumination) and r=.61 (PCS Helplessness) with other catastrophising scales. The PAMS scale correlated r=.56 with CSQ Catastrophising, which was lower but comparable to the r=-0.66 reported by Peters, et al. (2000). The PAMS Catastrophising scale demonstrated correlations with a range of other appraisal-related measures, including MPI Life Control, MPI Life Interference, and CSQ Control Over Pain, perhaps reflecting the broad spectrum and predictive importance of the catastrophising construct (for example, the PCS contains subscales reflecting primary appraisal and secondary, control-related, appraisals of pain). Convergence between momentary and recall versions of the PAMS Pain Expectancy scale were not conducted because of the inherently momentary nature of that variable and because no comparable standard-measures were available.

PAMS Passive- and Active- Coping correlated r=.62 and 0.68 with the relevant PAMS-R scales, respectively. This was comparable to Stone's (1998) reported average correlation of 0.6 between momentary and recall versions of the scales of the Ways of Coping questionnaire. Peters, et al. (2000) reported lower convergence for CSQ scales. Their *positive self-talk* scale did not correlate significantly, and their *diverting attention* and *ignoring/denying pain* scales correlated r=.41 with recall versions. PAMS Passive Coping correlated significantly with CSQ Passive Coping (r=.31), CSQ Divert Attention (r=-0.3) and Praying or Hoping (r=.29). It is noted that the CSQ scales do not appear to provide a good comparison, content-wise, with the passive coping scale used in the current study. For PAMS Active Coping, significant correlations were found with CSQ Active Coping

(r=.41) and with the CSQ scales Divert Attention (r=.57) and Praying or Hoping, Reinterpret Pain Sensations, and Increased Behavioural Activity (r=.3 to 0.44).

PAMS Function correlated 0.68 with the PAMS-R Function scale. Its relationships with the DQ (r=-0.69) was comparable, possibly suggesting significant method-variance in the assessment of function. This would appear to make sense on the basis that functioning is likely to vary within and across days depending on tasks that need doing, time-of-day, and other procedural factors that may be reflected in momentary, but not recalled-based, ratings. PAMS Function correlated r=.46 with SF-36 Physical Functioning – less than the r=.73 correlation reported by Peters, et al. (2000) for momentary and recall versions of that SF-36 scale. It also correlated significantly (between r=.28 and 0.46) with the SF-36 scales Role Functioning – Physical, General Health, and Social Functioning. By comparison, using the MPI, Lousberg, et al. (1997) reported a non-significant relationship between momentary and recall "general activity" scales, and an r=.4 relationship for "household chores".

PAMS Activity-Level demonstrated the lowest convergence with PAMS-R (r=.57) – suggesting that activity-level is likely to be highly susceptible to recall error. The scale correlated with only one standard measure – SF-36 Health Transition (r=.28). SF-36 Vitality was expected to provide the best convergent validation of PAMS Activity-Level, and the correlation with Health Transition was unexpected.

The lack of convergence between PAMS-R and average PAMS scales was attributable to participants over-estimating all variables during recall, except self-efficacy which was predominantly under-estimated. Thus, the majority of participants tended to recall their pain and distress as being worse than they were according to momentary ratings, and

their appraisals as being excessively negative, but their functioning (as measured by activity-level) as being better than it was. Activity-level tended to be particularly prone to over-estimation, demonstrating the highest average degree of inaccuracy (15.3 points on the 100-point measurement scale), whereas self-efficacy appeared most liable to be under-estimated (being out by 17.6 points on average).

6.3.3 Reactivity

Prior to focal analyses, preliminary multi-level analyses were conducted to rule out the possibility that systematic changes in monitoring ratings were associated with the process of monitoring *per se*. Self-monitoring may cause individuals to focus on their pain, functioning, and/or mood-states, thereby altering ratings as monitoring progresses. For example, Tennen, et al. (2000) provide the example of a person whose usual coping strategy of distraction might be disrupted by the self-focused attention required from EMA participants. No such reactivity to monitoring has been reported in studies of chronic pain except by Stone, et al. (2003), who found that pain-ratings decreased over the course of monitoring for participants completing three entries per day, and increased for those completing six entries per day. If such reactivity to monitoring exists it should reveal itself by analysing criterion variables as a function of the number of monitoring entries completed (ie. entry number) or time since monitoring commenced (eg. monitoring day) (eg. Peters, et al., 2000; Cruise, et al., 1996). Thus, entry-number and monitoring-day were entered separately as possible predictors of pain-intensity, distress, function, and activity-level ratings.

No reactivity was observed for pain-intensity, distress, or function measures. However, ratings of activity level increased over monitoring days. This affect was not attributable

to day-of-the-week. It is possible that participants initially under-estimated their activity levels and shifted their average ratings upwards as monitoring progressed, for example, to accommodate a lack of moments of higher activity. Alternatively, the study may have initially interfered with participant's functioning but as monitoring progressed they may have become familiar with study procedures, incorporated monitoring into their daily routine, and gradually resumed usual levels of activity. However, if the latter explanation were the case, systematic increases in the function scale might also have been expected. Reactivity in the activity-level measure accounted for a notable amount of variance between days – almost 6%, though this was somewhat less than the almost 13% accounted for by day-of-the-week. In terms of total variance, reactivity accounted for only 0.22% of variance in activity-level, compared to almost 7% accounted for by day-of-the-week.

Rather than systematic drifts in ratings, reactivity may reduce variability in ratings – such as by participants progressively scoring more ratings towards the midline. Fatigue or boredom with the study procedure may be mechanisms by which this could occur. Csikszentmihalyi and Larson (1987), for example, found that whilst mean levels of psychological variables did not change between the first and second halves of the monitoring week, their variability decreased. This possibility was tested in the current study by comparing the standard deviation for each of the four criterion measures between the first and second half of entries. Distress and activity-level ratings demonstrated decreased variability in the second half of monitoring. Csikszentmihalyi and Larson (1987) interpreted such findings as reflecting participant's developing better "anchoring" to the response categories – suggesting that decreased variability may be

associated with less random variability in ratings. Alternatively, participants' responses may drift towards the midline as the process of monitoring becomes more demanding.

6.4 Results – Part B: Within-Person Analyses of Coping and Appraisal

Part B of Study Two focused on the key analyses of the current project, addressing the question of whether pain coping and appraisal independently predict distress, functional status and activity-level in the daily lives of those with chronic pain.

Distress was analysed first, followed by functioning and activity level.

For each outcome a series of preliminary analyses are reported. Firstly, a variance-components model was calculated to determine the percentages of variance in the outcome measure that occurs on a within-person basis prior to the inclusion of any predictors. This model provides a baseline for determining the effect of subsequent predictors in terms of the proportion of within-person variance they account for. The control models are reported next, in which covariates were added to the prediction equation (analogous to the first step in a hierarchical regression analysis). These models were investigated after the variance-components models so that the impact of key coping and appraisal variables could be assessed in subsequent analyses in terms of additional variance accounted for beyond that accounted for by the covariates in the control model. For the outcomes of distress and activity-level, same-lag analyses were conducted after the preliminary analyses. Finally, cross-lag analyses are conducted for each outcome variable. For both same-lag and cross-lag analyses the independent effect of the appraisal variables was investigated first, followed by the independent effect of the coping variables.

The first-order relationships between the outcome variables and each of the key predictors at both lag1 and lag2 were calculated, using the data-set consisting of only entries separated by no more then three hours, to determine the utility of these variables for inclusion in the focal hierarchical analyses (see Appendix D, Table D.8). All variables demonstrated some predictive utility at both lag one and lag two.

Descriptive statistics for the reduced dataset of entries made within three hours can be found in Table D.7 in Appendix D. The first-order relationships between all key predictors in the three-hour dataset can be found in Appendix D, tables D.9 (for outcomes at lag 1) and D.10 (for outcome sat lag 2). The relationship between key predictors and entry-number was also assessed (see Appendix D, Tables D.9 and D.10), given the finding that the activity-level outcome varied over the course of the monitoring week. No variable demonstrated a reactivity effect, thus entry-number was ruled-out as a possible confound and was not covaried in subsequent analyses.

6.4.1 Distress

6.4.1.1 Variance-Components and Control Models

Inspection of the variance components model revealed that 42.7% of variance in lag2 distress was at the within-subjects level (see Table 6.16, model 1). The control model for cross-lagged analyses, composed of all co-variates, was compared to the variance-components model, as was a control-model for same-lag analyses, composed only of covariates at lag2 (see Table 6.16). All covariates demonstrated significant effects.

Table 6.16 Variance-components model and control model for lag2 Distress: standardized coefficient (S.E.)

	Model		
	1	2	3
Fixed Effect	Var. Components	Control (cross-lag)	Control (same-lag)
Intercept	37.08 (2.18)***	41.33 (2.68)***	42.13 (2.75)***
Distress		0.34 (0.03)***	
Lag2 Evening		-0.11 (1.65)**	-0.14 (1.76)**
Lag2 Work Hrs.		-0.1 (1.64)*	-0.12 (1.75)**
Pain		-0.16 (0.02)***	
Lag2 Pain		0.48 (0.02)***	0.53 (0.02)***
	Variance		
Between-Person	237.93 (57.3%) ***	241.62 ***	240.55***
Within-Person	177.23 (42.7%)	107.73	122.99
Deviance (df)	11101.98 (3)	10449.5 (8)	10623.05 (6)

* p<.05 ** p<.01 *** p<.001
Percentage of total variance in the variance components model is in brackets

The variables in model two of Table 6.16, the cross-lag control-model, collectively accounted for 39.21% of the within-person variance in the variance-components model. Model three accounted for 30.6% of within-person variance. Both model two (χ^2 (5)=652.47, p<.001) and three (χ^2 (3)=478.93, p<.001) provided a significantly better fit than model one. In both model two and three, same-lag pain was the strongest predictor, with greater pain associated with greater distress. Prior distress also displayed a strong relationship to lag2 distress in model two, with high prior distress associated with high current distress.

Interestingly, in model two, pain in the previous lag was negatively associated with distress. Given that lag2 pain-intensity was also included in this model it would not appear that this effect could be due to regression-towards the mean from lag1 pain-intensity to lag2 pain-intensity.

Both time-of-day variables were also significant, with evening and working-hours associated with reduced distress compared to pre-work hours. Inspection of the unstandardised coefficients for model two revealed that, relative to pre-work hours,

working hours were associated with an average decrease in distress of 4.19%, and evening hours with a decrease of 4.68%.

6.4.1.2 Same lag-Analyses

A first set of analyses was conducted to address Hypotheses A and B outlined in the introduction to Section 6 – testing whether distress was related to concurrent appraisals and coping efforts made in the same time-lag, controlling for the effect of time-of-day and concurrent pain (see Table 6.17).

Table 6.17 Same-lag analysis of lag2 Distress: standardized coefficient (S.E.)

	Model			
Lag2 Fixed Effects	1 Control	2 Appraisals	3 Coping	4 Full
Intercept	42.13 (2.75)***	39.8 (2.66)***	41.87 (2.74)***	39.78 (2.66)***
Evening	-0.14 (1.76)**	-0.08 (1.61) ns	-0.13 (1.75)**	-0.08 (1.61) ns
Work Hours.	-0.12 (1.75)**	-0.06 (1.59) ns	-0.11 (1.74)**	-0.06 (1.6) ns
Pain	0.53 (0.02)***	0.2 (0.03)***	0.5 (0.02)***	0.2 (0.03)***
Pain Self Efficacy		-0.09 (0.02)***		-0.09 (0.02)**
Catastrophising		0.25 (0.03)***		0.25 (0.03)***
Pain Expectancy		0.06 (0.03)*		0.06 (0.03)*
Perc. Interference		0.2 (0.02)***		0.2 (0.02)***
Passive Cope			0.09 (0.03)***	0.01 (0.02) ns
Active Cope			0 (0.02) ns	0 (0.02) ns
		Variance		
Between-Person	240.55***	242.02***	240.6***	242.01***
Within-Person	122.99	101.48	121.18	101.46
Deviance (df)	10623.05 (6)	10371.11 (10)	10603.63 (8)	10370.91 (12)

* p<.05 ** p<.01 *** p<.001

Model two was compared to model one to determine whether lag2 appraisals accounted for variance in lag2 distress beyond what was accounted for by the control variables. Model two accounted for 42.74% of within-person variance, contributing an additional 12.14% to that explained by the control model. The effect of coping was examined by comparing model three to model one. Model three explained 31.62% of within-person

variance, accounting for only 1.02% more than the control model. Both models two (χ^2 (4)=251.93731, p<.001) and three (χ^2 (2)=19.42, p<.001) provided a significantly better fit than model one.

Inspection of model two reveals that catastrophising was the strongest appraisal predictor, followed by perceived interference. The predictor with the smallest, though still significant effect, was pain expectancy. These three predictors were associated with increased distress. Self-efficacy was associated with lower distress.

In model three only passive coping was significantly related to lag2 distress, with greater passive coping being associated with increased distress.

The separate effects of appraisal and coping, controlling for the other, was examined by comparing the full model (model four) with model two and three, respectively. Model four provided a significantly better fit than model three (χ^2 (2)=232.72, p<.001), but not model two (χ^2 (2)=0.206, p=ns). It accounted for 42.75% of within-person variance, 11.13% more than model three, and only 0.01% more than model two. Thus, it appeared that whilst the addition of coping to appraisals did not significantly improve prediction of lag2 distress, appraisals contributed significant independent prediction of lag2 distress beyond that associated with coping. Further, whilst Passive Coping became non-significant with the addition of appraisals, the addition of coping to the model did not alter the coefficients associated with lag2 appraisals.

The addition of appraisals in model two appeared to account for more than half of the effect of pain on distress, though pain still appeared to have an effect on distress independently of the appraisals included in the analysis. The addition of appraisals

reduced the effect of time-of-day to a non-significant level. The addition of coping (in model three) appeared to have no substantial impact on the effect of pain or time-of-day.

Table 6.18 Cross-lag analysis predicting lag2 Distress from lag1 appraisals: standardized coefficient (S.E.)

	Model			
	1	2	3	4
Fixed Effects	Control	Appraisal	Δ Appraisal	Full
Intercept	41.33 (2.68)***	41.37 (2.68)***	39.52 (2.61)***	39.03 (2.6)***
Lag1 Distress	0.34 (0.03)***	0.36 (0.03)***	0.43 (0.02)***	0.35 (0.03)***
Lag2 Evening	-0.11 (1.65)**	-0.11 (1.64)**	-0.07 (1.52) ns	-0.05 (1.5) ns
Lag2 Work Hrs.	-0.1 (1.64)*	-0.1 (1.63)**	-0.06 (1.51) ns	-0.05 (1.48) ns
Pain	-0.16 (0.02)***	-0.11 (0.03)***	0 (0.02) ns	-0.07 (0.02)*
Lag2 Pain	0.48 (0.02)***	0.5 (0.02)***	0.3 (0.02)***	0.21 (0.03)***
Pain Self Efficacy		-0.02 (0.02) ns		-0.08 (0.03)*
Catastrophising		-0.06 (0.03) ns		0.13 (0.04)***
Pain Expectancy		-0.1 (0.03)***		-0.02 (0.03) ns
Perc. Interference		0.04 (0.03) ns		0.14 (0.03)***
Δ Self Eff.			-0.05 (0.02)**	-0.08 (0.02)***
Δ Catastroph			0.12 (0.03)***	0.16 (0.03)***
Δ Expectancy			0.08 (0.02)***	0.07 (0.03)***
Δ Perc. Int.			0.07 (0.02)***	0.1 (0.02)***
		Variance		
Between-Person	241.62***	241.7***	242.75***	243.02***
Within-Person	107.73	105.97	90.94	87
Deviance (df)	10449.5 (8)	10427.91 (12)	10227.46 (12)	10169.48 (16)

* p<.05 ** p<.01 *** p<.001

Cross-lag change values are referred to with the symbol Δ

To summarise, same-lag analyses of PAMS Distress supported Hypothesis A as it relates to the Distress outcome – both coping and appraisals were associated with distress independently of pain and time-of-day effects. However, Hypothesis B was only partly supported – the relationship between appraisals and distress could not be attributed to coping, however there was no evidence to suggest that the association between coping and distress was not due to the effect of appraisals on distress.

6.4.1.3 Cross-lag Analyses

Appraisals. The following analyses were conducted to test Hypothesis C and D (see the beginning of section 6). A first set of cross-lag analyses were conducted as a test of Hypothesis C, to determine whether appraisals at lag1 were associated with distress at lag2 (see Table 6.18).

The strongest predictor of lag2 distress, in all four analyses, was prior distress. The effect-size of this co-variate was not attenuated by the addition of the appraisal variables. Lag2 pain-intensity was the next strongest predictor of lag2 distress, though the addition of change-in-appraisal (model three and four) appeared to account for some of the effect of same-lag pain. Lag1 pain was also related to subsequent distress, though in a negative direction. This effect appeared to be attenuated by the inclusion of the cross-lag appraisal variables in subsequent models.

The control model was compared to a model that also included lag1 appraisals (model two) to investigate the effect of appraisals at lag1. Model two was a significantly better fit than model one (χ^2 (4)=21.6, p<.001). It accounted for 40.21% of within-person variance, which was 0.99% more than the control model. Model two revealed that only pain-expectancy was associated with lag2 distress, such that higher pain expectancies were associated with less subsequent distress.

To provide further support for the hypothesis that prior appraisals would be associated with unique variance in subsequent distress, a full model incorporating appraisals, change-in-appraisals, and control variables (model four) was compared to a restricted model without the appraisal variables (model three). Model four was a significantly better fit than model three (χ^2 (4)=57.98, p<.001), supporting a unique effect of lag1 appraisals.

It accounted for 50.91% of within-person variance in the variance-components model – 2.22% more than the variance accounted for by model three.

To clarify the unique effect of specific lag1 appraisal predictors coefficients associated with lag1 appraisals were compared between models two and four. The pattern of predictors altered after change-in-appraisals were co-varied in model four. Perceived interference became the strongest of the three significant predictors, followed by catastrophising. Both were associated with increased subsequent distress. Self-efficacy was associated with decreased subsequent distress, and pain expectancy became non-significant as a predictor.

The following set of analyses was conducted to test Hypothesis D by determining whether coping accounted for the effect of appraisals on subsequent distress (see Table 6.19). Change-in-appraisal variables were included to clarify the interpretation of lag1 effects.

It was expected that lag1 appraisals would account for significant unique variance in lag2 distress even once coping was included in the model. This was tested by comparing a full model with lag1 appraisals, lag2 coping, and control variables (model three) to a model without appraisals (model two). Model three provided a significantly better fit than model two (χ^2 (4)=50.87, p<.001), accounting for an additional 1.92% of variance. Model three accounted for a total of 50.92% of within-person variance, compared to 48.99% accounted for by model three. Thus, it appears that lag1 appraisals accounted for a small amount of unique variance in subsequent distress that was not due to coping or to dynamic changes in appraisal between the two lags.

Table 6.19 Cross-lag analysis predicting lag2 Distress from lag1 appraisals, covarying lag2 coping: standardized coefficient (S.E.)

	Model		
	1	2	3
Fixed Effects	Control	Coping	Full
Intercept	39.03 (2.6)***	39.36 (2.61)***	0 (2.96)***
Distress	0.35 (0.03)***	0.42 (0.02)***	0.35 (0.03)***
Lag2 Evening	-0.05 (1.5) ns	-0.06 (1.52) ns	-0.05 (1.5) ns
Lag2 Work Hrs.	-0.05 (1.48) ns	-0.05 (1.51) ns	-0.05 (1.49) ns
Pain	-0.07 (0.02)*	0 (0.02) ns	-0.07 (0.02)*
Lag2 pain-intensity	0.21 (0.03)***	0.29 (0.02)***	0.2 (0.03)***
Pain Self Efficacy	-0.08 (0.03)*		-0.07 (0.03)*
Catastrophising	0.13 (0.04)***		0.13 (0.04)**
Pain Expectancy	-0.02 (0.03) ns		0.01 (0.03) ns
Perc. Interference	0.14 (0.03)***		0.13 (0.03)**
Lag2 Pass. Cope		0.05 (0.02)**	0.02 (0.02) ns
Lag2 Act. Cope		-0.01 (0.02) ns	-0.01 (0.02) ns
Δ Self Eff.	-0.08 (0.02)***	-0.05 (0.02)***	-0.07 (0.02)***
Δ Catastroph	0.16 (0.03)***	0.12 (0.03)***	0.16 (0.03)***
Δ Expectancy	0.07 (0.03)***	0.08 (0.02)***	0.08 (0.03)***
Δ Perc. Int.	0.1 (0.02)***	0.06 (0.02)***	0.09 (0.02)***
		Variance	
Between-Person	243.02***	242.75***	240.9***
Within-Person	87	90.4 (27.1%)	86.99
Deviance (df)	10169.48 (16)	10219.66 (14)	10168.79 (18)

* p<.05 ** p<.01 *** p<.001

Cross-lag change values are referred to with the symbol Δ

To determine whether the effect of the individual appraisals was influenced by the addition of coping, a model involving lag1 appraisals and change-in-appraisals (model one – identical to model four in Table 6.18) was compared to a model also including lag2 coping (model three). A comparison of model one to model three reveals no note-worthy changes in the effect of the appraisal variables when coping was included in the model. To summarise, analyses of distress supported Hypotheses C and D – appraisals evidenced a significant association with subsequent distress, and this effect was attributable to neither pain-intensity, time-of-day, nor coping.

Table 6.20 Cross-lag analysis predicting lag2 Distress from lag1 coping: standardized coefficient (S.E.)

	Model			
	1	2	3	4
Fixed Effects	Control	Coping	Δ Coping	Full
Intercept	41.33 (2.68)***	41.33 (2.68)***	41.36 (2.69)***	41.11 (2.68)***
Distress	0.34 (0.03)***	0.33 (0.03)***	0.34 (0.03)***	0.33 (0.03)***
Lag2 Evening	-0.11 (1.65)**	-0.11 (1.65)**	-0.11 (1.66)**	-0.11 (1.65)**
Lag2 Work Hrs.	-0.1 (1.64)*	-0.1 (1.63)*	-0.1 (1.64)*	-0.09 (1.64)*
Pain	-0.16 (0.02)***	-0.16 (0.02)***	-0.16 (0.02)***	-0.16 (0.02)***
Lag2 Pain	0.48 (0.02)***	0.48 (0.02)***	0.48 (0.02)***	0.46 (0.02)***
Passive Cope		0.05 (0.02)*		0.11 (0.03)***
Active Cope		-0.02 (0.02) ns		-0.03 (0.02) ns
Δ Passive Cope			0.02 (0.02) ns	0.07 (0.02)***
Δ Active Cope			0.01 (0.02) ns	-0.01 (0.02) ns
		Variance		
Between-Person	241.62***	241.64***	241.63***	241.66***
Within-Person	107.73	107.24	107.56	106.13
Deviance (df)	10449.5 (8)	10443.53 (10)	10447.39 (10)	10429.81 (10)

* p<.05 ** p<.01 *** p<.001

Cross-lag change values are referred to with the symbol Δ

Coping. The following analyses were conducted to test Hypotheses E and F (see the beginning of Section 6) as they relate to the outcome of Distress. The initial set of analyses, conducted to test Hypothesis E, examined the effect of lag1 coping on subsequent distress controlling for pain-intensity and time-of-day (see Table 6.20). The effect of lag1 coping on lag2 distress was first examined by comparing the effect of adding lag1 coping (model two) to the control model (model one). Model two accounted for 39.49% of within-person variance, only 0.28% more than was accounted for by the control model. However, model two was a significantly better fit than model one (χ^2 (2)=5.97, p=.049). Passive coping was the only significant coping predictor in model two, with use of a greater number of passive coping strategies associated with greater distress.

Table 6.21 Cross-lag analysis predicting lag2 Distress from lag1 coping, co-varying lag1 appraisals: standardized coefficient (S.E.)

	Model		
	1	2	3
Fixed Effects	Control	Appraisals	Full
Intercept	41.11 (2.68)***	41.09 (2.68)***	41.39 (2.68)***
Distress	0.33 (0.03)***	0.36 (0.03)***	0.36 (0.03)***
Lag2 Evening	-0.11 (1.65)**	-0.12 (1.65)**	-0.11 (1.64)**
Lag2 Work Hrs.	-0.09 (1.64)*	-0.1 (1.63)*	-0.09 (1.63)*
Pain	-0.16 (0.02)***	-0.11 (0.03)***	-0.11 (0.03)***
Lag2 Pain	0.46 (0.02)***	0.49 (0.02)***	0.48 (0.02)***
Passive Cope	0.11 (0.03)***		0.11 (0.03)***
Active Cope	-0.03 (0.02) ns		-0.03 (0.02) ns
Pain Self Efficacy		-0.02 (0.02) ns	-0.01 (0.02) ns
Catastrophising		-0.06 (0.03) ns	-0.67 (0.03)*
Pain Expectancy		-0.1 (0.03)***	-0.1 (0.03)***
Perc. Interference		0.05 (0.03) ns	0.02 (0.03) ns
Δ Passive Cope	0.07 (0.02)***	0.02 (0.02) ns	0.07 (0.02)***
Δ Active Cope	-0.01 (0.02) ns	0 (0.02) ns	-0.01 (0.02) ns
		Variance	
Between-Person	241.66***	241.7***	241.74***
Within-Person	106.13	105.84	104.28
Deviance (df)	10429.81 (12)	10426.28 (14)	10406.75 (16)

* p<.05 ** p<.01 *** p<.001

Cross-lag change values are referred to with the symbol Δ

The collective contribution of lag1 coping, controlling for change-in-coping, was assessed by adding change-in-coping to the model (model four) and comparing it to the model without coping (model three). Model four accounted for only 0.81% more within-person variance than model three, accounting for a total of 40.12%. Nonetheless, model four fit the data significantly better than model three (χ^2 (2)=17.57, p<.001), suggesting that coping at lag1 had a small but significant independent effect on lag2 distress. Finally, the unique effect of coping at lag1 on distress at lag2 was further explored by re-examining the coefficients of the coping variables once change-in-coping was controlled (model four). The addition of change-in-coping more than doubled the effect of passive coping, suggesting that the suppressing effect of the change scores had been removed.

Prior distress and lag2 pain remained the strongest predictors of subsequent distress, and lag1 pain and time-of-day also maintained significant effects. Interestingly, the coping and change-in-coping variables appeared to have no impact on the relationship between the control variables and lag2 Distress.

The influence of appraisals on the coping/distress relationship was investigated to test Hypothesis F (see Table 6.21). Cross-lag change variables for coping were covaried to facilitate interpretation of the lag1 coping effects. The full model was a better fit than model two (χ^2 (2)=19.53, p<.001). The full model contributed an additional 0.88% unique within-person variance to the 40.28% accounted for by model two. Namely, it appears that coping at lag1 contributed a small but significant amount of variance to the prediction of subsequent distress, controlling for appraisals, and for cross-lag change and the other control variables.

A comparison of the coping coefficients in models one and three revealed that the role of passive coping was not influenced by the addition of lag1 appraisal variables to the model, and active coping remained non-significant.

Passive-coping, not active coping, was associated with distress in previous analyses, so a final set of analyses examined the role of individual passive coping behaviours (see Table 6.22). The full model accounted for 39.98% of within-person variance, a contribution of only 0.77% to that already accounted for by the control model. Nevertheless, significance testing indicated that the full model provided a significantly better fit than the control model (χ^2(7)=18.804, p=.009). Specifically, use of medication on an as-required basis was associated with greater subsequent distress. Inspection of unstandardised coefficients reveals that use of such medication was associated with, on average, a 2.23% increase in

distress over subsequent hours. Avoidance of activity was also a significant positive predictor. This strategy was associated with, on average, a 2.62% increase in distress over subsequent hours.

Table 6.22 Relationship between lag1 coping strategies and lag2 Distress: standardized coefficient (S.E.)

	Model	
	1	2
Fixed Effects	Control	Full
Intercept	41.33 (2.68)***	40.59 (2.68)***
Distress	0.34 (0.03)***	0.33 (0.03)***
Lag2 Evening	-0.11 (1.65)**	-0.11 (1.65)**
Lag2 Work Hrs.	-0.1 (1.64)*	-0.1 (1.63)**
Pain	-0.16 (0.02)***	-0.17 (0.02)***
Lag2 Pain	0.48 (0.02)***	0.48 (0.02)***
Alcohol		0.01 (2.35) ns
Medication		0.04 (1.01)*
Sedative		0.01 (2.65) ns
Lay/Rest		0 (0.7) ns
Avoid Activity		0.05 (0.81)**
Hope/Pray		0.01 (0.8) ns
Tell self it doesn't hurt		-0.02 (1.09) ns
	Variance	
Between-Person	241.62***	232.16***
Within-Person	107.73	106.37
Deviance (df)	10449.5 (8)	10430.7 (15)

* p<.05 ** p<.01 *** p<.001

In summary, Hypotheses E and F, as they related to the Distress outcome, were supported. Coping demonstrated an effect on subsequent distress that was not attributable to pain-intensity, time-of-day, or appraisals. Passive coping – and avoidance of activity and use of as-required medication specifically – were associated with increased distress in subsequent hours.

Table 6.23 Prediction of lag2 Distress from lag1 appraisals and coping: standardized coefficient (S.E.)

	Model	
	1	2
Fixed Effects	Control	Full
Intercept	41.33 (2.68)***	39.14 (2.61)***
Distress	0.34 (0.03)***	0.34 (0.03)***
Lag2 Evening	-0.11 (1.65)**	-0.06 (1.51) ns
Lag2 Work Hrs.	-0.1 (1.64)*	-0.05 (1.5) ns
Pain	-0.16 (0.02)***	-0.08 (0.02)**
Lag2 Pain	0.48 (0.02)***	0.22 (0.02)***
Pain Self Efficacy		-0.07 (0.03)*
Catastrophising		0.13 (0.04)***
Perc. Interference		0.12 (0.03)***
Passive Cope		0.03 (0.03) ns
Δ Self Eff.		-0.08 (0.02)***
Δ Catastroph		0.19 (0.03)***
Δ Perc. Int.		0.11 (0.02)***
Δ Passive Cope		0.02 (0.02) ns
	Variance	
Between-Person	241.62***	242.89***
Within-Person	107.73	88.74
Deviance (df)	10449.5 (8)	10195.39 (16)

* p<.05 ** p<.01 *** p<.001

Cross-lag change values are referred to with the symbol Δ

Coping and Appraisals. In the last set of analyses of lag2 distress, the appraisals that were found to be significant in analysis four of Table 6.18 and the coping strategies that were found to be significant in analysis four of Table 6.20 were entered together to assess their relative effect (see Table 6.23). Thus, catastrophising, self-efficacy, perceived interference, and passive-coping were included. Change-scores were included to facilitate the interpretation of effects.

Inspection of Table 6.23 reveals that the model including key appraisal and coping variables (model two) accounted for 49.93% of within-person variance in lag2 Distress, adding 10.72% to the within-person variance accounted for by the control model. The fit of the full model was significantly better than that of the control model (χ^2 (8)=254.11,

p<.001). Catastrophising was the strongest lag1 predictor, followed by perceived interference and pain self-efficacy. With appraisals in the model, passive coping was non-significant as a predictor. Thus, whilst the psychological variables contributed unique prediction of lag2 distress this effect appeared to be attributable to appraisal only.

6.4.2 Function

Function-squared (correcting for non-normal distribution) was used as the outcome variable for all analyses of functioning.

6.4.2.1 Variance-Components and Control Models

Initial analyses were conducted to determine the proportion of within-person variance in functioning (the variance-components model), and how much of that variance was accounted for by the covariates (the control model).

Because function was measured retrospectively – such that the activities reportedly engaged in or avoided presumably occurred between entries – it was considered best to determine empirically whether control variables should be located at lag1 or lag2. For the same reason, same-lag analyses of Function were not conducted.

Initial HLM analyses were conducted to examine the relationship between lag2 function and potential confounding variables, including pain-intensity at both lags, function at lag1, and time-of-day at both lags. Only the lag1 predictors demonstrated significant effects and were thus included as co-variates in subsequent analyses. There was a significant autocorrelation effect (standardized coefficient=0.33, p<.001). Lag1 pain-intensity was associated with reduced function (standardized coefficient=-0.06, p<.05). Evening at lag1 (standardized coefficient=-0.12, p<.001), but not working hours (standardized coefficient=-0.04, p=ns) was associated with lag2 Function. As anticipated,

at lag2 neither time-of-day (standardized coefficient<.001, p=ns for evening; standardized coefficient= 0.07, p=ns for working-hours) nor pain (standardized coefficient= -0.03, p=ns) were related to lag2 Function.

Table 6.24 Variance-components and control models for lag2 function: standardized coefficient (S.E.)

	Model	
	1	2
Fixed Effects	Var. Components	Control
Intercept	4165.41 (222.42)***	4599.66 (261.55)***
Lag1 Function^2		0.34 (0.03)***
Evening		-0.15 (164.59)***
Work Hrs		-0.07 (155.53)*
Pain		-0.06 (2.71)*
	Variance	
Between-Person	2433117.99 (48.7%)***	2423341.52***
Within-Person	2558842.9 (51.3%)	2223097.81
Deviance (df)	24139.15 (3)	23954.19 (7)

* p<.05 ** p<.01 *** p<.001
Percentage of total variance in the variance components model is in brackets

According to the variance-components model, lag2 function varied slightly more at the within-subjects level (51.3% of variance) than it did between subjects.

The control model (model two), composed of the covariates for all subsequent analyses of function, was compared to the variance-components model (see Table 6.24).

The control model provided a significantly better fit than model one (χ^2 (4)=184.96, p<.001), accounting for 13.12% of within-person variance. Function at lag1 was the strongest predictor of subsequent function. Time of day at lag1, predominantly evening-hours, was also a significant predictor. Because the dependent variable was transformed, unstandardized coefficients for time-of-day were not inspected because on that scale their interpretation was not meaningful. Pain at lag1 was the weakest predictor, though it was significant – greater pain was associated with lower functioning in the next lag.

6.4.2.2 Cross-lag Analyses

Appraisals. A set of analyses was conducted to test Hypotheses C and D (see the introduction to Section 6) as they relate to the outcome of functioning. The following set of cross-lag analyses were intended to determine whether appraisals at lag1 were associated with function at lag2, as predicted according to Hypothesis C (see Table 6.25). Appraisals were related to lag2 function, controlling for pain and time-of-day. Model two was a significantly better fit than model one (χ^2 (4)=11.66, p=.02), though it accounted for 13.89% of within-person variance – only 0.77% more than what was accounted for by the control model. Model two reveals that only pain expectancy was significantly related to lag2 function, such that high pain expectancies were, unexpectedly, associated with better function.

Lag1 appraisals were associated with lag2 function beyond the effect of cross-lag changes in appraisal – model four was a significantly better fitting model than model three (χ^2 (4)=13.33, p=.01). It predicted 15.46% of within-person variance, contributing an additional 0.86% to that accounted for by model three. Controlling for change-in-appraisals had no noticeable impact on the effect of expectancy, however catastrophising became significant – associated with reduction in lag2 function.

Table 6.25 Cross-lag prediction of lag2 Function from lag1 appraisals: standardized coefficient (S.E.)

	Model			
	1	2	3	4
Fixed Effects	Control	Appraisal	Δ Appraisal	Full
Intercept	4599.66 (261.55)***	4602.29 (261.45)***	4609.51 (260.91)***	4614.24 (260.76)***
Lag1 Function[2]	0.34 (0.03)***	0.33 (0.03)***	0.35 (0.03)***	0.33 (0.03)***
Evening	-0.15 (164.59)***	-0.15 (164.46)***	-0.16 (163.48)***	-0.16 (163.21)***
Work Hrs	-0.07 (155.53)*	-0.08 (155.31)*	-0.08 (154.25)*	-0.08 (154)*
Pain	-0.06 (2.71)*	-0.08 (3.81)*	-0.1 (2.87)***	-0.08 (3.79)*
Pain Self Efficacy		-0.03 (3.33) ns		-0.01 (4.1) ns
Catastrophising		-0.07 (4.62) ns		-0.14 (5.69)**
Pain Expectancy		0.11 (4.07)**		0.12 (5.02)**
Perc. Interference		-0.02 (3.56) ns		-0.04 (4.25) ns
Δ Self Eff.			0.03 (2.9) ns	0.03 (3.59) ns
Δ Catastroph			-0.02 (3.81) ns	-0.06 (4.73)*
Δ Expectancy			-0.05 (3.39)*	0 (4.22) ns
Δ Perc. Int.			-0.03 (3.11) ns	-0.04 (3.76) ns
		Variance		
Between-Person	2423341.52***	2424055.89***	2424274.84***	2425002.46***
Within-Person	2223097.81	2203418.9	2185425.79	2163332.75
Deviance (df)	23954.19 (7)	23942.53 (11)	23931.76 (11)	23918.43 (15)

* p<.05 ** p<.01 *** p<.001

Cross-lag change values are referred to with the symbol Δ

There did not appear to be any noteworthy or systematic effect of adding the appraisal variables to the relationship between the control variables and lag2 function.

Table 6.26 displays analyses regarding Hypothesis D, investigating the possible role of coping in accounting for the effect of appraisals at lag1 on lag2 function. Cross-lag change scores for appraisals were covaried to facilitate interpretation of the lag1 effects.

Table 6.26 Cross-lag prediction of lag2 Function by lag1 appraisals, co-varying lag2 coping: standardized coefficient (S.E.)

	Model		
	1	2	3
Fixed Effects	Control	Coping	Full
Intercept	4614.24 (260.76)***	4558.54 (259.96)***	4565.58 (282.9)***
Lag1 Function^2	0.33 (0.03)***	0.32 (0.03)***	0.32 (0.04)***
Evening	-0.16 (163.21)***	-0.14 (161.75)***	-0.14 (172.4)***
Work Hrs	-0.08 (154)*	-0.07 (152.08)*	-0.07 (144.72)*
Pain	-0.08 (3.79)*	-0.06 (2.89)*	-0.08 (4.24) ns
Pain Self Efficacy	-0.01 (4.1) ns		-0.05 (4.83) ns
Catastrophising	-0.14 (5.69)**		-0.12 (7.23) ns
Pain Expectancy	0.12 (5.02)**		0.12 (7.7) ns
Perc. Interference	-0.04 (4.25) ns		0.01 (4.83) ns
Lag2 Pass. Cope		-0.16 (3.34)***	-0.16 (3.98)***
Lag2 Act. Cope		0 (2.62) ns	0 (2.45) ns
Δ Self Eff.	0.03 (3.59) ns	0.02 (2.86) ns	0 (3.81) ns
Δ Catastroph	-0.06 (4.73)*	-0.01 (3.76) ns	-0.06 (5.64) ns
Δ Expectancy	0 (4.22) ns	-0.04 (3.35) ns	0 (4.22) ns
Δ Perc. Int.	-0.04 (3.76) ns	-0.01 (3.07) ns	-0.01 (3.84) ns
		Variance	
Between-Person	2425002.46***	2429130.04***	2429771.88***
Within-Person	2163332.75	2114655.46	2095175.32
Deviance (df)	23918.43 (15)	23888.63 (13)	23876.49 (17)

* p<.05 ** p<.01 *** p<.001

Cross-lag change values are referred to with the symbol Δ

Appraisal appeared to account for unique variance beyond what was accounted for by the coping variables. Model three accounted for a total of 18.12% of within-person variance. It provided a better fit than model two (χ^2 (4)=12.14), p=.016), accounting for an additional 0.76% within-person variance compared to model two. However, with the addition of coping in model three, none of the effects associated with the appraisal or change-in-appraisal variables reached significance. Passive coping, on the other hand, was significant in both models two and three. That is, although appraisals accounted for significant amounts of variance in lag2 function despite the addition of coping to the model, none of the individual appraisal predictors remained significant.

In summary, the above analyses support Hypotheses C and D, suggesting that appraisals are significantly associated with subsequent functioning and that their effect is not due to pain-intensity or coping, however there was no clear effect of any specific appraisal variables once coping was controlled.

Coping. The following analyses were conducted to investigate Hypotheses E and F as they relate to functioning. An initial set of analyses was conducted to test Hypothesis E by examining the effect of lag1 coping on subsequent function (see Table 6.27).

The addition of lag1 coping appeared to account for the effect of lag1 pain-intensity on lag2 function – in both models two and four lag1 pain-intensity did not reach significance. The effect of working-hours on lag2 function also vanished when change-in-coping was incorporated in the model. Neither the effects of lag1 Function nor Evening appear to be influenced by the coping variables.

Table 6.27 Cross-lag prediction of lag2 Function by lag1 coping: standardized coefficient (S.E.)

	Model			
	1	2	3	4
Fixed Effects	Control	Coping	Δ Coping	Full
Intercept	4599.66 (261.55)***	4594.42 (261.18)***	4556.3 (261.62)***	4543.04 (260.35)***
Lag1 Function^2	0.34 (0.03)***	0.32 (0.03)***	0.35 (0.03)***	0.31 (0.03)***
Evening	-0.15 (164.59)***	-0.15 (163.73)***	-0.14 (164.79)***	-0.13 (162.19)***
Work Hrs	-0.07 (155.53)*	-0.07 (154.83)*	-0.06 (155.45) ns	-0.06 (152.88) ns
Pain	-0.06 (2.71)*	-0.04 (2.78) ns	-0.07 (2.7)*	-0.02 (2.75) ns
Passive Cope		-0.07 (3.42)**		-0.19 (4.26)***
Active Cope		-0.06 (2.54)*		-0.03 (3.13) ns
Δ Passive Cope			-0.06 (2.7)**	-0.15 (3.35)***
Δ Active Cope			0.03 (2.29) ns	0.01 (2.81) ns
		Variance		
Between-Person	2423341.52***	2424516.48***	2425792.53***	2429244.46***
Within-Person	2223097.81	2196694.4	2202106.51	2129546.8
Deviance (df)	23954.19 (7)	23938.52 (9)	23941.78 (9)	23897.85 (11)

* p<.05 ** p<.01 *** p<.001

Cross-lag change values are referred to with the symbol Δ

Initial analyses revealed an effect of lag1 coping on lag2 function. Model two was a significantly better fit than model one (χ^2 (2)= 15.67, p=.001). It accounted for 14.15% of the within-person variance in lag2 function, 1.03% more than was accounted for by model one. Inspection of model two demonstrates that both passive and active coping were significantly and negatively related to lag2 function.

The effect of lag1 coping was not entirely attributable to change-in-coping across lags. Model four accounted for 2.84% more within-person variance than model three, accounting for a total of 16.78% within-person variance, and provided a significantly better fit than model three (χ^2 (2)= 43.93, p<.001).

The unexpected effect of active coping vanished once change-in-coping was added to the model, but the effect of passive coping more than doubled. These findings suggest that there was significant suppression obscuring the relationship between lag1 coping and lag2 function, which may have been due to regression-to-the-mean.

A series of analyses presented in Table 6.28 tested Hypothesis F – that the effect of lag1 coping would be independent of the effects of lag1 appraisal. Change-in-coping was included in the model to clarify the lag1 effects. This hypothesis was supported – model three was a significantly better fit than model two (χ^2 (2)=49.14, p<.001). It accounted for 17.82% of within-person variance – 3.14% more than what was accounted for by model two. A comparison of models one and three reveals that the addition of lag1 appraisals to the model did not alter the pattern of results for lag1 coping in any note-worthy way. Active coping remained non-significant in both analyses, and passive coping maintained a significant positive relationship.

Table 6.28 Cross-lag analysis predicting lag2 Function from lag1 coping, co-varying lag1 appraisals: standardized coefficient (S.E.)

	Model		
	1	2	3
Fixed Effects	Control	Appraisal	Full
Intercept	4543.04 (260.35)***	4559.99 (261.49)***	4550.07 (260.07)***
Lag1 Function[2]	0.31 (0.03)***	0.34 (0.03)***	0.31 (0.03)***
Evening	-0.13 (162.19)***	-0.14 (164.61)***	-0.13 (161.69)***
Work Hrs	-0.06 (152.88) ns	-0.07 (155.19)*	-0.07 (152.32)*
Pain	-0.02 (2.75) ns	-0.08 (3.8)*	-0.08 (3.73)*
Pain Self Efficacy		-0.03 (3.32) ns	-0.05 (3.27) ns
Catastrophising		-0.08 (4.6) ns	-0.06 (4.52) ns
Pain Expectancy		0.11 (4.05)**	0.11 (3.97)***
Perc. Interference		-0.02 (3.55) ns	0.03 (3.53) ns
Passive Cope	-0.19 (4.26)***		-0.21 (4.38)***
Active Cope	-0.03 (3.13) ns		-0.03 (3.11) ns
Δ Passive Cope	-0.15 (3.35)***	-0.06 (2.69)***	-0.15 (3.38)***
Δ Active Cope	0.01 (2.81) ns	0.03 (2.29) ns	0.01 (2.8) ns
		Variance	
Between-Person	2429244.46***	2426443.52***	2430156.44***
Within-Person	2129546.8	2183049.98	2102747.23
Deviance (df)	23897.84 (11)	23930.38 (13)	23881.24(15)

* p<.05 ** p<.01 *** p<.001

Cross-lag change values are referred to with the symbol Δ

Table 6.29 contains analyses investigating the relationship between specific passive coping behaviors and lag2 function, controlling for the usual covariates. Once again, because passive coping and not active coping was associated with lag1 Function in model four of Table 6.27, only passive coping behaviors were examined in more detail.

The full model accounted for 14.2% of variance in the variance-components model, 6.27% more than the control model, and provided a significantly better fit than the control model (χ^2 (7)=18.7985, p=.009). The only coping strategy whose coefficient reached significance was laying-down/resting, which was associated with decreased function at lag2. Once again, unstandardised coefficients were not inspected because their interpretation was not meaningful on the transformed lag2 function scale.

Table 6.29 Relationship between lag1 coping strategies and lag2 Function: standardized coefficient (S.E.)

	Model	
	1	2
Fixed Effects	Control	Full
Intercept	4599.66 (261.55)***	4825.08 (263.39)***
Lag1 Function[2]	0.34 (0.03)***	0.31 (0.03)***
Evening	-0.15 (164.59)***	-0.16 (164.3)***
Work Hrs	-0.07 (155.53)*	-0.08 (155.31)*
Pain	-0.06 (2.71)*	-0.04 (2.82) ns
Alcohol		-0.03 (337.92) ns
Medication		0.01 (145) ns
Sedative		0 (377.31) ns
Lay/Rest		-0.05 (102.91)*
Avoid Activity		-0.03 (117.23) ns
Hope/Pray		-0.04 (112.28) ns
Tell self it doesn't hurt		-0.03 (156.28) ns
	Variance	
Between-Person	2423341.52***	2307913.57***
Within-Person	2223097.81	2195543.48
Deviance (df)	23954.19 (7)	23935.39 (14)

* p<.05 ** p<.01 *** p<.001

Thus, Hypotheses E and F were supported as they related to the outcome of functioning. The relationship between coping and subsequent functioning was unattributable to pain-intensity, time-of-day, or appraisals. Specifically, the passive coping strategy of laying down and resting appeared to have the most detrimental impact on functioning.

Coping and Appraisals. In the last set of analyses of lag2 function, the appraisals that were found to be significant in analysis four of Table 6.25 and the coping strategies that were found to be significant in analysis four of Table 6.27 were entered together to assess their relative effect (see Table 6.30). Thus, catastrophising, pain expectancy, and passive-coping were included. Change-scores were included to facilitate the interpretation of effects.

Table 6.30 Prediction of lag2 Function by lag1 appraisals and coping: standardized coefficient (S.E.)

	Model	
	1	2
Fixed Effects	Control	Full
Intercept	4599.66 (261.55)***	4575.38 (259.62)***
Lag1 Function [2]	0.34 (0.03)***	0.31 (0.03)***
Evening	-0.15 (164.59)***	-0.14 (160.98)***
Work Hrs	-0.07 (155.53)*	-0.07 (151.5)*
Pain	-0.06 (2.71)*	-0.05 (3.57) ns
Catastrophising		-0.1 (5.15)*
Pain Expectancy		0.12 (4.72)**
Passive Cope		-0.19 (4.25)***
Δ Catastroph		-0.06 (4.21)*
Δ Expectancy		0 (4.01) ns
Δ Passive Cope		-0.13 (3.37)***
	Variance	
Between-Person	2423341.52***	2429180.74***
Within-Person	2223097.81	2100499.81
Deviance (df)	23954.19 (7)	23879.81 (13)

* p<.05 ** p<.01 *** p<.001

Cross-lag change values are referred to with the symbol Δ

Testing indicated that the full model was a significantly better fit than the control model (χ^2 (6)=74.38, p<.001). It accounted for a total of 17.91% within-person variance – 4.79% more than was accounted for by the control model. All three lag1 psychological predictors were significant. Passive coping – the strongest predictor – and catastrophising demonstrated negative associations with functioning, whereas pain expectancy demonstrated an unexpected positive association.

6.4.3 Activity-Level

6.4.3.1 Variance Components and Control Models

Again, a variance-components model was calculated to determine what proportion of the variance in the activity-level outcome was within-people. A control model composed of

the covariate variables was then calculated to determine the proportion of within-person variance attributable to these factors.

Lag2 activity-level varied at the within-subjects level notably more than it varied between people (70% of variance).

The control model for cross-lagged analyses (model two), composed of all co-variates, is compared to the variance-components model in Table 6.31, as is a control-model for same-lag analyses (model three), composed only of covariates at lag2. All control variables demonstrated significant effects.

Table 6.31 Variance-components and control models for lag2 Activity-Level: standardized coefficient (S.E.)

	Model		
	1	2	3
Fixed Effects	Var. Components	Control (cross-lag)	Control (same-lag)
Intercept	34.73 (1.73)***	26.46 (3.09)***	25.99 (3.14)***
Lag1 Activity-Level		0.21 (0.03)***	
Lag2 Evening		0.12 (2.69)*	0.13 (2.76)*
Lag2 Work Hrs.		0.24 (2.67)***	0.26 (2.74)***
Pain		-0.13 (0.03)***	
Lag2 Pain		0.21 (0.03)***	0.18 (0.03)***
	Variance		
Between-Person	137.96 (30%) ***	137.98***	137.17***
Within-Person	321.67 (70%)	287.81	304.12
Deviance (df)	11859.29 (3)	11712.84 (8)	11785.15 (6)

* p<.05 ** p<.01 *** p<.001

Percentage of total variance in the variance components model is in brackets

Both model two (χ^2 (5)=146.44, p<.001) and model three (χ^2 (3)=74.13, p<.001) provided a significantly better fit than the variance-components model – they accounted for 10.53% and 5.46% of within-person variance in the variance-components model, respectively.

In both models the strongest predictor was working-hours. Unstandardised coefficients reveal that in model two working-hours were associated with, on average, an increase in

activity of 10.71%, relative to pre-work hours. Evening was also significant, accounting for an average 5.42% increase in activity compared to pre-work hours. In model two, Activity at lag1 and pain at lag2 were also strong predictors, both being associated with increased activity at lag2. Pain at lag1 was a significant predictor, associated with decreased activity at lag2.

6.4.3.2 Same-lag Analyses

A set of analyses was conducted to test Hypothesis A (see the beginning of section 6) by investigating whether activity-level was related to concurrent appraisals and prior coping efforts made in the same time-lag, controlling for the effect of time-of-day and concurrent pain (see Table 6.32).

Table 6.32 Same-lag analysis of lag2 Activity-Level: standardized coefficient (S.E.)

	Model			
	1	2	3	4
Lag2 Fixed Effects	Control	Appraisals	Coping`	Full
Intercept	25.99 (3.14)***	26.14 (3.13)***	26.89 (3.13)***	26.8 (3.12)***
Evening	0.13 (2.76)*	0.13 (2.75)*	0.12 (2.74) ns	0.12 (2.73)*
Work Hrs.	0.26 (2.74)***	0.25 (2.72)***	0.23 (2.73)***	0.23 (2.71)***
Pain	0.18 (0.03)***	0.17 (0.04)***	0.23 (0.03)***	0.18 (0.04)***
Pain Self Efficacy		0.12 (0.04)**		0.1 (0.04)*
Catastrophising		0 (0.05) ns		0.01 (0.05) ns
Pain Expectancy		0.21 (0.05)***		0.21 (0.05)***
Perc. Interference		-0.1 (0.04)*		-0.07 (0.04) ns
Passive Coping			-0.14 (0.04)***	-0.13 (0.04)***
Active Coping			0.1 (0.03)**	0.09 (0.03)**
		Variance		
Between-Person	137.17***	137.56***	137.52***	137.89***
Within-Person	304.12	296.89	298.47	292.11
Deviance (df)	11785.15 (6)	11753.58 (10)	11760.59(8)	11732.33 (12)

* p<.05 ** p<.01 *** p<.001

Inspection of models two to four reveals that the effect of the control variables was largely unaffected by the introduction of the coping and appraisal variables. It appears that coping may have suppressed the effect of pain on activity to some degree, evidenced

by a slight increase in the effect of pain in model three. However, this effect vanished with the reintroduction of appraisals in model four.

Appraisals accounted for significant variance beyond the effect of control variables. Model two accounted for 7.7% of within-person variance, 2.25% more than was accounted for by the control model. Model two provided a significantly better fit than model one (χ^2 (4)=31.57, p<.001). Coping also appeared to predict Activity-Level significantly, beyond what was accounted for by the control variables. Model three accounted for 7.21% of within-person variance – 1.76% more than the control model. The difference between the models appeared to be significant (χ^2 (2)=24.56, p<.001). Both self-efficacy and active coping were associated with increased activity, as predicted. Also as predicted, passive coping was associated with decreased activity. Although pain expectancy was significant, as anticipated, it was – perhaps counter-intuitively – associated with increased activity. Pain expectancy was the strongest of the psychological variables in the model, and its positive effect was almost as great as the influence of working-hours on activity-level. A comparison between models two, three, and four revealed that whereas perceived interference was associated with reduced activity in model two, this association vanished with the addition of coping in model four.

Analyses also tested Hypothesis B, predicting that the effects of coping and appraisal on activity-level would be independent of each-other. Model four accounted for 9.19% of within-person variance – 1.49% more than was accounted for by model two, and 1.98% more than model three. Model four provided a significantly better fit than model two (χ^2 (2)=21.25, p<.001), and model three (χ^2 (4)=28.26, p<.001). Thus, both coping and appraisal appeared to contribute independently to the prediction of Activity-Level.

In summary, Hypotheses A and B were supported. The significant relationship between appraisals and concurrent activity was attributable to neither pain-intensity, time-of-day, nor coping. Similarly, the significant relationship between coping and activity was not due to pain-intensity, time-of-day, or appraisals.

Table 6.33 Cross-lag prediction lag2 Activity-Level from lag1 appraisals: standardized coefficient (S.E.)

	Model			
	1	2	3	4
Fixed Effects	Control	Appraisal	Δ Appraisal	Full
Intercept	26.46 (3.09)***	26.48 (3.08)***	26.22 (3.08)***	26.39 (3.07)***
Lag1 Activity-Level	0.21 (0.03)***	0.2 (0.03)***	0.22 (0.03)***	0.2 (0.03)***
Lag2 Evening	0.12 (2.69)*	0.12 (2.68)*	0.13 (2.68)*	0.13 (2.67)*
Lag2 Work Hrs.	0.24 (2.67)***	0.24 (2.66)***	0.25 (2.65)***	0.24 (2.64)***
Pain	-0.13 (0.03)***	-0.12 (0.04)**	-0.12 (0.04)**	-0.12 (0.04)**
Lag2 Pain	0.21 (0.03)***	0.22 (0.03)***	0.2 (0.04)***	0.19 (0.04)***
Pain Self Efficacy		-0.09 (0.04)*		0.03 (0.05) ns
Catastrophising		-0.04 (0.05) ns		-0.03 (0.07) ns
Pain Expectancy		0.09 (0.05)*		0.22 (0.06)***
Perc. Interference		-0.15 (0.04)**		-0.15 (0.05)**
Δ Self Eff.			0.1 (0.03)***	0.1 (0.04)***
Δ Catastroph			0.01 (0.04) ns	0 (0.06) ns
Δ Expectancy			0.05 (0.04) ns	0.13 (0.05)***
Δ Perc. Int.			0.05 (0.04) ns	0 (0.04) ns
		Variance		
Between-Person	137.98***	138.21***	138.32***	138.59***
Within-Person	287.81	284.49	283.22	278.62
Deviance (df)	11712.84 (8)	11697.63 (12)	11691.82 (12)	11670.32 (16)

* p<.05 ** p<.01 *** p<.001

Cross-lag change values are referred to with the symbol Δ

6.4.3.3 Cross-lag Analyses

Appraisals. The following analyses set out to test Hypotheses C and D as they related to the activity-level outcome. An initial set of analyses, conducted across-lags, was intended to determine whether appraisals at lag1 were associated with activity at lag2, as proposed by Hypothesis C (see Table 6.33).

The effect of the control variables on lag2 activity-level did not appear to be influenced by the inclusion of lag1 pain appraisals.

The effect of appraisals on subsequent activity was investigated by comparing model two to model one. Appraisal was associated with Activity-Level – model two was a significantly better fit than model one (χ^2 (4)=15.21, p=.005). It accounted for 11.56% of within-person variance – 1.03% more than was accounted for by the control model. Model two revealed three significant appraisal predictors, though only the strongest of the predictors, perceived interference, was in the predicted direction. Pain expectancy was associated with increased activity at lag2, and self-efficacy was associated with decreased activity.

The effect of change-in-appraisals on the relationship between lag1 appraisals and lag2 activity-level was investigated next, and, as predicted, lag1 appraisal appeared to maintain its relationship with lag2 activity-level. Model four provided a significantly better fit than model three (χ^2 (4)=21.5, p<.001). It accounted for 13.38% of within-person variance, contributing an additional 1.43% unique variance above that accounted for by model three. When change-in-appraisals were controlled the effect of self-efficacy vanished, suggesting that regression-to-the-mean may account for the effect seen in model two. Perceived interference remained significant in the predicted direction, however the unexpected effect of pain expectancy increased, making it the strongest of the appraisal predictors. Catastrophising appeared to have no lagged effect on activity in either model two or four.

Table 6.34 Cross-lag prediction of lag2 Activity-Level by lag1 appraisals, co-varying lag2 coping: standardized coefficient (S.E.)

	Model		
	1	2	3
Fixed Effects	Control	Coping	Full
Intercept	26.39 (3.07)***	26.94 (3.07)***	27 (3.06)***
Lag1 Activity-Level	0.2 (0.03)***	0.21 (0.03)***	0.19 (0.03)***
Lag2 Evening	0.13 (2.67)*	0.12 (2.66)*	0.12 (2.66)*
Lag2 Work Hrs.	0.24 (2.64)***	0.23 (2.65)***	0.22 (2.63)***
Pain	-0.12 (0.04)**	-0.1 (0.04)*	-0.13 (0.04)**
Lag2 Pain	0.19 (0.04)***	0.23 (0.04)***	0.2 (0.04)***
Pain Self Efficacy	0.03 (0.05) ns		0.01 (0.05) ns
Catastrophising	-0.03 (0.07) ns		-0.02 (0.07) ns
Pain Expectancy	0.22 (0.06)***		0.22 (0.06)***
Perc. Interference	-0.15 (0.05)**		-0.12 (0.05)*
Lag2 Pass. Cope		-0.12 (0.04)***	-0.12 (0.04)***
Lag2 Act. Cope		0.09 (0.03)*	0.09 (0.03)*
Δ Self Eff.	0.1 (0.04)***	0.09 (0.03)***	0.09 (0.04)**
Δ Catastroph	0 (0.06) ns	0.02 (0.04) ns	0.01 (0.06) ns
Δ Expectancy	0.13 (0.05)***	0.05 (0.04)*	0.13 (0.05)***
Δ Perc. Int.	0 (0.04) ns	0.05 (0.04) ns	0.01 (0.04) ns
	Variance		
Between-Person	138.59***	138.62***	138.86***
Within-Person	278.62	278.94	274.9
Deviance (df)	11670.32 (16)	11671.86 (14)	11652.75 (18)

* p<.05 ** p<.01 *** p<.001

Cross-lag change values are referred to with the symbol Δ

The hypothesis that the cross-lag relationship between appraisal and activity-level is not due to coping (as proposed by Hypothesis D) was examined in Table 6.34. Change-in-appraisal variables were included to facilitate interpretation of the lag1 effects. The hypothesis was supported – model three fit the data better than model two (χ^2 (4)=19.11, p=.001), suggesting that coping did not account for the effect of appraisals on subsequent activity. Model three accounted for 14.54% of within-person variance – 1.26% more than model two. Inspection of the specific effects in models one and three revealed that the only impact of the inclusion of lag2 coping on the appraisal/activity relationships was a small decrement in the effect of perceived interference.

To summarise, appraisals were related to subsequent activity-level and this effect was due to neither time-of-day, pain-intensity (as predicted according to Hypothesis C) nor coping (thus supporting Hypothesis D).

Coping. Analyses were performed to test Hypotheses E and F as they relate to the outcome of Activity-Level.

The following set of analyses was conducted to test Hypothesis E by examining the effect of lag1 coping on subsequent activity (see Table 6.35). The relationship between lag2 evening and increased activity-level appeared to be accounted for by coping and change-in-coping variables. Otherwise, the effect of the control variables on lag2 activity-level did not appear to be influenced by the coping variables.

In Table 6.35, the effect of coping on lag2 activity-level was inspected by comparing model two to model one. Model two was a significantly better fit than model one (χ^2 (2)=11.1, p=.004), accounting for 11.28% of within-person variance. It contributed a further 0.76% unique variance beyond what was accounted for by the control model. Coping appeared to account for significant variance even once change-in-coping was included in the model. Model four accounted for 1.11% more within-person variance than model three, predicting a total of 12.58% of within-person variance. Model four provided a better fit than model three (χ^2 (2)=16.49, p=.001). Model two revealed that only passive coping at lag1 was associated with lag2 activity-level. This pattern did not change once change-in-coping variables were added in model four.

Table 6.35 Cross-lag prediction of lag2 Activity-Level by lag1 coping: standardized coefficient (S.E.)

	Model			
	1	2	3	4
Fixed Effects	Control	Coping	Δ Coping	Full
Intercept	26.46 (3.09)***	26.75 (3.08)***	27.37 (3.09)***	27.74 (3.07)***
Lag1 Activity-Level	0.21 (0.03)***	0.21 (0.03)***	0.22 (0.03)***	0.21 (0.03)***
Lag2 Evening	0.12 (2.69)*	0.12 (2.68) ns	0.1 (2.69) ns	0.1 (2.67) ns
Lag2 Work Hrs.	0.24 (2.67)***	0.24 (2.66)***	0.22 (2.67)**	0.21 (2.66)***
Pain	-0.13 (0.03)***	-0.11 (0.03)**	-0.13 (0.03)***	-0.11 (0.03)**
Lag2 Pain	0.21 (0.03)***	0.22 (0.03)***	0.21 (0.03)***	0.25 (0.03)***
Passive Cope		-0.07 (0.04)*		-0.16 (0.05)***
Active Cope		-0.05 (0.03) ns		0.04 (0.04) ns
Δ Passive Cope			-0.02 (0.03) ns	-0.09 (0.04)***
Δ Active Cope			0.08 (0.03)***	0.09 (0.03)***
		Variance		
Between-Person	137.98***	138.1***	138.15***	138.37***
Within-Person	287.81	285.38	284.78	281.21
Deviance (df)	11712.84 (8)	11701.74 (10)	11698.95 (10)	11682.46 (12)

* p<.05 ** p<.01 *** p<.001

Cross-lag change values are referred to with the symbol Δ

Table 6.36 displays analyses aimed at evaluating the possible role of lag1 appraisals in the coping/activity-level relationship, thus testing Hypothesis F. Cross-lag change-in-coping variables were once again included to clarify interpretation of lag1 effects. The full model provided a better fit than model two, the model without lag1 coping (χ^2 (2)=14.76885, p=.001). Model three accounted for 13.41% of within-person variance – 0.98% more than model two. Thus, it appears that coping at lag1 had an effect on lag2 activity-level beyond what was accounted for by intervening (lag1) appraisals. A comparison of models one and three revealed that the effect of passive coping appeared largely uninfluenced by the addition of appraisals to the model.

Table 6.36 Cross-lag prediction of lag2 Activity-Level by lag1 coping, co-varying lag1 appraisals: standardized coefficient (S.E.)

	Model		
	1	2	3
Fixed Effects	Control	Appraisals	Full
Intercept	27.74 (3.07)***	27.37 (3.08)***	27.75 (3.07)***
Lag1 Activity-Level	0.21 (0.03)***	0.21 (0.03)***	0.2 (0.03)***
Lag2 Evening	0.1 (2.67) ns	0.11 (2.68) ns	0.1 (2.67) ns
Lag2 Work Hrs.	0.21 (2.66)***	0.22 (2.66)**	0.21 (2.65)**
Pain	-0.11 (0.03)**	-0.12 (0.04)**	-0.12 (0.04)**
Lag2 Pain	0.25 (0.03)***	0.22 (0.04)***	0.24 (0.04)***
Pain Self Efficacy		-0.08 (0.04) ns	-0.1 (0.04)*
Catastrophising		-0.04 (0.05) ns	-0.03 (0.05) ns
Pain Expectancy		0.09 (0.05)*	0.09 (0.05)*
Perc. Interference		-0.14 (0.04) ns	-0.11 (0.04)*
Passive Cope	-0.16 (0.05)***		-0.15 (0.05)***
Active Cope	0.04 (0.04) ns		0.04 (0.04) ns
Δ Passive Cope	-0.09 (0.04)***	-0.02 (0.03) ns	-0.09 (0.04)**
Δ Active Cope	0.09 (0.03)***	0.08 (0.03)**	0.09 (0.03)**
		Variance	
Between-Person	138.37***	138.36***	138.56***
Within-Person	281.21	281.71	278.55
Deviance (df)	11682.46 (12)	11684.79 (14)	11670.02 (16)

* p<.05 ** p<.01 *** p<.001

Cross-lag change values are referred to with the symbol Δ

Table 6.37 reports analyses regarding the effect of individual coping behaviours on lag2 activity-level, controlling for the covariates. Again, only passive strategies were included due to the lack of effect for active coping demonstrated in model four of Table 6.35. The full model accounted for 11.72% of within-person variance, adding 1.2% unique variance to that accounted for by the control model. The full model provided a significantly better fit than the control model (χ^2 (9)=89.436, p<.001). Specifically, lower activity at lag2 was associated with prior use of sedative medications, and the appraisal strategy of telling one-self that the pain does not hurt. Inspection of unstandardised coefficients revealed that these strategies were associated with an average decrease in activity of 10.55% and 4.6% respectively.

Thus, for analyses of activity-level both Hypotheses E and F were supported – coping was significantly related to activity-level and the effect was not attributable to pain-intensity or appraisals. Passive coping (in particular, use of sedatives and denial of the pain) appeared to be the key coping factor associated with reduced activity-levels.

Table 6.37 Relationship between lag1 coping strategies and lag2 Activity-Level: standardized coefficient (S.E.)

	Model	
	1	2
Fixed Effects	Control	Full
Intercept	26.46 (3.09)***	27.53 (3.16)***
Lag1 Activity-Level	0.21 (0.03)***	0.21 (0.03)***
Lag2 Evening	0.12 (2.69)*	0.13 (2.69) ns
Lag2 Work Hrs.	0.24 (2.67)***	0.25 (2.67)***
Pain	-0.13 (0.03)***	-0.11 (0.04)**
Lag2 Pain	0.21 (0.03)***	0.22 (0.03)***
Alcohol		-0.02 (3.83) ns
Medication		-0.02 (1.64) ns
Sedative		-0.06 (4.29)*
Lay/Rest		-0.02 (1.16) ns
Avoid Activity		-0.03 (1.31) ns
Hope/Pray		0 (1.27) ns
Tell self it doesn't hurt		-0.07 (1.77)**
	Variance	
Between-Person	137.98***	139.76***
Within-Person	287.81	283.96
Deviance (df)	11712.84 (8)	11695.72 (15)

* p<.05 ** p<.01 *** p<.001

Coping and Appraisals. In the last set of analyses of lag2 Activity-Level the appraisals that were found to be significant in analysis four of Table 6.33 and the coping strategies that were found to be significant in analysis four of Table 6.35 were entered together to assess their relative effect (see Table 6.38). Thus, pain expectancy, perceived interference, and passive coping were included. Change-scores were included to facilitate the interpretation of effects.

The full model provided a significantly better fit than the control model (χ^2 (6)=42.69, p<.001). It accounted for a total of 13.4% within-person variance, contributing 2.87% unique variance beyond what was accounted for by the control model. All three predictors were significant. The strongest, pain expectancy, was positively related to subsequent activity. Passive coping, the next strongest, was negatively correlated, as was perceived interference.

Table 6.38 Prediction of lag2 Activity-Level by lag1 appraisals and coping: standardized coefficient (S.E.)

	Model	
	1	2
Fixed Effects	Control	Full
Intercept	26.46 (3.09)***	26.35 (3.06)***
Lag1 Activity-Level	0.21 (0.03)***	0.19 (0.03)***
Lag2 Evening	0.12 (2.69)*	0.13 (2.66)*
Lag2 Work Hrs.	0.24 (2.67)***	0.24 (2.63)***
Pain	-0.13 (0.03)***	-0.1 (0.04)*
Lag2 Pain	0.21 (0.03)***	0.16 (0.04)***
Pain Expectancy		0.23 (0.06)***
Perc. Interference		-0.11 (0.05)*
Passive Cope		-0.15 (0.05)***
Δ Expectancy		0.13 (0.05)***
Δ Perc. Int.		-0.01 (0.04) ns
Δ Passive Cope		-0.08 (0.04)**
	Variance	
Between-Person	137.98***	138.61***
Within-Person	287.81	278.58
Deviance (df)	11712.84 (8)	11670.15 (14)

* p<.05 ** p<.01 *** p<.001

Cross-lag change values are referred to with the symbol Δ

In summary, previous analyses revealed that appraisals and coping demonstrated significant independent effects on subsequent activity-level. The above analyses demonstrated the key appraisal and coping factors that are associated with activity-levels in subsequent hours – pain expectancy, passive coping, and perceptions of life interference.

6.5 Discussion – Part B

In Study Two, the PAMS instrument was administered to 55 participants via PDA, with entries signalled by alarms up to nine times per day for up to nine days. Fifty-three participants provided sufficient data for use in focal analyses. Part B of Study Two addressed the focal hypotheses of the current project. It was anticipated that pain appraisals and coping would account for significant variance in each of the three outcomes assessed – distress, function, and activity level. Concurrent (same-lag) relationships between the psychological variables and the indices of adjustment were investigated for distress and activity-level (which were both measured on a momentary basis), and delayed (cross-lag) effects were investigated for all three outcomes. The key hypotheses (outlined in the introduction to Study Two) predicted that appraisal and coping would have effects beyond the separate effect of pain-intensity on adaptation. To test these hypotheses pain intensity was covaried in all analyses. Also, it was hypothesized that appraisal and coping would demonstrate separate effects. To test this, the effect of appraisal and coping were assessed in separate analyses whilst controlling for the other. To further control for extraneous sources of variance, time-of-day was controlled, and in cross-lag analyses first-order autocorrelation was also controlled.
No specific hypotheses were made about the relative effect of specific appraisal and coping predictors, though theory and prior research did allow for speculation. To facilitate the interpretation of the individual effects in certain cross-lag analyses, cross-lag change variables were entered for the relevant appraisal or coping variables. It was hoped that this might control for possible cross-lag regression-to-the-mean effects that may have otherwise suppressed the true effect of the lag1 variables.

Prior to focal analyses a number of exploratory analyses were conducted in Part One of Study Two to address methodological issues relating to compliance, convergent validity, and reactivity effects.

The current chapter will review the findings of Part B of Study Two. Implications for the focal hypotheses of the current research will be discussed first – in Sections 6.5.1 and 6.5.2. In the following section, 6.5.3, findings will be discussed as they relate to each specific outcome and predictor variable. The importance of specific predictors for each of the three outcome variables will be discussed first. Section 6.5.3.4 will conclude by re-examining these same findings on a predictor-by-predictor basis. In this chapter, current findings will be discussed with reference to the hypotheses of the current study and to previous relevant research. An examination of implications of the current findings for theoretical models of adaptation to chronic pain will be deferred until Chapter 7 – the General Discussion.

6.5.1 Independence of Appraisal and Coping From Pain Intensity

The current study set out to address two key issues in a Stress and Coping model of adjustment to chronic pain. The first issue, addressed by Hypotheses A, C, and E, was whether appraisal and coping were related to adaptation outcomes above-and-beyond the potential direct effect of pain on adaptation.

Three EMA studies support the notion that appraisal and coping are related to emotional functioning independently of pain-intensity. Affleck, Urrows, et al. (1992) found that summary-measures of daily coping strategy use were associated with trends in mood after controlling for both average pain levels and pain trends. Keefe, et al. (1997) found that appraisal (pain control self-efficacy) and coping, entered together, accounted for

significant variance in positive and negative affectivity, controlling for pain intensity – though the effects of each were not assessed separately. Grant, et al. (2002) also demonstrated that, entered together after control for daily changes in pain-intensity, appraisals (catastrophising and pain-coping self-efficacy) and coping (distraction and ignoring) were related to evening mood. No prior studies have investigated the same question with function and/or activity-level as the outcome variables – this is the first to do so.

Both same-lag analyses (for distress and activity-level) confirmed the hypothesis, revealing that appraisal and coping had significant effects whilst controlling for pain intensity. Cross-lag analyses also confirmed the hypothesis. For all three outcome variables, appraisal and coping factors at lag1 were related to lag2 adaptation independently of the effects of pain-intensity (at either lag) on adaptation.

Controlling for pain-intensity, appraisal and coping accounted for 12.14% and 1.02% (respectively) within-person variance in same-lag distress – a total of 12.15%. This compared favourably to Keefe, et al.'s (1997) finding that, controlling for pain intensity, 3.8% of within-person variance in NA and 6.1% in PA was accounted for by coping and pain-coping self-efficacy.

In cross-lag analyses, total within-person variance accounted for by lag1 appraisal and coping variables was not calculated, however appraisal and coping were associated with 2.22% and 0.81% (respectively) of within-person variance in next-lag distress after controlling for pain intensity, cross-lag change effects, and other control variables. These proportions of within-person variance accounted-for were comparable to Keefe, et al.'s

(1997) finding that coping and pain-coping self-efficacy, together, accounted for 2% of within-person variance in next-day PA.

Compared to distress, a lower proportion of variance in same-lag activity-level was accounted for by both appraisals and coping, controlling for pain-intensity – only 3.7%. Appraisal and coping accounted for 2.25% and 1.76% unique variance, respectively. In cross-lag analyses, the percentages of within-person variance accounted for by appraisal and coping, controlling for pain-intensity and cross-lag effects, were 1.43% and 1.11% respectively. Because the current study is the first to do such analyses of within-person activity-level in chronic pain, there are no studies against which to compare variance accounted-for.

After controlling for the effect of a number of variables including cross-lag change variables and pain-intensity, appraisal and coping were associated with 0.86% and 2.84% within-person variance in next-lag functioning, respectively. Once again, no comparison studies were available.

In summary, Study Two supported Hypotheses A, C, and E. Same-lag analyses suggested that appraisal and coping are related to a person's adaptational status (measured as distress and activity-level) at any given moment, and that these effects cannot be attributable to the intensity of momentary pain. Although the effects were smaller, cross-lag analyses supported the notion that appraisal and coping are causally related to changes in adaptational status (operationalised as distress, function, and activity-level) in the course of every-day life, independently of momentary pain-intensity.

6.5.2 Separate Effects Of Appraisal And Coping

The second question investigated, tested via Hypotheses B, D, and F, was whether appraisal and coping have independent effects on adaptation. Like Turner, et al. (2000), the independent effects of appraisal were evaluated by controlling for coping, and *visa versa* for analyses of coping.

Appraisal contributed independently to the prediction of same-lag distress and activity-level when coping was covaried. It was associated with 11.13% unique within-person variance in distress. This was consistent with Grant's (1998) findings: 12% of within-person variance in night-time depressed mood and 10% in night-time anxious mood was accounted for by appraisal variables (though neither pain intensity nor coping were covaried).

Contrary to expectations, the relationship between coping and same-lag distress appeared to be attributable to appraisals. Coping was uniquely related to only 0.01% within-person variance in distress. Such a finding appears to support the primacy of appraisals in determining momentary affect (see Lazarus, 1991). By comparison, Grant (1998) reported that 1% within-person variance in night-time depressed and anxious mood was attributable to coping, covarying appraisals (but not pain intensity). Further investigation may reveal mediation effects whereby passive coping prompts changes in appraisal (reappraisal) – such as reduced pain self-efficacy – and re-appraisals are associated with momentary changes in mood-state. Alternatively, it may be that appraisal had an artificially larger relationship with distress because both were measured momentarily, whereas coping was measured in a short-latency recall manner. However, if this were the case, one might expect to see the same effect when appraisal was covaried in the activity-

level analyses. That was not found – coping contributed independently to the prediction of activity-level when appraisal was covaried – accounting for 1.49% unique variance. Appraisal also accounted for a small amount of unique variance in activity-level – 2.24%. In the current study, cross-lag analyses confirmed hypotheses that the effects of appraisal and coping on adaptation are independent. Coping accounted for unique variance in lag2 distress (0.88%), function (3.14%) and activity-level (0.98) after controlling for appraisal. Keefe, et al.'s (1997) study supports the notion that coping variables are significantly associated with lag2 (in their case, next-day) distress after controlling for pain-intensity and pain-coping self-efficacy appraisals. In the current study appraisal, also, was associated with unique within-person variance in next-lag distress (1.92%), function (0.76%), and activity-level (1.26%) after covarying coping.

In contrast with the current finding that appraisal was independently related to subsequent distress, Keefe, et al. (1997) did not find a significant cross-lag effect of appraisal independent of coping or pain-intensity. They investigated the effect of only one appraisal variable – pain-coping self-efficacy. Pain self-efficacy was a significant cross-lag predictor in the current study. These discrepant findings may be related to the different time-lags investigated – whilst the current study found a delayed effect of appraisal over a period of hours, Keefe and colleagues found no such effect across days. Although appraisal was associated with significant unique variance in lag2 function after coping was controlled, no individual appraisal predictors remained significant. Thus, although interpretation of these findings is ambiguous, it might be considered that the cross-lag effect of appraisal on functioning is attributable to coping.

In summary, same-lag analyses revealed that the relationship between appraisal and momentary adaptational status (operationalised as distress and activity-level) was not attributable to the use of coping strategies. Cross-lag analyses were consistent with theorising that the effect of appraisal on momentary adaptational status (measured as distress, function, and activity-level) is a causal one. Similar conclusions could be drawn regarding the independent effects of coping on adaptation – except when adaptation was operationalised as distress. The findings for this outcome were more complex. A unique effect of coping was demonstrated in cross-lag analyses – supporting a causal effect of coping on distress that is independent of appraisal – however no effect was observed in same-lag analyses. Such a pattern of results may suggest that coping has a delayed effect on mood-states but that any more temporally proximal effects are better attributed to correlated appraisal processes.

6.5.3 Specific Predictors of Adaptational Outcomes

6.5.3.1 Distress

Time of day. Distress displayed a decreasing daily trend, such that both evening-hours and working-hours were associated with lower distress than pre-working hours.

First-order autocorrelation. A positive relationship was observed between lag1 and lag2 distress, suggesting a degree of stability in distress throughout the day.

Pain-intensity. Same-lag pain-intensity was associated with greater distress, confirming similar findings by a number of authors (eg. Catley, 1999; Vendrig & Lousberg, 1997). The impact of pain-intensity on distress appeared to be ameliorated by the inclusion of appraisals in the model, but was still a significant predictor. That is, whilst to some degree appraisals of pain, rather than pain *per se*, appear to account for

distress, pain intensity (or other unmeasured factors) nonetheless appears to directly influence distress to some degree.

Lag1 pain demonstrated an unexpected negative effect on lag2 distress. Such an effect is inconsistent with other cross-lag analyses by Gil, et al. (2003) and Feldman, et al. (1999), though these authors investigated cross-day effects. The current study is the first to investigate such an effect across hours. The lagged effect of pain on distress appeared to be reduced by appraisal variables, and in some cases with cross-lag appraisals the effect of lag1 pain was accounted for. This finding may be attributable to the analytic strategy rather than any substantive effect. Given that lag2 and lag1 pain were entered together in all analyses, lag1 pain is left to explain residual variance in distress after controlling for the positive effect of same-lag pain. Thus, the interpretation of the negative effect of lag1 pain may be that an increase in pain from lag1 to lag2 (given that lag2 pain is statistically held at an average) is associated with greater distress at lag2.

Psychological Predictors. Distress was likely to be greater when pain self-efficacy was low, and catastrophising, pain expectancy, and perceived interference were high. Coping-strategies preceding measurement of mood (but in the same lag) appeared to have no effect when analysed simultaneously with appraisals. Analyses of the simultaneous effects of key psychological predictors in the previous lag revealed that subsequent distress was likely to be greater if self-efficacy was low, and catastrophising and perceived interference were high in the preceding hours. Consistent with cognitive theories of emotions (eg. Beck, 1967), these findings suggest a causal effect of catastrophising, self-efficacy, and perceived interference on distress. Coping in the previous lag (specifically, passive coping) appeared to have an effect when lag1

appraisals, but not cross-lag change in appraisals, was covaried. A possible interpretation of this is discussed later in this chapter when findings regarding passive-coping are discussed in more depth.

6.5.3.2 Function

Time of day. Function demonstrated a declining rate over the day, with both evening-hours and working-hours associated with reduced function compared to pre-work hours. This may reflect greater engagement in self-care behaviours and less task avoidance in pre-work hours.

First-order autocorrelation. A positive first-order autocorrelative effect was observed – function in lag1 was associated with greater function at lag2. Once again, this suggested that functional status across hours is to some degree stable.

Pain-intensity. Pain intensity at lag1 was related to reduced function at lag2. This reflects Linton's (1985) finding of a negative pain/function relationship in the majority of people who demonstrated a relationship between daily pain and daily engagement in ADLs. However, the effect of pain intensity appeared to be reduced or, in certain analyses, accounted for by coping and/or change-in-coping variables. This suggests that people's capacity to perform functional tasks, or, people's tendency to avoid such duties, may be related to how they cope with the pain rather than the intensity of the pain *per se*. For example, people may be more likely to cope with severe pain via passive coping strategies (eg. Watkins, et al., 1999) that directly interfere with capacity to perform activities. This hypothesis warrants further direct testing.

Psychological Predictors. In cross-lag analyses, prior use of passive coping strategies was associated with impaired functioning. Poor functioning was also associated with

higher prior catastrophising and lower pain expectancies. Possible reasons for this positive effect of pain expectancies are explored below, when the findings for pain expectancy are discussed specifically. However, these appraisals were non-significant when lag2 passive-coping was covaried – only lag1 passive coping appeared to be independently related to next-lag functioning. Thus, the effect of catastrophising and pain expectancy appeared to be attributable to coping strategies used more proximally to the functional tasks.

6.5.3.3 Activity-Level

Time of day. Time-of-day effects suggested that activity-level increased from pre-work-hours to working hours, and then reduced to a medium-level in the evening.

First-order autocorrelation. A positive first-order autocorrelative effect was apparent, with greater activity at lag1 associated with greater activity at lag2.

Pain-intensity. Same-lag pain intensity was associated with increased activity, suggesting that pain may be exacerbated by simultaneous activity. Vendrig and Lousberg (1997), whose study also involved same-lag analyses of within-day pain/activity-level relations, found the same effect in the majority of participants who demonstrated a pain/activity relationship. The opposite effect was found for lag1 pain – like the findings for function, prior pain was associated with decreased subsequent activity. One interpretation of this effect, consistent with fear-avoidance models of pain (Vlaeyen & Linton, 2000) is that people may reduce their activity-level to recover from pain (or, to avoid a further exacerbation). The effect of lag1 and lag2 pain-intensity on activity-levels appeared relatively uninfluenced by cognitive and coping predictors at either lag. Thus, unlike results for function, there appears to be a direct effect of pain experienced in

previous hours on physical activity-level that is not mediated by the psychological variables investigated. Such a pattern of results suggests that whereas pain directly influences activity *per se*, engagement in functional activities in more influenced by coping factors.

Psychological Predictors. Higher activity-levels were associated with high pain self-efficacy and pain expectancies. Use of active-coping in the same time-lag was also associated with greater activity-levels and passive coping strategies with reduced activity. When key predictors were analysed simultaneously in cross-lag analyses, greater activity levels were associated with lower use of passive coping, lower perceptions of life interference, and high pain expectancies in the preceding hours. Again, the unexpected effects of pain expectancy on activity-level are discussed below.

6.5.3.4 Roles of Individual Predictors

Catastrophising. The current study supports work by Grant, et al. (2002) suggesting that catastrophising was positively related to within-person distress, and that the effect is attributable to neither pain-intensity nor coping. An effect of catastrophising was observed for both same-lag and cross-lag distress, controlling for pain-intensity. The cross-lag effect was observed after the influence of cross-lag change was removed, and remained when coping was covaried.

A cross-lag effect of catastrophising was also observed for function, but this effect appeared to be attributable to lag2 coping. Although no within-person studies have investigated the relationship between catastrophising and function, previous cross-sectional studies also failed to demonstrate that catastrophising was related to function beyond the effect of covariates such as pain-intensity and coping strategy usage (Turner,

et al., 2000; Geisser, et al., 1994). Likewise, no effect of catastrophising on activity-level was observed, suggesting that catastrophising may play a key role only in its effect on emotional functioning.

Pain Self-Efficacy. Grant (1998) found a negative effect of pain-coping self-efficacy on night-time anxious and depressed mood, and an unexpected positive effect of general pain self-efficacy on night-time depression. When pain-intensity was controlled the positive effect of general pain self-efficacy vanished but the effect of pain-coping self-efficacy remained (Grant, et al., 2002). Keefe, et al. (1997) also demonstrated that pain-coping self-efficacy was associated with reduced same-day NA and increased PA, and established that these effects were independent of coping and pain intensity. The current study found that pain self-efficacy was related to decreased distress, controlling for pain-intensity and after controlling for coping.

After controlling cross-lag change effects, a cross-lag effect of self-efficacy was also observed for distress. This effect, also, was not related to coping strategy usage. In contrast, Keefe, et al. (1997) found no cross-lag relationship between pain-coping self-efficacy when it was analysed simultaneously with coping and controlling for pain-intensity. However, it is noted that Keefe, et al's (1997) cross-lag analyses were concerned with across-day effects, rather then the across-hours effect observed in the current study.

The relationship between pain self-efficacy and activity-levels appeared to be restricted to momentary processes, thus limiting speculation about causality. It was related to higher concurrent levels of activity, controlling for co-occurring pain levels. Pain self-efficacy demonstrated an unexpected cross-lag effect – associated with reduced next-lag

activity – but the effect vanished once cross-lag change effects were controlled. As such, it would appear that the relationship between pain self-efficacy and lowered subsequent activity-levels may have been attributable to artefactual cross-lag regression-to-the mean effects. That is, if same-lag self-efficacy is linked to higher activity, high prior self-efficacy is likely to appear to be related to reduced subsequent activity-level merely because lag2 self-efficacy is likely to be closer to the mean than lag1 self-efficacy. Pain self-efficacy demonstrated no cross-lag effect with functioning, contrasting with predictions based on Social Learning Theory and a body of cross-sectional research (eg. Strahl, et al., 2000; Strong, et al., 1990) that supports a relationship between pain self-efficacy and functioning. However, this study is the first to investigate the relationship between pain self-efficacy and functioning on a within-person basis. The current findings suggest that factors such as an individual's appraisal of the likelihood of experiencing a pain flare-up, the meaning they assign to the pain, and dysfunctional means of coping with the pain may be more important in determining their selection of and engagement in activities than their appraisal of their ability to cope with the pain. Alternatively, pain self-efficacy may be related to functioning only in closer time-frames (such as it is in same-lag analyses of activity-level). As suggested by Social Learning Theory (Bandura, 1986), it may be related to behavioural engagement and maintenance only on a moment-by-moment basis.

Perceived Interference. The current study is the first to examine the relationship between perceptions of pain-related life-interference and momentary adaptational status. The variable was associated with same-lag and next-lag distress (once cross-lag change effects were removed), suggesting a casual relationship. Such findings support cross-

sectional studies that demonstrate a key role of perceptions of life interference, separate from the effects of pain intensity, in depression amongst people with chronic pain (Catley, 1999; Rudy, et al., 1988; Jacob, et al., 1993; Maxwell, et al., 1998). Furthermore, the effect of perceived interference on distress at both time-lags was independent of the effects of coping.

The chronic pain literature, both cross-sectional and within-person, has neglected the relationship between perceptions of life-interference and physical/social functioning. Perceived interference was a significant same-lag predictor of activity-level, being associated with reduced activity. However, this effect vanished when coping was covaried. The time-frames over which the variables were measured precludes a mediation-type model whereby perceptions of interference lead to inactivity via dysfunctional coping. A more likely model is a “third variable” model whereby prior passive coping (passive, not active, coping was associated with both same- and cross-lag activity levels) contributes to the subsequent perception of life-interference and, separately, disruption of activities.

Perceived interference was related to next-lag activity-levels independently of pain-intensity and coping. Thus, the relationship between perceived interference and activity engagement appears to be a delayed one. This effect may be explainable via a behavioural-habituation framework – a possibility elaborated on in Section 7.3.5.

In contrast with the findings for activity-level, perceived interference appeared to be unrelated to next-lag functioning. Again, a potential interpretation of this finding will be discussed in Section 7.3.5.

Pain Expectancy. In the context of chronic pain, investigations of pain expectancy have been restricted to laboratory-based studies interested in engagement in or avoidance of activities (eg. exercise tasks). This study is the first to investigate "free-flowing" expectancies in the natural environment, and the first to investigate the direct relationship between pain expectancies and emotional functioning.

Pain expectancy was associated with increased same-lag distress, and this effect was due to neither actual pain intensity nor coping. The only available precedent for such a result was Murphy, et al's (1997) finding that during task performance expectations of increased pain were associated with anxiety. In the current study, the relationship with concurrent distress may reflect anxious anticipation of subsequent pain, or it may also reflect more "depressive" emotions relating to feelings of helplessness or hopelessness about the predicted pain experience. It may be interesting to disaggregate the distress measure to investigate the differential effect of pain expectancies on a range of emotional states. No effect, however, was observed in cross-lag analyses after cross-lag change effects were removed, suggesting that the negative effect was probably attributable to regression-to-the-mean at lag2. Thus, the relationship between distress and pain expectancies appeared to be a momentary one, and the causal direction of the effect cannot be clarified. Rather than pain expectancies influencing momentary mood, pain expectancies may be influenced by current mood-states and the cognitive-biases that accompany negative affect (eg. Teasdale & Barnard, 1993).

Pain expectancies were related to improved lag2 function until coping was covaried. A mediation model may account for this finding. For example, expectations that pain will increase may prompt use of coping strategies that reduce (or avoid) subsequent pain –

thereby facilitating improved functioning – or use of coping strategies that are activity-based (eg. stretching, pleasant activities, exercise).

Pain expectancy was associated with increased same-lag and next-lag activity-levels. These effects were independent of both pain-intensity and coping. Perhaps the most obvious interpretation, with the delayed effects of pain expectancies suggesting a causal role, is that expectations of higher pain generate greater involvement in activity. However, this interpretation appears to run counter to previous findings and theoretical expectations. For example, pain-expectancy theory suggests that high expectations of pain should be associated with avoidance of activity and decreased task-performance (Dolce, et al., 1986), and this position has been supported by a number of laboratory studies (eg. Lackner, et al., 1996; Crombez, et al., 1996). On the other hand, Murphy, et al.'s (1997) findings appear to suggest that the effect of pain expectancies on subsequent effort expenditure depends on whether the prediction was an over- or under- estimation of subsequent pain. Namely, they found that over-prediction of pain on a first experimental trial was associated with better performance on subsequent trials. This finding may shed light on the cross-lag findings in the current study. In the current study, pain at both lags was covaried in all analyses involving pain expectancies, and variables were centred at each individual's average score. Therefore, positive coefficients for pain expectancy refer to the effect on the outcome measure of a given pain expectancy when current and subsequent pain are at average levels. Thus, low free-floating pain expectancies are likely to be under-predictions of subsequent (average) pain, and an expectation that pain will decrease relative to current (average) pain. Consistent with Murphy and colleague's findings, such under-predictions were associated with

subsequent behavioural avoidance. This interpretation should be tested in further analyses to explicitly test the impact of relative pain expectancies (ie. relative to actual subsequent pain) on activity-level. Alternatively, an interaction term could be added whereby the hypothesis tested would suggest that subsequent activity-levels will be lowest when both pain expectations are low and subsequent pain is high. Such an analysis may also reveal a lagged interaction effect of pain expectancies on function and distress (namely, under-predictions may be associated with subsequent distress).

The relationship between pain expectancies and same-lag activity may reflect participant's heuristic for predicting future pain. Given the strong belief amongst many chronic pain patients that activity is linked to pain (eg. Linton, 1985), high current activity-levels may serve as a basis for an expectation of high subsequent pain, and this may account for the positive same-lag relationship observed between the two.

The fact that pain-expectancy demonstrates a positive relationship with distress but also with activity-level provides a good example of the potential differential effects that may be observed across indices of adjustment, and justifies the inclusion of multiple outcomes in the current study.

Coping Strategies. The current study is the first to investigate the effect of passive- and active- coping on momentary adaptational status in chronic pain, though three previous studies have demonstrated that coping strategies in general are related to daily mood. Keefe, et al., (1997) found that coping (measured via scales of the Daily Coping Inventory) demonstrated independent effects on both same-day and next-day PA and NA. These effects were not due to pain-intensity or pain coping self-efficacy. Specifically, pain reduction efforts were associated with increased negative affect (NA) and reduced

positive affect (PA) on the same-day, venting of emotions was associated with increased NA, and coping via distraction and seeking emotional support were related to increased PA. Pain-reduction efforts, seeking emotional support, and relaxation were related to improved next-day PA, and seeking spiritual support was associated with increased next-day NA.

Affleck, Urrows, et al. (1992) found that, controlling for average pain and pain trending (but not appraisals), coping was related to an upward trend in mood over monitoring days (specifically, the diversity of strategies used and coping via seeking emotional support). Grant, et al. (2002) found that distraction coping (measured via the CSQ) was related to a decrease in night-time depression and anxiety, ignoring pain was related to decreased night-time depression, and that these effects were independent of pain and appraisals. Grant (1998), who controlled for appraisals but not pain-intensity, also found that praying/hoping was related to increased depression and anxiety but only on days with high average pain.

Passive Coping. Cross-sectional studies have demonstrated that passive coping is associated with poorer emotional functioning (eg. Brown and Nicassio, 1987; Mercado, et al., 2000). However, the current study found that on a within-person basis passive coping was associated with greater distress prior to controlling for appraisal, though not after appraisals were controlled. This may suggest a mediation model whereby passive coping induces negative appraisal processes (such as reinforced perceptions of life interference, and lessened sense of internal locus of pain control), which have a more proximal (or indeed, momentary) impact on mood. This finding reinforces the notion of the primacy of cognition in generating affective states (eg. Lazarus, 1999). However, the

cross-lag analyses revealed a delayed effect of passive-coping that was not attributable to appraisals, which would suggest that such strategies, *per se*, have a delayed detrimental impact on mood. Specifically, use of pain medication on an as-required basis and avoidance of activity were the key passive-coping strategies predicting next-lag distress. Contrasting with this finding, Focht, et al. (2002) did not find a relationship between earlier medication usage and momentary negative affect, though interestingly prior medication usage was related to increased pain reports.

The effect of lag1 passive coping found in the current project may require further investigation. Whilst lag2 appraisals were co-varied in the same-lag analysis, which found no effect for coping, lag1 appraisals were covaried in cross-lag analyses. Thus, the effect of passive coping on next-lag distress may be attributable to appraisal processes occurring concurrently with the distress but not to appraisal processes prior to that. Such a conclusion would appear to be supported by analyses where passive coping and key appraisal predictors were analysed simultaneously, including their respective cross-lag change variables (see Table 6.23). The effect of lag1 passive coping on lag2 distress vanished when it was included in this model, and this would appear to be attributable to the covariation of the cross-lag change-in-appraisal variables.

Passive coping was associated with reduced same-lag and next-lag activity-levels (possibly suggesting a causal role), and with next-lag functioning. These effects were not attributable to appraisal variables or pain-intensity. Specifically, laying-down/resting was associated with impaired lag2 functioning, and use of sedative medications and pain denial (“tell myself it does not hurt”) were associated with reduced lag2 activity-levels. These findings were confirmatory of cross-sectional studies demonstrating a link between

greater use of passive coping and higher levels of disability and impaired social/physical functioning (eg. Brown & Nicassio, 1987; Evers, et al., 2003; Strahl, et al., 2000).

Active Coping. In the majority of cross-sectional studies active-coping has been associated with less emotional dysfunction (eg. Bishop & Warr, 2003; Mercado, et al., 2000) and reduced disability and greater physical/social function (eg. Strahl, et al., 2000; Bishop & Warr, 2003; Brown & Nicassio, 1987). In all analyses of the current study active coping was unrelated to distress. It demonstrated an initial relationship with poor function that, though unpredicted, does have a precedent in the literature (Snow Turek, et al., 1996). However, this effect vanished once cross-lag change effects were covaried, and may have been attributable to cross-lag artefacts. Such a finding leaves open the possibility that active-coping strategies may have more proximal effects on engagement in functional activities, a possibility supported by the additional finding that active-coping had a same-lag effect on activity-level. Active coping in the lag immediately preceding activity ratings was associated with higher levels of activity, as would be predicted by cross-sectional findings (eg. Bishop & Warr, 2003; Snow-Turek, el al., 2000). No cross-lag effect for active coping was observed. Perhaps the most obvious interpretation of the discrepant same-lag and cross-lag analyses of active-coping and activity-level is the difference in time-lags – active-coping strategies may have a "therapeutic window" picked up by the same-lag analyses, but not by the cross-lag analyses. However, it is noted that same-lag and cross-lag models contained a different set of covariates, potentially complicating this interpretation (only the cross-lag model controlled for activity and pain at time one).

To summarise, Study Two revealed that appraisal and coping were related to adaptational status in the everyday lives of people with chronic pain, and that these effects were at least partly independent and unattributable to factors such as time-of-day and momentary pain intensity. Furthermore, there was strong support for the notion that appraisal and coping play a casual role in adaptational status, though in the case of the relationship between coping and emotional distress findings were better interpreted as a delayed effect of coping on distress. At the level of individual predictors, a number of findings supported previous EMA findings and cross-sectional models of adaptation to chronic pain. There were also a number of unexpected findings that may have theoretical implications. These will be discussed in the following chapter.

In the final chapter the findings of Studies One and Two will be reviewed and integrated, and implications will be discussed. Methodological issues will be addressed – including compliance rates, the value of conducting within-person studies of chronic pain, the utility of taking repeated measures within days (as opposed to once-per-day measures), and the value of investigating cross-lag effects. Implications of the current findings for specific theoretical models will be examined next, as will potential future "lines-of-enquiry" for EMA studies of adaptation to chronic pain. Finally, the applied implications of the current studies for clinical practice will be discussed.

7 GENERAL DISCUSSION

7.1 Overview of the Current Research

The current research was conducted with the broad aim of addressing the question of whether appraisal and coping are independently related to the adaptational status of individuals with chronic pain throughout the course of their every-day lives (that is, their momentary adaptational status). The specific hypotheses (reiterated below) were guided by the framework for understanding adaptation to chronic pain provided by Lazarus and Folkman's (1984) Stress and Coping theory.

The current study adopted EMA methodology to investigate within-person momentary adaptation status in a chronic pain sample. However it did not investigate effects across days, but across hours, and was the first study in the area to do so. The current study contributed uniquely to existing literature in a number of additional ways: it adopted PDAs as monitoring instruments, investigated a wider range of psychological predictors, investigated multiple indices of adjustment (incorporating physical as well as psychological functioning), and conducted cross-lag analyses to investigate delayed effects of predictors. The current study addressed the relationship between pain expectancies and distress, and between perceptions of life-interference and functional status. These relationships have been neglected in the chronic pain literature, and the constructs of pain expectancy and perceived interference have not been investigated at all as they relate to within-person momentary adaptational status. The current study sought to redress this problem. Also, physical functioning as an index of adjustment has been overlooked in the within-person chronic pain literature, but was investigated in the

current study. The theoretically important passive- and active- coping dimensions investigated in the current study have also been neglected in the within-person chronic pain literature.

The PAMS was developed and validated in Study One. It was designed for use in EMA studies to measure constructs proposed by a Stress And Coping perspective on adaptation to chronic pain – pain intensity, appraisals (pain self-efficacy, pain expectancy, catastrophising, and perceived interference), coping (passive- and active- coping), and adaptation (measured as distress, function, and activity-level). With this in mind, a minimum set of items were selected, with each item measuring constructs in real-time (ie "What is happening now?") or short latency recall (ie "What happened since the last alarm?"). Scales demonstrated adequate to excellent internal consistency, convergent validity, and, where assessed, predictive validity. The Pain Self-Efficacy scale appeared to reflect pain self-efficacy for an internal locus of pain control, as opposed to general pain self-efficacy as measured in such scales as the PSEQ. Conventional cross-sectional analyses involving the PAMS scales revealed that appraisal and coping factors accounted for approximately 22% of the variance in distress, that appraisals were uniquely associated with distress, and that catastrophising was a key appraisal factor associated with distress. These findings were confirmed by similar analyses involving standard questionnaires, although a greater amount of variance was accounted for in the PAMS Distress outcome, and conflicting findings regarding the role of coping and pain in distress were observed. Namely, coping was uniquely associated with distress in the PAMS analyses but not the Multidimensional Pain Inventory (MPI) analyses. These differences may have been attributable to the inclusion of a measure of passive coping in

the PAMS whilst the construct was inadequately assessed by the standard questionnaires. Analyses of PAMS Function suggested that appraisals were uniquely associated with functioning, but coping was not. Pain-intensity was also related to a significant proportion of variance in functioning when entered in the first step of a hierarchical analysis, however this effect appeared to be attributable to appraisal factors. Similar analyses of the Disability Questionnaire (DQ) supported these findings, however a greater proportion of variance was explained in the DQ, and pain-intensity and psychological factors appeared to play a larger role in predicting function when measured by the DQ. In addition, the analyses disagreed on the proportion of variance in functional disability that was uniquely attributable to appraisals, and on the specific predictors associated with functional disability. The outcome of the PAMS analyses suggested that appraisals played a lesser role in influencing functioning, and it was passive-coping that was chiefly associated with disability. The outcome of the DQ analyses, on the other hand, suggested that two appraisal factors – perceived interference and pain self-efficacy – were the key predictors. These differences in interpretation may also have been due to inadequate assessment of passive coping in the DQ analyses.

In Study Two, three dimensions of adaptation were assessed – psychological distress, functioning (a composite reflecting involvement in a range of activities of daily living), and activity-level. This range of outcomes was investigated in acknowledgement of the importance of selecting multiple indicators of adjustment (eg. Weber, 1997). Presumably, factors influencing adjustment may have differential effects depending on the outcome being assessed. For example, Jensen and Karoly (1991) identified different roles for coping and control appraisals for activity-level and distress.

Same-lag analyses were conducted with distress and activity-level as outcome variables. A same-lag analysis was not conducted for function because that factor was measured in a short-latency recall fashion (the predictors, many of which were measured on a momentary basis, should be considered to have occurred after the time-point the functional behaviours presumably occurred, thereby complicating the interpretation of same-lag analyses). However, the causal relationships between factors measured at the same time-point cannot be established using the current methods. Within limits (for example, the effect of unmeasured third-variables), cross-lag analyses can be used to more adequately investigate causal relationships (Bateman & Strasser, 1984). Cross-lag analyses were used in Study Two in an attempt to untangle the possible direction of the relationship between appraisals, coping and adjustment. In these analyses, variables at lag1 were used to predict outcome variables at lag2, controlling for the outcome variable at lag1. In certain analyses the effect of change in key predictors from lag1 to lag2 was also covaried in order to isolate the unique effect of the predictor at lag1.

This chapter will first address methodological issues relevant to the current research, including shortcomings of the current study, implications for future use of this methodology arising from the findings of the current study, and suggestions for future research design. Secondly, the findings of the current study will be discussed in terms of implications for theoretical models of adjustment to chronic pain. Recommendations for future research into intra-individual models of adjustment to pain will also be presented. Finally, implications of the current research for applied settings will be discussed, including applications of PAMS for daily-diary monitoring with chronic pain patients.

7.2 Methodological Implications

7.2.1 Compliance Issues

Even without considering voluntary midnight diary entries, compliance was relatively low in the current study in comparison with other EMA studies with chronic pain samples (eg. Stone, et al., 2002; Peters, et al., 2000). The large majority of missing entries was due to timing-out of the alarm, rather than deliberate dismissal of entries.

Aside from reduced data-pools, the key problem with low compliance is the potential context-relatedness of non-compliance (Csikszentmihalyi & Larson, 1987). That is, if missing entries are non-randomly distributed relative to other measured variables or, even worse, important but unmeasured variables, this may introduce bias in study findings. In the current case, data may be non-representative if people missed entries whilst in high degrees of pain, emotional distress, or whilst involved in certain functional activities or coping behaviours. There is no way to determine the context-relatedness of missed entries in the current study, or of determining the likelihood of biases resulting from systematic non-compliance. However, it was established that compliance was not related to day of the week or time of day (except for lower compliance with voluntary midnight alarms). There were fewer completed entries after the seventh day of monitoring, demonstrating that participants were generally willing to comply with the duration of the project. Though there appeared to be fewer entries on the first day of monitoring, this was likely to be due to certain participants voluntarily beginning monitoring part-way through the day prior to their formal commencement.

Compliance rates appeared to be related to certain participant characteristics. Older participants were less likely to respond to alarms. Participants in some form of work

demonstrated greater compliance and those in greater pain and with greater disability were less likely to miss alarms, suggesting that compliance may be greater amongst those who are less mobile during the day.

One conclusion, drawn from participant feedback, was that the alarms on the PDAs may have been too quiet. Thus, a natural recommendation for future research is to ensure that monitoring devices have sufficient volume to signal participants within the home environment.

A second factor that may have influenced compliance was the current study's lack of a monetary incentive. Whilst most EMA studies with chronic pain populations provide some form of monetary incentive, the current study did not. A monetary reward for participants may be a further recommendation for future research in this area.

7.2.2 Value of a Within-Person Approach

Whilst EMA has advantages over cross-sectional approaches, the methodology nonetheless has a number of potential problems. Reactivity is an example of one such potential problem. A participant's responses to diary entries may systematically increase or decrease (or, "drift") over the course of monitoring or may demonstrate progressive changes in variability. It is considered that a reactivity effect has occurred if such systematic changes can be attributed to the process of monitoring itself. Few studies have reported clear reactivity effects for pain ratings (eg. Peters, et al., 2000; cf. Stone, et al., 2003), and no such effect was observed in the current study.

The current study found that over monitoring days ratings on the activity-level variable tended to drift upwards and become more similar. Distress ratings, also, became less variable over monitoring days. Though such reactivity effects do not appear to be

common, they have nevertheless been reported (eg. Csikszentmihalyi & Larson, 1987). One possibility is that these changes reflect actual changes in participants' states resulting from monitoring. For example, activity may have been disrupted early in monitoring and, as subjects became familiar with procedures, their activity returned to usual levels. Alternatively, the reactivity effects may reflect artefacts of the measurement process. Namely, artificial drifts in and reduced variability of ratings may result from boredom or fatigue arising from involvement in the project.

A tendency for participants to progressively provide more similar ratings (thereby resulting in a reduction in the variability of ratings) may occur in response to increased introspective-awareness during the self-monitoring process. Such a tendency may manifest itself as participants familiarise themselves with self-monitoring. That is, they may begin monitoring assuming large variability in their subjective experience, but after the intensive introspective process of self-monitoring may become aware of the "sameness" of their experience. Alternatively, in the course of encountering more extreme states as the monitoring week progresses participants may direct their usual ratings more towards the midline to accommodate the more diverse experiences. An obvious but seemingly wasteful approach may be to provide some days self-monitoring rehearsal before collecting monitoring data.

Artefactual measurement drift is likely to be more common in less stable scales, such as those that are poorly anchored. The activity-level scale in the current project is likely to be such a scale – verbal anchors were provided along the graphical-rating scale, but these were not concrete anchors such as "lifting 10kg", or "walking" versus "running". Better anchoring of this scale may reduce measurement-reactive drift.

If reactivity is a demonstrable risk in an EMA study it may pose a risk to the validity of findings. In the current study the effect of systematic drifts in activity-level ratings over the course of monitoring were small – accounting for only 0.22% of total variance in activity-level. Fortunately, predictor variables did not demonstrate a reactivity effect, so it was unlikely that such an effect may have confounded the interpretation of analyses of activity-level. Hence, monitoring-day or entry-number were not controlled in any of the focal analyses.

Despite such methodological concerns, a number of authors recognise the value of within-person studies over cross-sectional studies. Grounds for such recommendations include limitations in recall and judgement accuracy in cross-sectional research (eg. Torgangeau, 2000), enhanced ecological validity of EMA data (eg. Hormuth, 1986), and the inability of cross-sectional approaches to address inherently within-person questions (Tennen & Affleck, 1996). The potential risks to validity of reactivity in EMA studies should be weighed up against the risks to internal validity (such as recall biases) and external validity of using cross-sectional studies to address within-person questions.

The current study confirmed findings of recall and judgement errors when cross-sectional questionnaires are used as summaries of weekly phenomena. A comparison between the average PAMS scales and a recall-based paper-and-pencil version of the same items (the PAMS-R) revealed that whilst each recall-based scale was correlated with its respective momentary scale, the degree of relationship varied amongst the scales. Namely, recall of pain intensity, activity-level, and passive and active coping strategies demonstrated greater discrepancy with momentary ratings. Other authors have reported low to non-significant correlations between recalled and momentary reports of coping (eg. Peters, et

al., 2000; Stone, et al., 1998) and functioning (eg. Lousberg, et al., 1997; Peters, et al., 2000). All continuously-measured scales were over-estimated by the majority of participants (except self-efficacy, which was under-estimated significantly more frequently), with activity-level and self-efficacy seeming particularly prone to mis-estimation. Pain-ratings, also, tended to be over-estimated by 13% on the rating scale.

A large body of cross-sectional research suggests that a range of appraisal and coping factors are associated with differential adaptation between people (see Jensen, Turner, Romano & Karoly, 1991). However, Lazarus (1993) stated that because processes of coping and adaptation vary over time and depend on contexts, within-person designs must be used to investigate these processes. Further, Tennen and Affleck (1996) warn that within- and between- person studies address different questions, and between-person analyses may reveal effects of differing size and direction compared to within-person analyses. Indeed, the current study revealed that sizable proportions (41% to 75%) of variance in pain-intensity, distress, function, and activity-level were within-person.

A comparison between the findings relating to distress and activity-level in Study One and the same-lag analyses of distress and activity-level in Study Two highlights the potentially different results provided by within- and between- person studies.

The between- and within- person analyses differed in the proportions of variance accounted for and the apparent role of specific predictors. In Study One, participants reporting greater pain, catastrophising, and use of passive coping were likely to report greater distress. Pain-intensity and catastrophising also demonstrated an independent effect on distress in the same-lag within-person analyses of Distress in study two. However, passive coping appeared to play no role when controlling for appraisals. In

addition, a number of additional appraisal variables appeared to be related to momentary mood though they demonstrated no effect in the between-person analyses, namely pain self-efficacy, perceived interference, and pain expectancy.

In terms of variance-accounted-for, in between-person analyses pain intensity, entered alone, accounted for 14% of variance in PAMS Distress. The psychological predictors accounted for an additional 22% variance – appraisals were associated with 11% unique variance in Distress, and coping with 4.4% (with the remainder being shared variance). A total of 36% variance in Distress was accounted for. By contrast, first-order within-person analyses (reported in Appendix D, Table D.8) revealed that same-lag pain was associated with 30% of within-person variance. In within-person analyses, the psychological predictors accounted for a further 17.5% within-person variance – appraisals were associated with 12% unique within-person variance and coping with only 1%. A total of 42.7% within-person variance was accounted for.

In analyses of activity-level, differences in interpretation were apparent between the two levels of analysis. Between-subjects analyses revealed that passive coping was the only significant predictor. Passive coping was also strongly related to activity-level in same-lag within-subjects analyses, however pain expectancy was the strongest predictor. Pain self-efficacy and active-coping were also significant predictors. Some differences were also apparent in terms of variance-accounted for, with between-person analyses suggesting a greater role for psychological predictors in general and coping in particular. In between-subjects analyses 10% of variance was accounted for – 1.4% attributable to pain-intensity before other predictors were entered (though this was non-significant), and 9% attributable to psychological predictors. Appraisal was associated with 2% unique

variance, and coping with 4%, though neither amount reached statistical significance. By comparison, same-lag within-person analyses revealed that appraisal and coping were associated with almost 2% and 1.5% within-person variance respectively. A total of 9.2% within-person variance was accounted for, with almost 4% of this attributable to the psychological predictors. In first-order analyses, pain-intensity at lag2 was associated with 2.6% within-person variance in activity-level.

In summary, for both outcomes a wider range of (appraisal) factors appeared to be important in influencing momentary adaptational status than were involved in between-person differences in adaptation. In the case of distress, whereas passive coping appeared to distinguish between people in terms of distress-levels, passive coping appeared to be unrelated to momentary distress levels when appraisals were controlled on a within-person basis.

There were some important consistencies in variance-accounted for between the within-person and between-person analyses of distress and activity-level. For distress and (to a lesser extent) activity-level, more total variance was accounted for on a within-person basis than was accounted for between people, though it is noted that the within-person analysis also accounted for time-of-day effects. Appraisal and coping factors, together, appeared to be less important in same-lag within-person analyses than between-person analyses. Instead, in the distress analyses pain-intensity appeared to play a greater role on a within-person basis than it did between-people. Appraisal accounted for comparable amounts of unique within- and between- person variance, though coping appeared to be less important on a within-person basis than it was between people.

A brief review of the literature appears to support the differences found between proportions of variance-accounted-for in study one and two. In fact, Jensen and Karoly's (1991) cross-sectional study demonstrated very similar proportions of variance accounted for to those found in Study One. Pain intensity accounted for 13% of variance in psychological functioning, and psychological predictors contributed an additional 21%, accounting for a total of 34%. Pain intensity accounted for 6% variance in activity-level, with psychological predictors contributing a further 14% to account for a total of 20%. Turner, et al. (2000) reported that pain intensity accounted for 6% of variance in depression, with catastrophising and coping accounting for an additional 43% – a total of 51%. Pain intensity accounted for 8% variance in disability, with catastrophising and coping contributing a further 34% to account for a total of 42%. Few studies have reported variance accounted for by pain-intensity on a within-day basis. Vendrig and Lousberg (1997) reported that 4.8% of variance in positive mood was accounted for by pain-intensity. They reported an even lower effect of pain on activity-level (0.01% variance). Keefe, et al. (1997) reported smaller within-person effects of psychological variables than the current study. Coping and pain-coping self-efficacy accounted for 3.8% unique within-person variance in same-day negative mood and 6.1% in same-day positive mood after controlling for pain-intensity (negative mood was also controlled in the latter analysis). Grant (1998) reported proportions of variance in mood attributable to coping and appraisal variables that were more comparable to those found in the current study, though it is noted that she did not control the effects of pain-intensity. Grant found that appraisal and coping variables and morning depressed mood accounted for 36% within-person variance in night-time depressed mood, with 13% attributable to the

psychological variables. Twenty-nine percent of within-person variance in night-time anxious mood was accounted for, with 18% within-person variance attributable to morning anxious mood and a further 11% attributable to coping and appraisal.

The above review demonstrates the differences between a within-person and a between-person approach, and lends weight to the importance of within-person approaches. Unfortunately, such comparisons were not the focus of the current study, and analyses were not conducted for the purpose of direct comparison between studies one and two. A more systematic comparison may further reinforce the point, with between- and within-person analyses conducted within the same data-set. Of course, the sample size (that is, the level-2 data-set) of such analyses would have to be sufficient to support these between-person analyses. In the current study it was not.

7.2.3 Value of a Within-Day Approach

The current study demonstrated that, whilst almost all (c.f. Catley, 1999) within-person studies involving Stress-And-Coping models of adjustment to chronic pain have been conducted on an across-day basis (eg. Grant, 1998; Keefe, et al., 1997), the majority of within-person variance occurred within-days. As part of analyses of reactivity, HLM was used to calculate a variance-components model whereby variance in each of the outcome variables was partitioned into between-person, across-day, and within-day components. For all but one measure, at least half of variance was within-person (54% for pain-intensity, 41% for distress, 50% for function, and 75% for activity-level), and in the case of activity-level three-quarters of variance was within-person. Further, in all cases the majority of within-person variance was found to be within-day (72% for pain-intensity, 68% for distress, 76% for function, and 92% for activity-level). Activity-level, in

particular, demonstrated far more variation within-days than between-days or between-people. These findings suggest that large amounts of important information relating to variation in these states is missed when studies make comparisons across days or, even more-so, between people.

The current study identified a number of discrepant findings in comparison with daily studies of adjustment to chronic pain. For example, whereas Keefe, et al. (1997), Affleck, Urrows, et al. (1992) and Grant (1998) reported relationships between same-day coping and mood, the current study found no relationship between mood and coping on an hourly basis (though it is noted that the current study explicitly covaried a number of appraisal variables that were not investigated in previous studies).

The difference between processes that operate over hours and over days might be further explored in subsequent studies by simultaneously investigating effects across three levels of a multi-level model – within-day, across day, and between person (as was done in the current study for analyses of reactivity). Such analyses might reveal that momentary measurement of certain constructs is redundant given the predominant daily effects of those variables. For example, use of passive coping strategies may have no noteworthy independent effect on concurrent mood-states, but may be related to daily mood tone.

7.2.4 Value of Cross-lag Analyses

As well as same-lag analyses, Keefe, et al. (1997) used cross-lag analyses to look for delayed-effects of psychological predictors, thereby supporting the casual role of these variables. Although they investigated different (cross-day) time-lags, theirs is the only other study to use cross-lag analyses to explore appraisal and coping factors in adaptation to chronic pain. Effects observed in same-lag analyses that are mirrored in cross-lag

analyses may suggest a causal relationship. For example, the current study found that appraisals (specifically, self-efficacy, catastrophising, and perceived interference) were associated with same-lag distress, but were also predictive of next-lag distress. Passive coping was also predictive of activity in both same and cross-lag analyses.

Whilst cross-lag analyses might reveal delayed effects of predictors and suggest causal effects, the proportions of variance-accounted-for are likely to be smaller. This was true of the current study. In same-lag analyses appraisals accounted for 12.14% of within-person variance in distress, and 2.25% in activity-level, but in cross-lag analyses the unique effect of previous-lag appraisals accounted for only 2.25% of within-person variance in distress and 1.43% in activity-level. Similarly for coping: 1.02% of the within-person variance in same-lag distress and 7.21% in same-lag activity-level was accounted for, but unique previous-lag effects only accounted for 0.81% and 1.11% respectively. A similar pattern was reported by Keefe, et al. (1997). Whilst they reported accounting for 6.1% of variance in same-day positive mood, they accounted for only 2% of next-day positive mood. In a separate set of analyses, their predictors accounted for 12.2% of same-day pain, but only 1.5% of next-day pain.

Issues of causality appear to have been particularly relevant to the study of pain and activity, where effects in both directions have been observed in previous studies (eg. Linton, 1985; Vendrig & Lousberg 1997). Namely, pain has been associated with increased activity – which might be explained on the basis that activity promotes pain – and with decreased activity – presumably because pain discourages involvement in activity. A negative relationship might also be argued on the basis that certain forms of activity, such as stretching, may lead to pain reduction, and that general activity might,

over time, lead to improvement in pain conditions due to reduced physical deconditioning. Despite the fact that people experiencing pain tend to demonstrate strong beliefs that activity and pain are linked, other analyses have found no such association (Linton, 1985). The current study found that pain was associated with reduced activity in subsequent hours. Thus, cross-lagged analyses in the current study provided support for a directional relationship between pain and activity. Whilst pain and activity-level were positively related in same-lag analyses in the current study, subsequent analyses could clarify the cross-lagged effect of activity on pain, investigating whether previous-lag activity is associated with increased next-lag pain.

Use of cross-lag analyses begs the question of what time-lag is the most appropriate to investigate (Bateman & Strasser, 1984). That is, in what kind of time-frame is the phenomenon of interest supposed to have a delayed effect? For some of the variables examined in the current study, effects may be different or more pronounced over days rather than hours. For example, Feldman, et al. (1999) reported a reciprocal relationship between depression and pain over days. Similarly, effects of activity on pain may occur overnight rather than over hours. Such temporal effects require further investigation. Cross-lag analyses may also be of value for demonstrating different momentary and delayed effects. Keefe, et al. (1997) reported, for example, that pain-coping self-efficacy was the strongest of their predictors of same-day mood but was unrelated to next-day mood. In the current study, pain expectancy appeared to have a momentary effect on mood, but no delayed effect. Similarly, self-efficacy and active coping demonstrated only proximal effects on activity-levels. By comparison, whereas perceived interference appeared to have no immediate relationship with activity-level, higher perceptions of life-

interference tended to impair activity-levels over a period of hours. Further research based on avoidance theory (eg. Asmundson, et al., 1999) may demonstrate that immediate reinforcing effects of passive coping on mood contrast with delayed detrimental effects. Again, such issues could be investigated in three-level multi-level models comparing cross-lag effects across hours to those across days.

7.3 Theoretical Implications

7.3.1 Stress and Coping Theory

The key hypotheses of the current study related to Stress and Coping Theory, and were concerned with whether appraisal and coping were independently associated with momentary adaptational status in chronic pain, and whether the effects of each were independent of pain intensity. Jensen and Karoly (1991) noted that "few researchers have dealt with the potential confounding effects of pain intensity" and identified that "perceived pain intensity may well act as a powerful 'third variable' that influences both coping efforts and adjustment" (p431). Their cross-sectional investigation of coping and pain-coping self-efficacy dealt with this issue by covarying pain-intensity, and that approach was taken in the current project. Turner, et al. (2000) noted that the relationship of appraisals (in their case, catastrophising) and coping to adjustment were usually investigated separately. They state that psychological factors "may interact reciprocally and dynamically over time… yet it is important to examine whether [they] independently predict patient adjustment" (p 116), and thus need to be investigated within the same analyses. Beyond the theoretical importance of such research, Turner and colleagues stated that it may have important applications for developing and targeting psychological treatments for chronic pain. Like Turner and colleagues' cross-sectional study, the

current study covaried the effects of coping to identify the unique effect of appraisals, and covaried appraisals to identify unique effects of coping. These key hypotheses would appear to be supported theoretically according to Stress and Coping Theory, which holds that appraisal and coping have interacting yet independent effects on adjustment, and it is these factors rather than the stressor that influence adjustment (Lazarus and Folkman, 1984).

The cross-sectional literature has demonstrated mixed support for the above hypotheses. In general, support has been found for an independent effect of coping (Turner, et al., 2000; Geisser, et al., 1994) and appraisal (Jensen & Karoly, 1991) on indices of physical functioning and for independent effects of appraisal on distress, but less support has been demonstrated for an independent effect of coping on distress (Geisser, et al., 1994; Turner, et al., 2000). The cross-sectional analyses conducted in Study One of the current research supported the independent effect of appraisal on distress and functioning, but in contrast with previous findings an independent effect of coping was found for distress but not functioning. These differential findings may relate to discrepancies in the coping variables investigated (namely, more adequate assessment of passive coping in the current study). This possibility appears to be supported by analyses of MPI Affective Distress in Study One. These analyses were more consistent with prior findings – the CSQ scales failed to demonstrate an independent effect of coping on distress.

Little work has been done to address these issues on a within-person basis. A number of authors have established that the intra-individual effects of appraisal and coping are independent of pain-intensity (eg. Grant, et al., 2002; Keefe, et al., 1997, Affleck, Urrows, et al., 1992). In terms of the independence of appraisal and coping, independent

effects of appraisal on same-day mood have been reported (Keefe, et al., 1997), though somewhat more support has been found for independent effects of coping on mood (Keefe, et al., 1997, Grant, 1998). Keefe, et al. (1997) also reported that coping, but not appraisal, had a carry-over effect on next-day mood. No studies have investigated within-day effects of appraisal and coping on function-related outcomes.

In Study Two of the current research, appraisal demonstrated a relationship with emotional functioning that was not attributable to pain intensity or coping. A delayed effect of appraisal on distress was also observed, suggesting that the effect of appraisals may be causal. The short-term effect of coping on emotional functioning appeared to be attributable to the effect of proximal appraisals on distress, and although coping (specifically, passive coping) demonstrated a delayed effect on distress, there was some suggestion that this effect, too, was attributable to appraisals occurring concurrently with the experience of distress. This possibility requires further testing.

Physical functioning (measured both as functioning and activity-level) was associated – to some extent independently – with both appraisal and coping. The effects of appraisal and coping were not attributable to pain intensity, and delayed effects of both suggested that their effects were causal. The current study was the first to establish such a finding.

The current research demonstrated that both appraisal and coping are important elements for understanding adjustment to chronic pain. They appear to have effects on adjustment that are separate from the effects of pain intensity, and delayed effects of each suggest that their effects may be causal. Additionally, they appear to have separate effects, although this depends on the outcome being evaluated. Appraisal and coping had independent effects only when investigating indices of physical functioning, however

mood appeared to be predominantly responsive to appraisal processes. This finding is consistent with Stress and Coping Theory – Lazarus (1991) stated that cognition is "both a necessary and sufficient condition [for emotion]. *Sufficient* means that thoughts are capable of producing emotions; *necessary* means that emotions cannot occur without some kind of thought" (p353).

7.3.2 Self-Efficacy and Models of Control Appraisals

The importance of a person's perceptions of control over pain has been highlighted by a number of models linking pain and depression – including Locus of Control theory (Calhoun, et al., 1974) and Seligman's (1972) theory of Learned Helplessness. Also, a person's perception that they are capable of controlling or coping with pain – referred to as pain self-efficacy – is a crucial factor in models of pain based on Social Learning Theory. Pain self-efficacy is purportedly related directly to an individual's engagement in and maintenance of functional activities and coping behaviours (Jensen, Turner, Romano, & Karoly, 1991). Thus pain self-efficacy may be linked to emotional distress indirectly, via coping.

A number of cross-sectional studies have supported direct links between pain-control constructs (eg. Crisson & Keefe, 1988; Strahl, et al., 2000) and distress. However, cross-sectional research has also suggested that those who are more self-efficacious when it comes to their pain are likely to be less distressed only because of their use of coping strategies (Jensen & Karoly, 1991), thus supporting a Social Learning Theory interpretation. An established link between self-efficacy and behavioural outcomes, such as activity-level and reduced functional disability, also supports a Social-Learning perspective (eg. Jensen & Karoly, 1991; Strong, et al., 1990).

In contrast with the above findings, cross-sectional analyses in Study One of the current research found that there was no relationship between self-efficacy and any index of adjustment. A note-worthy difference between this and previous studies is that the current study was the first to investigate the relationship between pain self-efficacy and adjustment whilst controlling for a wide range of other key appraisal and coping factors. On a within-person basis, however, Study Two found that pain self-efficacy was directly related to distress, and it also demonstrated a delayed effect that suggested the effect of pain self-efficacy on distress might be causal. Such a finding supports previous within-person research that has investigated pain-control appraisals (eg. Grant, 1998; Keefe, et al., 1997), and suggests that distress is ameliorated during and after periods of perceived capacity to cope with or control pain without relying on external sources. Such findings support Locus of Control theory and a Learned Helplessness perspective.

The current study was the first to also investigate the within-person relationship between pain self-efficacy and functioning. On an intra-individual basis, activity-levels were higher during periods of high pain self-efficacy – thus supporting Social Learning Theory. However, pain self-efficacy demonstrated no delayed effect on activity-level or functioning, thus there was no evidence to support a causal effect of pain self-efficacy on physical functioning.

In summary, whilst none of the within-person effects of pain self-efficacy on adjustment translated into between-person effects in the current study, support was found for an effect of pain self-efficacy appraisals on momentary mood. Less support was found for the intra-individual effect of this construct on physical functioning. Thus, whilst Locus of

Control and Learned Helplessness theories were supported, less support was found for a Social Learning Theory perspective.

7.3.3 Catastrophising and Cognitive Theories of Emotional Disorders

According to cognitive theories of emotional disorders (eg, Beck, 1967), dysfunctional thinking is directly responsible for the onset of negative emotional states. This view is also consistent with Stress and Coping Theory in that Lazarus (2000; 1991) supports the necessity for cognition in the generation of emotion. In the context of chronic pain, the key cognitive construct representing dysfunctional thinking has been pain catastrophising. For example, fear-avoidance models suggest catastrophising, via pain-related fear and the resulting behavioural avoidance, contribute to both depression and disability (Vlaeyen & Linton, 2000). Cross-sectional studies (eg Robinson, Henson, & Geisser, 1994; Turner, et al., 2000) support the model – people who demonstrate high levels of catastrophic thinking tend to be more distressed than others, even after controlling for factors such as pain intensity and coping. The role of catastrophising in same-day emotional states has also been demonstrated in previous within-person studies of chronic pain (Grant, 1998).

The current study confirmed previous cross-sectional and intra-individual findings, thus supporting cognitive theories of emotional disorders as applied to chronic pain populations. In Study One, distress was greater in those evidencing more catastrophic thinking. In Study Two, distress was greater during moments when catastrophic thinking was apparent, and this style of thinking also demonstrated delayed effects on mood over subsequent hours. The latter finding suggests that catastrophic thinking plays a causal role in its relationship with distress.

Previous cross-sectional research also suggests that “catastrophisers” are more functionally disabled than “non-catastrophisers” (eg. Robinson, et al., 1997), although the link with function has been less supported than the link with distress, and there is some evidence that any link with functioning may be attributable to the use of coping strategies (eg. Geisser, et al., 1994; Turner, et al., 2000). Such an interpretation would be consistent with a fear-avoidance perspective, where avoidance behaviour can be seen as a form of passive coping.

Interestingly, Study One of the current research found no differences in functioning or activity-level between people differing in their tendency to catastrophise, either before coping was covaried or after. In Study Two, the current study also failed to support any link between catastrophising and activity-level on an intra-individual level. Catastrophising demonstrated a delayed effect – it was related to subsequent functioning – though this effect was not apparent when passive coping measured in the same timeframe as functioning was covaried. Although this needs further direct testing, this pattern suggests a mediation model consistent with fear-avoidance models, whereby the effect of catastrophising on function was attributable to subsequent passive coping behaviours.

In summary, the findings of the current study suggest that at an intra-individual level, pain catastrophising is linked to emotional distress, as suggested by Beck (1967), but not directly to activity-engagement or functional disability.

7.3.4 Expectancy Theory

Expectancy theory suggests that behavioural engagement and performance in functional tasks will reduce if individuals expect an increase in pain (Dolce, et al., 1986), a view

also proposed by recent fear-avoidance models where anxious-anticipation of pain is accorded a central role in disability (Asmundson, Norton, & Vlaeyen, 2004). Laboratory studies have confirmed this hypothesis (eg. Lackner, et al., 1996), however match/mismatch effects have also been reported (Murphy, et al., 1997) whereby subsequent performance is suppressed after an under-prediction of the pain involved in a task.

The current study was the first to investigate the effect of free-floating pain expectancies in a naturalistic setting on a within-person basis. Pain expectancies were related to concurrent activity-levels, suggesting that people may formulate their pain expectancies on the basis of their current activity-levels. This would appear to be consistent with Linton's (1985) finding that people strongly believed that pain is linked to activities. Cross-lag findings were consistent with a match/mismatch perspective. When people predicted that their pain in subsequent hours would be low (representing an under-prediction because subsequent pain was statistically controlled and held at an average), both activity-levels and engagement in functional activities were suppressed over subsequent hours. An alternative explanation for this finding is that people may be quite accurate in their predictions: if people judge their pain expectancies on their knowledge of the activities they have to perform over coming hours, a relationship between expectations of high pain and an increase in activity would merely refect the playing-out of what might be referred to as their *activity-expectancies*. Future studies might benefit from controlling for such activity-expectancies to control for this alternative explanation and reveal the true lagged-effect of pain expectancies.

The current study is also the first to investigate the relationship between free-floating pain expectancies and emotional distress. It was revealed that when people expected to experience increased pain they became more emotionally distressed. This was consistent with Murphy, et al.'s (1997) finding that pain expectancies were related to the experience of anxiety.

Interestingly, pain expectancy appeared to play no role in differentiating between people in the cross-sectional studies in Study One of the current research. Such a discrepancy supports the need for within-person studies and, in particular, within-person studies of variables that fluctuate on an intra-individual basis – such as pain expectancy.

In summary, the current study supported prior findings relating to expectancy theories of pain, but highlighted the importance of examining the match or mismatch between expectancies and subsequent experience for understanding the functional consequences of pain expectancies.

7.3.5 Perceived Interference and Behavioural Models of Depression

According to Lewinsohn's (1974) behavioural model of depression, depressed mood is related to a limitation in access to positive reinforcement. On the basis of this model Rudy, et al. (1988) suggested that, given that chronic pain imposes limitations on individuals' involvement in rewarding activities of every-day life, those who perceive greater life-interference resulting from their pain should also demonstrate greater symptoms of depression. A number of cross-sectional studies have supported this hypothesis (Rudy, et al., 1988; Maxwell, et al., 1998; Jacob, et al., 1993).

The current study was the first to investigate the relative effect of this variable when analysed with a wide range of other key predictors of distress. The cross-sectional

analyses presented in Study One failed to support the above findings, showing that relative to these other predictors perceived interference displayed no effect.

The current study is the first to investigate the within-person role of perceived interference. In contrast with the cross-sectional findings, on an intra-individual level perceived interference was the second strongest of the psychological predictors of distress. It also demonstrated a delayed effect, supporting its purported causal effect on distress.

The current study was also the first to investigate the potential role of perceived interference in activity engagement and physical functioning. In Study One it demonstrated no effect in differentiating between people on the basis of activity-level or functioning. Interestingly, the construct was related to functioning, though this effect appeared to be attributable to the effect of coping behaviours. Within-person analyses revealed that perceived interference had a delayed effect on activity level, such that moments of reduced activity were likely to be preceded by moments of heightened perceptions of life-interference.

A behavioural model may also explain why perceived life interference demonstrated a delayed effect on activity-level. Namely, behavioural engagement may undergo extinction after periods where it is perceived that activity has not been rewarded (as reflected in the perception of interference due to pain). Another way of expressing this is that perceptions of life interference may act as a disincentive for subsequent expenditure of effort. If this model is viable, subsequent studies may find an interaction effect whereby maximal lag2 activity-levels are observed when high levels of lag1 activity (ie.

the response) are accompanied by low perceived interference (reflecting absence of punishment, and representing a greater incentive for lag2 effort).

No delayed effect of pain interference on functioning was observed. This seeming inconsistency with the activity-level findings may reflect a differential role of perceived interference on subsequent key (ie. “living-related”) activities than on subsequent general activity. For example, more powerful contingencies (such as task priorities) may operate to influence engagement in key activities, which over-ride the disincentive process described above. That is, whereas a person may come to feel that there is “no point going for a walk in the park”, they may continue to go to work or do house-chores “because I have to”.

In summary, the current study supported a behavioural model of depression and chronic pain, demonstrating that momentary changes in perception of life interference were associated with, and possibly cause, fluctuations in mood state. Furthermore, perceptions of life interference also appeared to influence momentary levels of physical engagement.

7.3.6 Theoretical Models of Coping: Active and Passive Coping

Theoretical models of coping with chronic pain have distinguished between active and passive coping (Brown and Nicassio, 1987; Katz, et al., 1996). Avoidant ways of reacting to pain, incorporated under the umbrella of passive coping, are directly related to disability according to fear-avoidance models of chronic pain. Whilst passive coping has been strongly linked to both emotional dysfunction and functional disability in cross-sectional studies, the findings for active coping have been less consistent (eg. Brown & Nicassio, 1987; Mercado, et al., 2000; Strahl, et al., 2000; Snow-Turek, et al., 1996). It has been linked to improved emotional and physical functioning, though it has also been

associated with a greater frequency of null results (eg. Evers, et al., 2003) and even with negative outcomes (Snow Turek, et al., 1996). The current study found no between-persons effect for active coping on any measure of adaptation. However, an effect for passive coping was apparent – those who reported greater use of passive coping were more distressed, less active, and more functionally disabled.

Whilst a number of within-person studies have demonstrated that various coping strategies (usually measured by the CSQ) are related to same day (Keefe, et al., 1997; Grant, et al., 2002) and next day (Keefe, et al., 1997) distress, the current study was the first to investigate the within-person effects of active and passive coping, and the first to investigate physical functioning outcomes.

In Study Two of the current research, active-coping appeared to play no role except for a short-term effect on activity level. This effect may have been attributable to the activity involved in the strategies themselves (such as distracting activities, exercises, or stretching). As mentioned, this effect did not translate into a between-person effect whereby those who demonstrated more active coping were more physically active in general.

The apparent absence of findings for active coping in the current study seems surprising, given the amount of research attention dedicated to active coping strategies (Katz, et al., 1996; Jensen, Turner, Romano, & Karoly, 1991). A number of issues that may have implications for these findings should be noted. Firstly, as stated by Rosenstiel and Keefe (1983) and Robinson, et al. (1997), participants' understanding of reported coping behaviours may not be consistent with the definition of such strategies as understood by the researcher, implied in the questionnaire, or taught in coping-skills training. Further,

people's application of such strategies may vary widely in terms of technique, persistence, ability, and skill. That is, skilled application of relaxation techniques may be more efficacious than application of a "naïve" relaxation technique (eg. closing one's eyes), or an appropriate relaxation technique that is practiced at an inadequate frequency or applied for an inadequate duration (eg. Hoodin, Brines, Lake, Wilson, & Saper, 2000). Similarly, cognitive-coping techniques may be more effective for those with high capacity for dissociation, opportunity to absorb themselves in the technique (eg. Marino, Gwynn & Spanos, 1989; Devine & Spanos, 1990), or imagery ability (Leichter, 1988; Kwekkeboom, 2000). Such factors are not assessed by coping scales, and were not evaluated in the current study. The apparent effectiveness of coping may differ if active-coping strategies are defined in a consistent manner, the application of the technique is assessed, and if participant's skill-level and ability is gauged where relevant (eg. for relaxation, mindfulness, and imagery).

Passive coping evidenced a short term relationship with activity-level, and delayed effects on both activity-level and functioning – suggesting a casual relationship with these indices of physical and social functioning. A subset of passive coping strategies appeared to be linked to subsequent (next lag) physical functioning: use of sedatives was linked with reduced subsequent activity-level, as was denial of the pain ("I tell myself it doesn't hurt"), whereas laying down and resting was related to task avoidance and impaired functioning.

Passive coping did not evidence a short-term effect on distress that was separable from the more powerful effect of appraisals. A delayed effect of passive coping was apparent, though this too may have been better explained by appraisals occurring more proximally

to the distress. These findings suggest a mediation effect whereby passive coping influences appraisal processes, which subsequently influence distress. Such a model should be tested explicitly. Two passive coping strategies appeared to play some role in subsequent distress: taking *as required* medication, and avoiding activity. The first strategy may induce distress in subsequent hours via detracting from internal pain-control self-efficacy, whereas the second of these strategies may contribute to distress by fuelling a sense of life-interference.

In summary, the current study strongly supported the effect of passive coping on physical and social functioning, but was less clear about its effects on emotional functioning. No apparent benefits of active coping were observed apart from some effect on physical activation. The current study appeared to support Keefe, et al.'s (1987) position that positive adjustment to chronic pain is more dependent on avoiding passive coping than engaging in active-coping.

7.3.7 Future Research Directions

The current study investigated a sample of appraisal and coping factors suggested by both theoretical models and prior empirical findings. Expectations about the specific effect of these predictors were relatively straight-forward, with certain variables expected to be detrimental and other expected to be adaptive on the basis of theory and previous findings. These variables were investigated in order to test more general hypotheses regarding the independent relationship between appraisal, coping, and adjustment. Further research is needed regarding the effect and mode of action of these predictors on momentary adaptational status. In such research, appraisal and coping variables should be selected on the basis of a theoretical rationale, though exploratory studies such as this one

may guide this process. Furthermore, the proposed relationship of appraisal and coping variables to various outcomes, and their supposed mechanism of action, ought to be tested on a case-by-case basis based on appraisal-specific theoretical models. For example, specific models of catastrophising suggest that it may influence adaptation and pain perception via attentional mechanisms (eg. van Damme, et al., 2004). Models of pain expectancy might investigate the "match/mismatch" effect of over- or under-predictions of pain suggested by the current study. A model of pain expectancy based on avoidance theory might suggest that high pain expectancies will contribute to reduced functioning only when accompanied by a belief that activity leads to exacerbated pain.

7.3.7.1 Models of Coping

A number of models may be employed to understand the relationship between coping and adjustment, and testing such models explicitly may reveal effects that were not observed in the current study.

A direct-effects model was assumed in the current project – certain coping strategies are likely to have direct implications for adaptational outcomes (see Example A in Figure 7.1). Examples of this might include positive engagement in activities, the immediate effects of alcohol consumption on mood, social-support seeking leading to reduced distress, and activity avoidance, social solicitation, and use of sedatives and opioids reducing engagement in activities of daily living. However, different effects of coping may be revealed by testing alternate, more complex, models of coping. Such models include those in which the effect of coping is moderated by appraisal, mediated by appraisal, mediated by pain, or moderated by pain (see Figure 7.1).

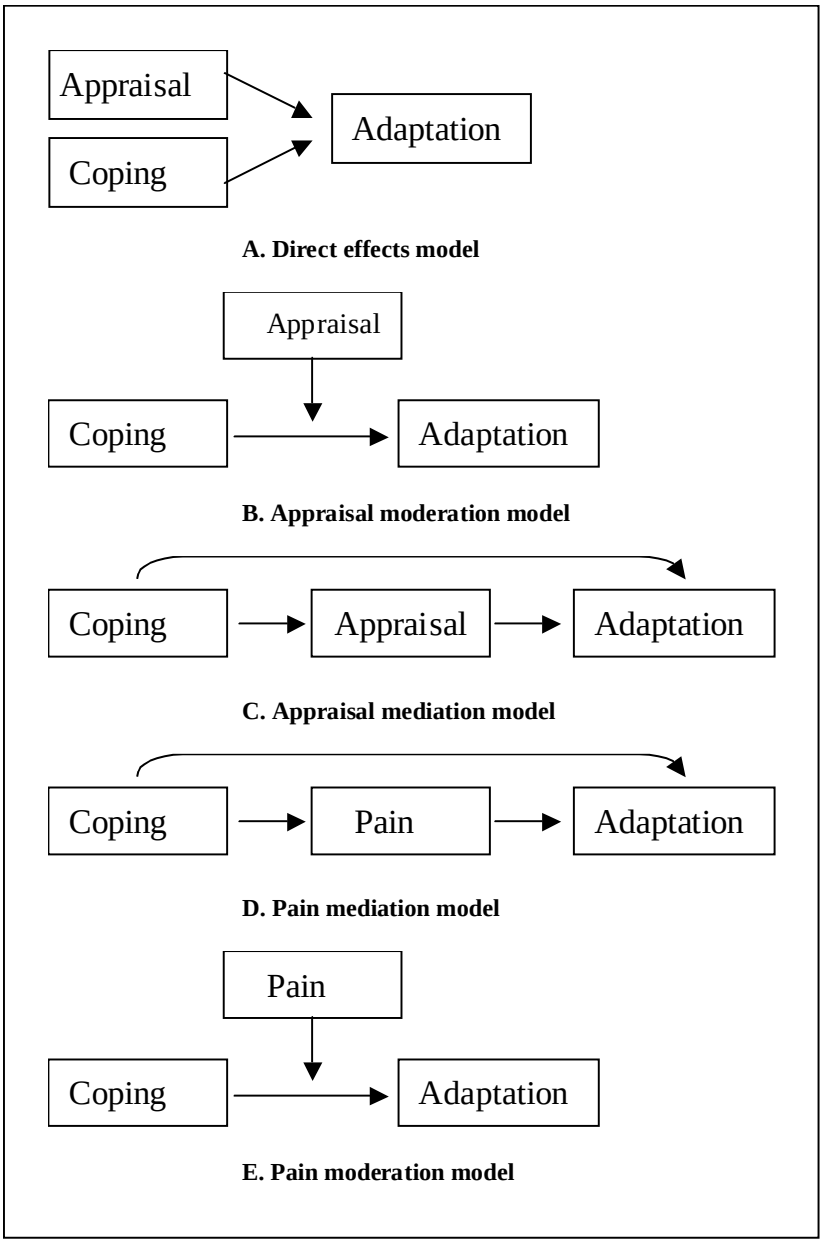


Figure 7.1 Alternate Models of Coping with Chronic Pain

An example of an appraisal moderation model (Example B in Figure 7.1) might suggest that active coping is more effective when approached with a high sense of self-efficacy or an expectancy of success (eg. Marino, et al., 1989). Similarly, detrimental effects of passive coping may be reduced when such activities are engaged in with a sense of control. For example, an individual might consume medication out of a sense of

desperation and with an external locus of pain control. Such a coping behaviour might reinforce a low sense of personal control, and contribute to reduced mood. Alternatively, an individual might approach medication usage in a self-regulated manner and with a high sense of personal control, having carefully chosen to commence medication use. For such an individual, coping via use of medication may not be associated with a degraded sense of personal control, and hence there may be no medication/distress relationship. Indeed, passive-coping strategies such as activity avoidance and use of pain-medications involve behaviours over which individuals have a high degree of perceived control. Thus, it is likely that such strategies may be often associated with a high sense of personal control over pain. Indeed, Linton (1985) illustrated that people with chronic pain strongly endorse the belief that activity and pain are related – that certain activities will promote pain and certain activities will reduce it. By contrast, cognitive-coping, whilst seen as an adaptive strategy because it *approaches* the pain problem rather than *avoiding* it, may be engaged in with a lower sense of pain-control. Thus, coping strategies should be investigated independently of constructs such as pain self-efficacy and outcome expectancy, contrasting with established definitions of coping (eg. Snow Turek, et al., 1996) whereby passive coping is associated *a priori* with low personal control and active coping with high personal control.

A model in which the effect of coping on adaptation is mediated by appraisal would suggest that coping strategies contribute to reappraisals, and reappraisals subsequently influence momentary adaptational status (Example C in Figure 7.1). For example, the mechanism of many active coping techniques may be via changes in pain-coping self-efficacy or outcome expectancy (Rokicki, Holroyd, France, Lipchik, France & Kvaal,

1997; Kongstvedt, 1987). As another example, passive-coping may have a detrimental effect on internal-locus of pain-control, and this cognitive change may have a more proximal impact on adaptational states. The current findings for lag1 passive coping appear to suggest such a model, and this deserves to be tested directly.

As well as direct effects on the adaptational outcome itself and potential effects involving appraisal, coping may have indirect effects on adaptation via pain – as suggested by a mediation model of pain and coping (Example D in Figure 7.1). Examples of possible direct effects of coping on pain include the pharmacological impact of medication use, mechanical effects of activity avoidance, and attentional effects of cognitive techniques. According to a pain-mediation model, changes to the pain experience itself then purportedly impacts on distress and function.

A number of cross-sectional studies (eg. Jensen & Karoly, 1991) and one EMA study (Grant, 1998), have supported models whereby pain-intensity moderates the impact of coping on distress (Example F in Figure 7.1). Grant (1998) found that on high-pain days coping via ignoring sensations was more strongly associated with improved night-time depressed mood, and praying/hoping was associated with worsened night-time depressed and anxious mood. On low-pain days, distraction coping had a stronger beneficial effect on night-time anxiety. Thus, it appears that the effect of coping on within-person adaptation depends to some degree on pain intensity. Such analyses in the current study might have revealed differential effects, such as an effect for active coping. Namely, strategies for coping actively with pain may be effective – thereby beneficially impacting on adaptation – only at low-levels of pain.

A further interesting possibility is that active and passive coping may interact. Lazarus (2000) stated that he believed emotion- and problem- focused coping "are interdependent and work together, one supplementing the other in the overall coping process" (p.669). Thus, active coping may, for example, demonstrate a beneficial effect only in the absence of passive strategies, or the detrimental impact of passive strategies may be ameliorated by use of active strategies.

A related issue is potential temporal sequencing of coping strategies. For example, according to the "fallback hypothesis" discussed by Tennen, et al. (2000), emotion-focussed strategies may be more readily adopted if problem-focussed strategies have also been attempted. Thus, lagged effect may be observed whereby passive-coping is more prevalent at lag2 if accompanied by high reported levels of lag1 active-coping. Additional interaction effects may exist whereby this "fallback" only occurs when lag1 active coping "fails", as reflected by a cross-lag increase in pain or distress.

7.3.7.2 Models of Appraisal

Investigating similar models of appraisal might reveal interesting and complex processes. Pain-moderation models (see Figure 7.2, Example B), whereby the impact of appraisals on adaptation depends on pain intensity, have been supported in the cross-sectional literature (eg. Jensen and Karoly, 1991), and investigated but not supported in the within-person literature (eg. Grant, 1998).

A pain-mediation model of appraisal (see Example C in Figure 7.2) would suggest that appraisal influences adaptation (partly or entirely) via direct effects on the pain experience. A model suggesting full mediation of appraisal by pain-intensity, though logically sound, would not be supported on theoretical grounds according to social

learning theory (Bandura, 1977) and cognitive theories of emotion (Beck, 1967). However, partial mediation may be demonstrable. Although no known studies have tested such a model in its entirety, a number of cross-sectional (eg. Sullivan, Bishop, & Pivik, 1995; Robinson, et al., 1997) and within-person (eg. Grant, 1998; Banks, 1998) studies have linked catastrophising to the intensity of experienced pain. The mechanism linking catastrophising to pain experience may be attention modulation (Van Damme, Crombez, & Eccleston, 2002). Keefe, et al. (1997) also demonstrated that pain-coping self-efficacy was associated with both same- and next- day pain intensity.

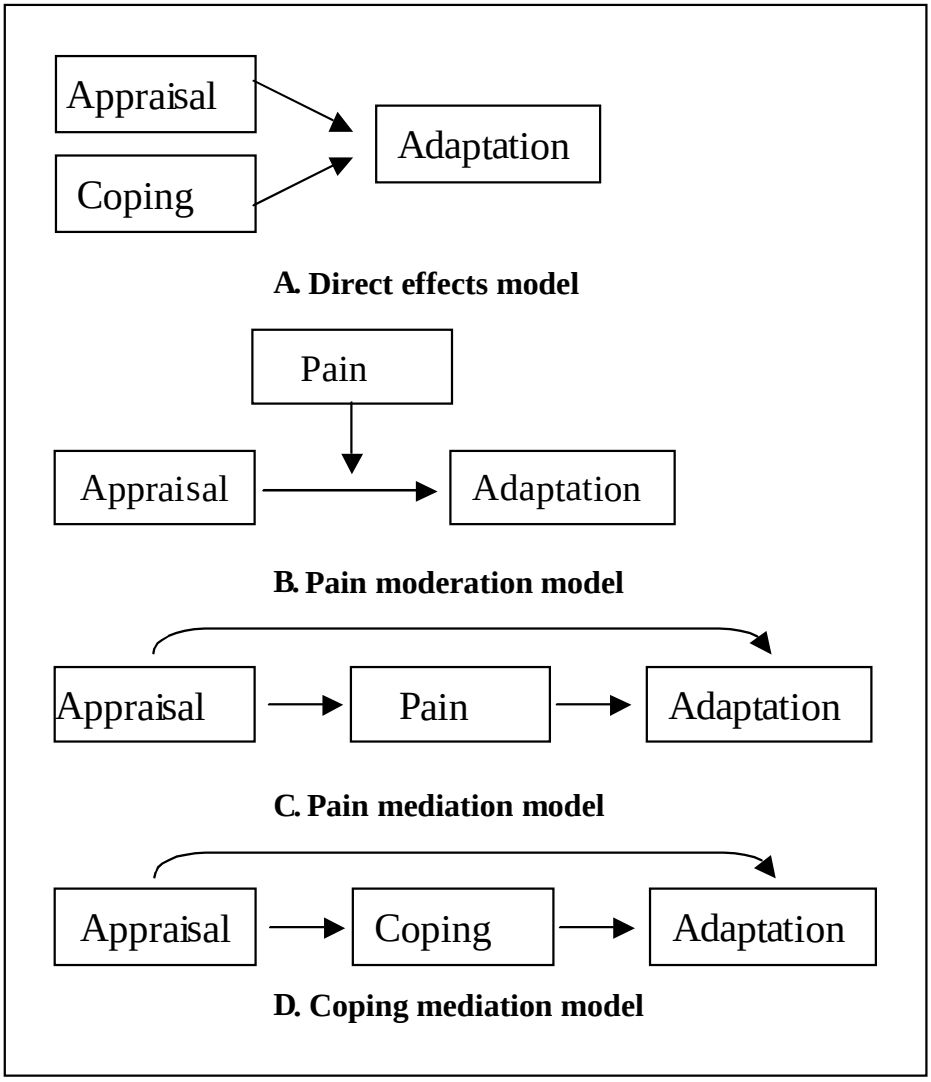


Figure 7.2 Alternate Models of Appraisal and Chronic Pain

Stress and Coping theory (Lazarus and Folkman, 1984) suggests that the impact of appraisals on adjustment may be partially or even fully mediated by coping behaviours (see Example D in Figure 7.2). For example, findings of the current study suggested that the delayed effect of catastrophising and pain expectancy on functioning may be mediated by subsequent passive coping. Social-learning theory (Bandura, 1977) would also support a coping-mediation model as it relates to self-efficacy and outcome expectancies. Jensen and Karoly's (1991) work suggested such a model cross-sectionally – pain-coping self-efficacy appeared to have no relationship with distress once coping strategy usage was controlled. However, no support was found in the current study for a model of pain self-efficacy whereby its effect is mediated by coping.

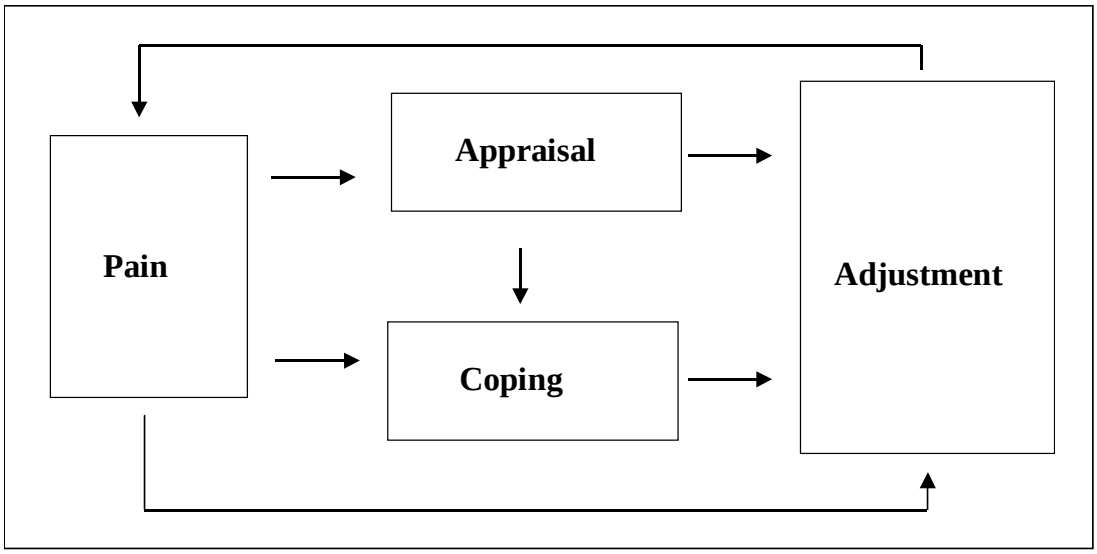


Figure 7.3 An Integrated Model of Momentary Adaptation To Chronic Pain

7.3.7.3 Integrated Stress and Coping Models

By testing both mediation-based and moderation-based models, Catley (1999) investigated interesting and complex models of the interaction between appraisal,

affective, and pain processes, though only her moderation model involved momentary processes. Subsequent within-person studies should be aimed at more directly testing general models of adaptation to pain derived from the perspective of Stress and Coping theory. For example, an integrated model (see Figure 7.3) might suggest that both momentary appraisals and coping strategies mediate the effect of pain-intensity (the stressor) on various indices of adjustment, though pain may maintain a direct effect as well. Further, the impact of appraisals on adjustment may be both direct and mediated by coping. An integrated model might also demonstrate that changes in adaptation outcomes feed back to alter the stressor itself and the appraisal/coping process. Research supporting a link between mood and activity-level and subsequent pain are consistent with such theorising (eg. Feldman, et al., 1999; Focht, et al., 2002).

7.3.8 Integration of Between- and Within- Person Approaches

Given sufficient level-two sample sizes, multi-level modelling applied to EMA data allows the researcher to simultaneously investigate within-person processes and between person differences (Schwartz and Stone, 1998). For example, when level-one predictors are person-centred, the mean of the untransformed variable for that person can be included as a level-two predictor (Snijders & Bosker, 1999). Such a model allows the researcher to compare the separate effect of the predictor on within-person fluctuations in the outcome variable and between-person differences on the outcome variable. In the current context, such an approach may fruitfully address a number of pertinent questions. The most basic questions to address with such an approach involve direct-effects. What is the relationship between momentary appraisals and stable cognitive factors such as beliefs and commitments? Is it necessary to understand momentary fluctuations in

appraisal to understand people's mood, or is it sufficient to know their "average" appraisals, or, beliefs? Such questions may lead to more complex models. For example, in her moderation analysis, Catley (1999) conceptualised her appraisal variables as stable trait-like factors. Her model suggested that momentary pain influences momentary mood, and that general cognitive constructs (namely, beliefs relating to life-control and life-interference) influence the nature of the momentary pain/affect relationship. An alternative model, testable via the methods described above, would suggest that we need to understand more than just general beliefs to understand momentary fluctuations in pain – that momentary changes in appraisal are associated with mood fluctuations even when controlling for average appraisals. Such a model would be supported by Stress and Coping theory (Lazarus and Folkman, 1984).

Another of the many possible questions that could be addressed by a simultaneous cross-level approach concerns a pain-moderation model. Jensen and Karoly's (1991) research supported a pain-moderation model whereby the adaptive effect of pain-coping self-efficacy and certain coping strategies depended on the amount of pain the person usually experienced. Grant (1998) demonstrated the same model, but on a within-day basis. Jensen and Karoly's work suggests that people who report that they usually use a given coping strategy and who experience low levels of pain are likely to be better adjusted, whereas Grant's (1998) findings demonstrate that when a person is having a low pain day and they are using a certain coping strategy, they are likely to experience better night-time mood. Does the effect of coping differ depending on the average level of pain a person tends to experience, or is the moderating effect of pain-intensity on coping a momentary process? Research distinguishing these between- and within- person

interpretations would have non-trivial implications. The first alternative would suggest that certain strategies should be advised for some people but not others, whilst the other suggests that people may benefit from learning which strategies to use at different levels of pain experience.

As well as averaged level-one predictors, other variables relating to the person can be entered at level two to integrate the between- and within- person approaches. Such an approach could be used to address questions of whether there are person-factors that modify the within-person relationship between pain, appraisal, coping, and adaptation. Affleck, Tennen, et al. (1992) have already taken such an approach to investigate the effects of neuroticism on the within-person pain/mood relationship. Besides basic demographic characteristics, other potentially fruitful person-level mediators may involve clinical versus non-clinical status, differences between pain conditions, pain history, and bodily pain locations.

7.3.9 Wider Outcome Assessment

Aside from the current study, the current literature on momentary adaptational status in chronic pain is limited to emotional outcomes. Our understanding of the processes involved in adaptation to pain would benefit from exploration of diverse outcomes, including subsequent pain, function in various roles (family, work, community), and health-care utilisation. In terms of the current project, more in-depth exploration of emotional outcomes may be warranted – the PAMS distress measure could conceivably be broken down into PA and NA components, or separate indices reflecting anxiety, frustration, and depressed mood. Certain predictors may have selective effects on such affective outcomes, as suggested by studies involving PA and NA (eg. Catley, 1999;

Keefe, et al., 1997). For example, pain expectancy may specifically induce anxiety and perceived interference may selectively induce depressed mood. Subsequent research might reveal that certain active-coping strategies might demonstrate an effect on positive or negative affect where no effect was apparent on the PAMS's general measure of distress.

7.3.10 Limitations of the Current Research

Thus far this chapter has overviewed the findings of the current study and discussed methodological and theoretical implications. In the discussion of these implications a number of caveats have been raised, in terms of limitations of the current research. For example, Section 7.2.1 described the relatively low compliance with monitoring obtained from participants in the current study, Section 7.2.2 discussed the problem of reactivity to measurement, and how such a phenomena was apparent in the activity-level and distress measures used in Study Two, and Section 7.2.4 described the need for further exploration of the time-frame of delayed effect in lagged-analyses. Section 2.3 reported a number of hypotheses that were not tested in the current study, and potentially viable models of coping and adaptation to chronic pain that are worthy of further investigation. Section 7.3.9 described the need to assess a wider variety of possible outcomes, including a more diverse array of indices of emotional-functioning.

A number of other limitations, not explicitly raised earlier in this chaper, bear mentioning at this point.

Firstly, it may be argued that the validity of a number of PAMS scales was not suitably established, and that this requires further attention. As anticipated, factor analysis of the

coping scales indicated two dimensions, which respectively reflected passive- and active-types of responses to pain. The resulting scales composed 15 of the 23 original items analysed, but accounted for only 26.6% of total variance. Thus, it is clear that there are important dimensions of coping not captured by the current scales. Thus may account for the relative lack of effect observed for Active Coping in the current project, where strategies such as information-seeking, talking and venting emotions, and problem-solving were not measured. In terms of convergent validity, whilst ratings in EMA studies are not meant to be stable (that is, they are meant to reflect drifts in the participant's experience and internal-states), average scores should nonetheless reflect cross-sectional measurements of the same constructs taken on well-established scales. All scales demonstrated significant relationships with relevant standard scales, though in some cases these correlations were not strong. For example, average of ratings from the PAMS passive- and active coping scales, discussed above, correlated only r=.31 and r=.41 with the CSQ passive- and active- coping scales, respectively. The average of ratings from the PAMS Self-Efficacy scale correlated only r= .34 with another measure of pain self-efficacy, the PSEQ. The activity-level scale also did not correlate well with other questionnaire-based measures of functioning. In each of these cases the convergent validity of scales may have been better supported by the use of alternate, more suitable, convergent scales. Namely, the PAMS Pain Self-Efficacy scale appears to have been a measure of internal locus of pain control and may have benefited from comparison with a scale more reflective of this construct than the PSEQ. Similarly, active and passive coping may have been better assessed using the Vanderbilt scales, and the activity-level

measure may have been more prudently compared to ambulatory measures of activity (such as via accelerometry or a pedometry).

In terms of divergent validity, the PAMS Catastrophising scale demonstrated a lack of specificity in its relationship to standard measures of appraisal-type constructs, in both studies one and two. Specifically, as well as substantial relationships with other catastrophising scales it demonstrated similarly significant relationships with a measure of perceived life-interference in both studies, a measure of pain self-efficacy in study one, and, in study two, measures of perceived life-control and perceived pain control. This is perhaps unsurprising given the presumably important role of catastrophising and the wide birth of the construct (for example, the PCS has three scales reflecting helplessness, rumination, and magnification). In addition, it would be anticipated that many of these constructs, being from the realm of *primary appraisals* of pain, would share a large amount of variance.

The findings of the current study must be evaluated in light of the psychometics short-comings of the scales noted above, particularly the relatively strong findings for catastrophising (which, as a scale, may be too wide in its content coverage), and the weak findings for pain self-efficacy and active coping (which would appear too narrow in their content focus).

Secondly, it might be suggested, given the large level-one sample size of Study Two (n=1363 in the focal analyses), that the current study was over-powered. This would potentially risk liberal findings and interpretations, especially given that an alpha-value of 0.05 was adopted as the criteria for significance in all analyses. This criterion was adopted due to the exploratory nature of the current study, and it is recommended that

further studies of this type, testing specific theoretical models, adopt more stringent control of error-rates. Nonetheless, when considering the findings of the large cross-sectional literature in this field, and the findings of the few within-person studies that have been conducted, it is not considered that the findings of the current study were overly-liberal. Though many effects were quite small the majority were theoretically consistent. In fact, that many predictors that demonstrate strong effects in the literature failed to demonstrate an effect that reached statistical significance in the current study, when analysed concurrently with other important predictors, argues against the notion of these analyses being over-powered. ****

A third potential issue relating to the current research is the heterogeneity of the chronic pain sample investigated. Authors have noted that the psychological correlates of pain are similar across a wide range of conditions and bodily-locations (Philips & Rachman, 1996), and much research into psychological factors is conducted on heterogeneous pain samples (eg. Geisser, et al., 1994; Jensen, Turner, Romano & Lawler, 1994). However, it is also cautioned that effects may differ depending on the typical characteristics of a given condition (Jensen, Turner, Romano & Karoly, 1991; Turk & Okifuji, 2002). For example, some studies suggest that, compared to rheumatoid and osteo- arthritis where active coping is associated with better functioning and passive-coping with worse (Zautra, Burleson, Smith, Blalock, Wallston, & Devellis, 1995), both passive- and active-coping have been associated with impaired functioning amongst those with fibromyalgia syndrome (Nicassio, Schoenfeld-Smith, Radojevic & Schuman, 1995). The current study consisted of a sample of predominantly back-pain, arthritis, and neck and shoulder pain patients. Unfortunately, sample sizes were too small within each of these groups to make

sufficiently powerful between-groups comparisons to test the constancy of the within-person effects observed. Any differences that may exist between diagnostic groups may have reduced the sensitivity of analyses and contributed to null-findings or the observed small effect sizes. Subsequent research would benefit from focussing investigations on a diagnostically homogenous sample or, given sufficient sample sizes, compare within-person effects across diagnostic groups.

Finally, it is worth noting that certain decisions were made in the course of the current study regarding the selection of covariates for the multi-level analyses that may have influenced the findings and could limit the generalisability of conclusions, namely control of autocorrelation and cross-lag effects.

An important issue in repeated-measures multi-level analysis is the control of autocorrelation (West & Hepworth, 1991), and this is commonly performed by covarying the lag-1 value of the lag2 criterion variable (eg. Keefe, et al., 1997; Suls, Wan, & Blanchard, 1994). However, given that lag1 and lag2 outcome variables demonstrated a high degree of relationship (see Table D.8) it is likely that lag1 values may have accounted for much of the effect of other key predictors before the key predictors were entered into the analysis. This may account for the generally low levels of prediction observed for the psychological variables here and in Keefe, et al.'s (1997) study. However, by failing to account for autocorrelation effects studies with cross-lag analysis would be unable to rule out the possible interpretation that previous-lag predictors are associated with lag2 outcomes only by virtue of their same-lag relationship with the outcome. Further studies may be able to approach this problem systematically by

investigating predictors without controlling for autocorrelation prior to adding the covariate to observe any interpretational changes.

In study two, cross-lag change variables were utilised in certain cross-lag analyses to control for potential regression-to-the mean effects on the predictors in lag1. The effect of a predictor at lag2 on a lag2 outcome is likely to be stronger than the effect of the same predictor at lag1. Because it is likely that the predictor at lag1 and the lag1/lag2 change score for that predictor would share a negative relationship (when the lag1 value is high the lag2 value is likely to be lower, and *visa versa*) failing to control for these effects may mean that the observed relationship between the lag1 predictor and outcome would be suppressed. Such controls are important for clarifying the nature of the effect of the lag1 predictor, but may underestimate its effect (Affleck, Tennen, et al., 1994). This issue appears to be of some concern for the proper interpretation of results from repeated-measures multi-level model designs. One solution, which might be borne in mind in studies employing a similar analytic approach, would be to enter the lag1 predictor/s alone when the variance-accounted-for in lag2 outcomes is of key interest, but to covary cross-lag change variables or lag2 values (eg. Affleck, Tennen, et al., 1994) when investigating the nature of the effect of lag1 predictors. With regard to the second option, it must be noted that the meaning of the co-efficient/s of the focal predictor/s are interpreted as the (mean across-person) effect of the predictor on the outcome when other predictors in the analysis are held at zero. Thus, the interpretation of the coefficient of the lag1 predictor will change depending on which type of covariate is included to control cross-lag regression effects. In the case where an untransformed cross-lag change variable is covaried, the coefficient of the focal predictor can be interpreted as the (mean

cross-person) effect when the lag1 and lag2 values are identical (that is, when no change takes place in the predictor across lags). When mean-centred lag2 values are covaried the meaning of the coefficient for the lag1 predictor is translated as the (mean across-person) effect of the predictor on the criterion when the predictor is at its mean level at lag2 (which, on average, will mean that the predictor will have decreased in value across lags for a high lag1 value and increased across lags for a low lag1 value). It seems that further discussion and clarification of these issues is called for in the within-person literature.

7.4 Applied Implications

Whereas cross-sectional studies suggest that people who differ in terms of certain cognitive or coping variables differ along dimensions of adaptation, they can not demonstrate that such factors, as they change within people, are associated with changes in adaptational status. Within-person studies conducted over days, though they demonstrate that changes in psychological mechanisms are associated with changes within the person, do not reveal the momentary relationship between those processes. Momentary within-person studies, such as the current study, are able to demonstrate such micro-level relationships.

Micro-level findings reveal factors that, if modified in real-time, may produce associated changes in the momentary experience and behaviour of the individual. Such findings can be used to suggest strategies aimed at modifying these psychological processes as they occur.

In terms of momentary mood, the current study demonstrated that self-efficacious thoughts relating to one’s internal ability to cope with pain are directly related to positive

changes in mood. On the other hand, catastrophic thoughts about the meaning and consequences of pain, and thoughts about the negative impact of pain on one's life were directly related to negative shifts in mood. Expecting that pain would become worse in subsequent hours appeared to be related to negative shifts in mood, though the causal direction of this effect was not as clear. The current study suggested that coping behaviours play a lesser role than proximal thoughts in emotional responses to pain. However, there was some suggestion that engaging in passive coping strategies, such as taking pain medications on an *as required* basis, and avoiding activity, were associated with negative shifts in mood soon afterwards. This effect may be because such behaviours have a detrimental effect on the momentary thought-processes described above.

The current study suggested that both appraisals and coping responses need to be managed to improve physical functioning and involvement in physical activity. Disability in the daily lives of participants appeared to be predominantly (and, potentially, causally) related to recent use of passive coping strategies, including use of sedative medications, denial of the pain, and the tendency to cope via laying down and resting.

Active coping appeared to have no effect on distress and little influence on functioning and activity except for a short-term relationship with increased activity. This was unexpected considering the large body of research literature concerned with active coping (Jensen, Turner, Romano, & Karoly, 1991; Katz, et al., 1996) and the focus on active skills in coping skills training for pain management (eg. Philips & Rachman, 1996; Turk, Meichenbaum, Genest, 1983). However, it is acknowledged that the impact of active coping-strategies on pain intensity itself was not examined, and this may be where these

strategies are most effective (eg. Brown & Nicassio, 1987). Furthermore, the exact behaviours engaged in by participants when they report active coping was not assessed in the current study. Reports of coping were taken at "face value", and this may complicate interpretation along the lines argued by Robinson, et al. (1997). That is, if the current study was able to control the nature and quality of participants' application of active coping a different pattern of results may have emerged. Subsequent research should aim to address such shortcomings.

Moments characterised by expectations of increased pain were associated with increased activity and reduced disability over subsequent hours. This was likely to be because when people over-predict the pain resulting from their daily activities they "rebound" with a surge in activity. The resulting increase in involvement in functional activities may be because after such a "rebound" the individual is less inclined to use passive coping strategies to cope with their pain. This possibility requires further investigation.

Moments during which the individual believed they were internally capable of coping with pain were characterised by increased activity, though the causal direction of this effect was not suggested.

When people perceived that the pain was interfering with their life they appeared to become less active over subsequent hours. This may have been because of hopelessness associated with the process of behavioural extinction – when people perceive that their efforts are not rewarded they subsequently invest less energy.

Finally, moments of catastrophic thinking about the pain were associated with greater functional disability over subsequent hours. This effect may occur because

catastrophising prompts individuals to cope passively with their pain, such as by laying down and resting.

The findings of the current study support training in and practice of cognitive and behavioural skills for pain management. If individuals are proficient at recognising and modifying appraisals they may be more likely to act on detrimental thought processes in real-time. Similarly, individuals who have incorporated active strategies for managing pain into their daily routine and who avoid passive coping habits are likely to demonstrate better momentary adaptational status. Individuals skilled in self-management strategies for their pain may display lower average levels of daily distress and disability, but may also demonstrate fewer acute moments of adverse momentary adaptational experience. Such predictions are open to empirical examination, and momentary EMA studies appear well-suited to address them.

Predominant findings from the coping analyses in the current study support Keefe, et al.'s (1987) suggestion that successful management of psychosocial adjustment to chronic pain is less about what active strategies one uses and more about what unhelpful strategies one avoids. In line with this, the current study found that use of pain medications on a regulated basis, avoiding use of sedative medications, and use of pacing strategies aimed at regulating activities, resting at appropriate times, and acknowledging the pain as it occurs are beneficial strategies.

In terms of cognitive approaches, techniques aimed at rationalising expectations of pain would appear to benefit individuals' emotional and physical functioning. Techniques may be applied to enable participants to more accurately predict the probable pain elicited by regular activities. Cognitive-therapy techniques, including behavioural experiments, may

be helpful in reducing catastrophising and improving daily mood and functioning. Such techniques may also be useful for rationalising perceptions of life interference, thereby improving mood and reducing inactivity. However, varying degrees of life-interference can be expected with chronic pain conditions (eg. Kerns & Jacob, 1993). Scheduling of pleasant-events and recreational and occupational therapies may alleviate this to some degree. Finally, strategies to enhance a sense of self-efficacy may improve mood and increase activity. Systematic use of active-coping strategies to "experiment" with pain control may enhance an individuals' sense of their ability to manage pain without relying on external sources (eg. O'Leary, Shoor, Lorig & Holman, 1988).

Interestingly, the current study found that a unique and important predictor of momentary mood and function was pain itself. Thus, the current project supported multi-disciplinary approaches to managing pain and psychosocial adjustment to pain. Quality-of-life in general, and quality of daily-life in particular, may be best served by combined approaches to manage pain itself and the cognitive and behavioural patterns that maintain distress and dysfunction.

7.4.1 Use of PAMS Monitoring in Treatment

Repeated momentary measurement of pain patients using PAMS may prove to have clinical utility. For the same reasons that EMA approaches have advantages over questionnaire-based studies for research purposes they have potential advantages for clinical applications: the quality of the data provided by PAMS, and the methodology's capacity to address questions that cannot be answered by conventional questionnaires.

In most current rehabilitation and pain treatment settings, patients are expected to complete a battery of questionnaires aimed at assessing, amongst other things, the pain condition, physical and psychological adjustment, beliefs and appraisals, and coping. EMA data collected on these indices is likely to be less prone to recall inaccuracies and judgement biases on the part of the patient, and the data obtained by EMA is likely to be more ecologically validity (that is, more relevant to the "real life" contexts patients must return to).

Furthermore, questionnaires are limited in their ability to assess within-person phenomena, such as the covariation of internal states. The only way to assess such issues with cross-sectional questionnaires or clinical interviews is to ask patients about them directly. Such an approach is likely to have questionable validity – it has been shown that recall of states such as pain and mood are inaccurate and biased (eg. Lousberg, et al., 1997), and it is also likely that patients' have limited insight into the covariation of such states. Shiffman, et al. (1994) showed, for example, that whilst participants reported that there was no relationship between their drinking and smoking, such a relationship was apparent according to EMA monitoring.

The current study used an automated feedback system that analysed each participant's PAMS data and provided a customised report (see Appendix G). A system involving automated feedback from EMA monitoring, implemented as part of a pre-admission assessment battery for pain treatment centres, could prove useful for planning and evaluating customised treatment plans. The current system, developed to provide feedback to participants regarding their PAMS data, needs validating. However, this system, or a similar one, could be used to assess such factors as patient's pain/mood

relationship and pain/activity relationship, and factors that may prompt coping behaviours such as medication use or activity-avoidance.

Further research may reveal that personalised treatment plans, involving delivery of treatment modules on the basis of PAMS diary data, may reduce the time and cost involved in pain management treatments and may have beneficial effects on other key outcomes as well. Such a finding would be a positive practical outcome of the kind of research reported here, and would help reduce the costs to society and the personal cost to individuals of what is a widespread and disabling problem.

References

Affleck, G., Pfeifer, C., Tennen, H. and Fifield, J. (1988). Social support and psychosocial adjustment to rheumatoid arthritis: Quantitative and qualitative findings. *Arthritis Care and Research*, *1*, 71-77.

Affleck, G., Tennen, H., Urrows, S. and Higgins, P. (1991). Individual differences in the day-to-day experience of chronic pain: A prospective daily study of Rheumatoid Arthritis patients. *Health Psychology*, *10*(*6*), 419-426.

Affleck, G., Tennen, H., Urrows, S. and Higgins, P. (1992). Neuroticism and the pain-mood relation in rheumatoid arthritis: Insights from a prospective daily study. *Journal of Consulting and Clinical Psychology*, *60*, 199-226.

Affleck, G., Tennen, H., Urrows, S. and Higgins, P. (1994). Person and contextual features of daily stress reactivity: Individual differences in relations of undesirable daily events with mood disturbance and chronic pain intensity. *Journal of Personality and Social Psychology*, *66*(*2*), 329-340.

Affleck, G., Urrows, S., Tennen, H. and Higgins, P. (1992). Daily coping with pain from rheumatoid arthritis: Patterns and correlates. *Pain*, *51*(*2*), 221-229.

Andersson, H.I., Ejlertsson, G., Leden, I. and Rosenberg, C. (1993). Chronic pain in a geographically defined general population: studies of differences in age, gender, social class, and pain localization. *Clinical Journal of Pain*, *9*, 174-182.

Armentrout, D.P., Moore, J.E., Parker, J.C., Hewett, J.E. and Feltz, C. (1982). Pain patient MMPI subgroups: The psychological dimensions of pain. *Journal of Behavioural Medicine*, *5*, 201-211.

Asmundson, G.J.G., Norton, P.J. and Norton, G.R. (1999). Beyond pain: The role of fear and avoidance in chronicity. *Clinical Psychology Review, 19*(*1*), 97-119.

Asmundson, G.J.G., Norton, P.J., & Vlaeyen, J.W.S. (2004). *Fear-Avoidance Models of Chronic Pain: An overview*. In G.J.G. Asmundson, J.W.S. Vlaeyen, and G. Crombez (eds) Understanding and Treating Fear of Pain, Oxford University Press, Oxford.

Bandura, A. (1977). Self-efficacy: Towards a unifying theory of behavioral change. *Psychological Review*, *84*, 191-215.

Bandura, A. (1986). *Social Foundations Of Though And Actions: A social cogntive theory*. Englewood Cliffs, NJ, Prentice-Hall.

Bandura, A. (1997). *Self-Efficacy: The exercise of control*. New York, H.W. Freeman.

Bandura, A. and Schunk, D.H. (1981). Cultivating competence, self-efficacy, and intrinsic interest through proximal self-motivation. *Journal of Personality and Social Psychology*, *41*(*3*), 586-598.

Banks, S.M. (1998). The role of cognition in daily fluctuations of pain. *Dissertation Abstracts International*, *58*(*11-B*), 6224.

Banks, S.M. and Kerns, R.D. (1996). Explaining high rates of depression in chronic pain: A diathesis-stress framework. *Psychological Bulletin*, *119*(*1*), 95-110.

Barbini, B., Benedetti, F., Colombo, C., Guglielmo, E., Campori, E. and Smeraldi, E. (1998). Perceived mood and skin body temperature rhythm in depression. *European Archives of Psychiatry and Clinical Neuroscience*, *248*, 157-160.

Barnes, D. and Benjamin, S. (1987). The Self Care Assessment Schedule: The purpose and construction of a new assessment of self-care behaviours. *Journal of Psychosomatic Research, 31,* 191-202.

Barry, L.C., Zhenchao, G., Kerns, R.D., Duong, B.D. and Reid, M.C. (2003). Functional self-efficacy and pain-related disability among older veterans with chronic pain in a primary care setting. *Pain, 104,* 131-137.

Bateman, T.S. and Strasser, S. (1984). A longitudinal analysis of the antecedents of organisation commitment. *The Academy of Management Journal, 27*(*1*), 95-112.

Beck, A.T. (1967). *Cognitive Therapy and the Emotional Disorders*. New York, Meridian.

Beck, A.T. and Steer, R.A. (1987). *Manual for the revised Beck Depression Inventory*. San Antonio, The Psychological Corporation.

Beck, A.T., Epstein, N., Brown, G. and Steer, R.A. (1988). An inventory for measuring clinical anxiety: Psychometric properties. *Journal of Consulting and Clinical Psychology, 56,* 893-897.

Bellamy, N., Sothern, R.B. and Campbell, J. (1990). Rhythmic variations in pain perception in osteoarthritis of the knee. *Journal of Rheumatology*, *17,* 364-372.

Bergman, S., Herrstrom, P., Hogstrom, K., Petersson, I.F., Svensson, B. and Jacobsson, L.T. (2001). Chronic musculoskeletal pain, prevelance rates, and sociodemographic associations in a Swedish population study. *Journal of Rheumatology*, *28,* 1369-1377.

Bergner, M., Bobbitt, R.A., Carter, W.B. and Gibson, B.S. (1981). The Sickness Impact Profile: Development and final revision of a health status measure. *Medical Care, 19*, 787-805.

Bermas, B.L., Tucker, J.S., Winkelman, D.K. and Katz, J.N. (2000). Marital satisfaction in couples with rheumatoid arthritis. *Arthritis Care and Research*, *13*(*3*), 149-155.

Bishop, S. and Warr, D. (2003). Coping, catastrophising and chronic pain in breast cancer. *Journal of Behavioral Medicine, 26*(*3*), 265-281.

Bonica, J.J. (1985). Importance of the problem. In G.A. Aronoff (Ed.) *Evaluation and treatment of chronic pain*. Baltimore, Urban & Schwarzenberg, xxxi-xliv.

Bortz, W.M. (1984). The disuse syndrome. *Western Journal of Medicine, 141*, 691-694.

Bowsher, D., Rigge, M. and Sopp, L. (1991). Prevalence of chronic pain in the British population: a telephone survey of 1037 households. *Pain Clinic*, *4*, 223-230.

Brissette, I. and Cohen, S. (2002). The contribution of individual differences in hostility to the associations between daily interpersonal conflict, affect, and sleep. *Personality and Social Psychology Bulletin*, *28*(*9*), 1265-1274.

Brown, G. (1990). A casual analysis of chronic pain and depression. *Journal of Abnormal Psychology*, *19*, 127-137.

Brown, G.K. and Nicassio, P.M. (1987). Development of a questionnaire for the assessment of active and passive coping strategies in chronic pain patients. *Pain, 31*(*1*), 53-64.

Brown, G.K., Nicassio, P.M. and Wallston, K.A. (1989). Pain coping strategies and depression in rheumatoid arthritis. *Journal of Consulting and Clinical Psychology, 57*(*5*), 652-657.

Brunswick, E. (1949). *Systematic and Representative Design of Psychological Experiments*. Los Angeles, University of California Press.

Buckelew, S.P., Murray, S.E., Hewett, J.E., Johnson, J. and Huyser, B. (1995). Self-efficacy, pain, and physical activity among fibromyalgia subjects. *Arthritis Care and Research, 8*(*1*), 43-50.

Buckelew, S.P., Parker, J.C., Keefe, F.J., Deuser, W.E., Crews, T.M., Conway, R., Kay, D.R. and Hewett, J.E. (1994). Self-efficacy and pain behavior among subjects with fibromyalgia. *Pain, 59*(*3*), 377-384.

Burke, H.M., Zautra, A.J., Davis, M.C., Schultz, A.S. and Reich, J.W. (2003). Arthritis and Musculoskeletal Conditions. In A.M. Nezu, C.M. Nezu and P. Geller (Eds.) *Handbook of Psychology*. New York, Wiley. *9*.

Burton, A.K., Tillotson, M.T., Main, C.J. and Hollis, S. (1995). Psychosocial predictors of outcome in acute and subchronic low back trouble. *Spine, 20*, 722-728.

Buse, L. and Pawlik, K. (1984). Inter-setting-korrelationen und setting-persönlichkeits- Wechselwirkungen. *Zeitschift für Sozialpsychologie, 34*, 44-59.

Butler, R.W., Damarin, F.L., Beaulieu, C., Schwebel, A.I. and Thorn, B.E. (1989). Assessing cognitive coping strategies for acute postsurgical pain. *Psychological Assessment, 1*(*1*), 41-45.

Calhoun, L.G., Cheney, T. and Dawes, S. (1974). Locus of control, self-reported depression, and perceived causes of depression. *Journal of Consulting and Clinical Psychology, 42*, 736.

Cathey, M.A., Wolfe, F., Kleinheksel, S.M., and Hawley, D.J. (1986). Socioeconomic impact of fibrositis: A study of 81 patients with primary fibrositis. *American Journal of Medicine, 81*, 78-84.

Catley, D. (1999). Psychological Distress in Chronic Pain: Examination of integrative models of stress, and a cognitive-behavioural mediation model of depression. *Dissertation Abstracts International, Section B: The Sciences and Engineering, 60*(*8-B*), 4207.

Cipher, D.J. and Fernandez, E. (1997). Expectancy Variables Predicting Tolerance and Avoidance of Pain in Chronic Pain Patients. *Behaviour Research and Therapy, 35*(*5*), 437-444.

Council, J.R., Ahern, D.K., Follick, M.J. and Kline, C.L. (1988). Expectancies and functional impairment in chronic low back pain. *Pain, 33*, 323-331.

Crisson, J.E. and Keefe, F.J. (1988). The relationship of locus of control to pain coping strategies and psychological distress in chronic pain patients. *Pain, 35*(*2*), 147-154.

Crombez, G., Vervaet, L., Baeyens, F., Lysens, R. and Eelen, P. (1996). Do pain expectancies cause pain in chronic low back patients? A clinical investigation. *Behaviour Research and Therapy, 34*(*11/12*), 919-925.

Cruise, C.E., Broderick, J., Porter, L., Kaell, A. and Stone, A.A. (1996). Reactive effects of diary self-assessment in chronic pain patients. *Pain, 67*, 253-258.

Csikszentmihalyi, M.W. and Figurski, T.J. (1982). Self-awareness and aversive experience in everyday life. *Journal of Personality, 50,* 15-28.

Csikszentmihalyi, M.W. and Larson, R.J. (1987). Validity and reliability of the experience-sampling method. *Journal of Nervous and Mental Disease*, *175*(*9*), 526-536.

Csikszentmihalyi, M.W., Larson, R.J. and Prescott, S. (1977). The ecology of adolescent activity and experience. *Journal of Youth and Adolescence, 6,* 281-294.

Delespaul, P. and DeVries, M.W. (1987). The daily life of ambulatory chronic mental patients. *Journal of Nervous and Mental Disease, 175*(*9*), 537-544.

Derogatis, L.R. (1983). *SCL-90R Administration, Scoring, and Procedures Manual*. Towson, MD, Clinical Psychometric Research.

Devine, D.P. and Spanos, N.P. (1990). Effectiveness of maximally different cognitive strategies and expectancy in attenuation of reported pain. *Journal of Personality and Social Psychology*, *58*(*4*), 672-678.

DeVries, M.W. (1992). *The Experience of Psychopathology*. Cambridge, Cambridge University Press.

DeVries, M.W., Delespaul, P.A., Dijkman, C.I. and Theunissen, J. (1986). Advance in understanding temporal and setting aspects of schizophrenic disorders. In F. Massimini and P. Inghilleri (Eds.) *L'Esperienza quotidiana*. Milano, Franco Angeli, 477-493.

Deyo, R. and Centor, R. (1986). Assessing the responsiveness of functional scales to clinical change: An analogy to diagnostic test performance. *Journal of Chronic Disease, 39,* 897-906.

Dolce, J.J., Crocker, M.F., Moletteire, C. and Doleys, D.M. (1986). Exercise Quotas, Anticipatory Concern and Self-Efficacy Expectancies in Chronic Pain: A Preliminary Report. *Pain*, *24*, 365-372.

Dworkin, R.H., Hartstein, G. and Rosner, H. (1992). A high-risk method for studying psychosocial antecedents of chronic pain: The prospective investigation of herpes zoster. *Journal of Abnormal Psychology*, *101*, 200-205.

Elton, D., Stanley, G.V. and Burrows, G.D. (1983). *Psychological control of pain*. Sydney, Grune & Stratton.

Erdal, K.J. and Zautra, A.J. (1995). Psychological impact of illness downturns: A comparison of new and chronic conditions. *Psychology and Aging*, *10*(*4*), 570-577.

Estlander, A.M. and Haerkaepaeae, K. (1989). Relationships between coping strategies, disability and pain levels in patients with chronic low back pain. *Scandinavian Journal of Behaviour Therapy*, *18*(*2*), 59-69.

Evers, A.W.M., Kraaimaat, F.W., Geenen, R., Jacobs, J.W.G. and Bijlsma, J.W.J. (2003). Pain coping and social support as predictors of long-term functional disability and pain in early rheumatoid arthritis. *Behaviour Research and Therapy*, *41*(*11*), 1295-1310.

Evers, A.W.M., Kraaimaat, F.W., van Riel, P.L.C.M. and de Jong, A.J.L. (2002). Tailored cognitive-behavioural therapy in early rheumatoid arthritis for patients at risk: a randomized controlled trial. *Pain, 100*, 141-153.

Fahrenberg, J. (1996). Ambulatory Assessment: Issues and perspectives. In J. Fahrenberg and M. Myrtek (Eds.) *Ambulatory Assessment*. Seattle, Hogrefe and Huber.

Fahrenberg, J., Bruger, G., Foerster, F. and Kappler, C. (1999). Ambulatory assessment of diurnal changes with a hand-held computer: Mood attention and morningness-eveningness. *Personality and Individual Differences, 26*(*4*), 641-656.

Fairbank, J., Couper, J. and Davies, J. (1980). The Oswestry low back pain questionnaire. *Physiotherapy*, *66*, 271-273.

Feldman, S.I., Downey, G. and Schaffer-Neitz, R. (1999). Pain, negative mood, and perceived support in chronic pain patients: A daily diary study of people with reflex sympathetic dystrophy syndrome. *Journal of Consulting and Clinical Psychology*, *67*(*5*).

Fernandez, E. and Milburn, T.W. (1994). Sensory and affective predictors of overall pain, and emotions associated with affective pain. *Clinical Journal of Pain, 10*, 3-9.

Fernandez, E. and Turk, D.C. (1995). The scope and significance of anger in the experience of chronic pain. *Pain*, *61*(*2*), 165-175.

Fishbain, D.A., Goldberg, M., Meagher, B.R., R., S. and Rosomoff, H. (1986). Male and female chronic pain patients categorized by DSM-III psychiatric diagnostic criterea. *Pain, 26*, 181-197.

Fisher, B.J., Haythornthwaite, J.A., Heinberg, L.J., Clark, M. and Reed, J. (2001). Suicidal intent in patients with chronic pain. *Pain, 89*(*2-3*), 199-206.

Flor, H. and Turk, D.C. (1988). Chronic back pain and rheumatoid arthritis: Predicting pain and disability from cognitive variables. *Journal of Behavioral Medicine*, *11*(*3*), 251-265.

Focht, B.C., Ewing, V., Gauvin, L. and Rejeski, W.J. (2002). The unique and transient impact of acute exercise on pain perception in older, overweight, or obese adults with knee osteoarthritis. *Annals of Behavioral Medicine*, *24*(*3*), 201-210.

Folkard, S., Glynn, C.J. and Lloyd, J.W. (1976). Diurnal variation and individual differences in the perception of intractable pain. *Journal of Psychosomatic Research, 20*, 289-310.

Folkman, S. (1991). Improving Coping Assessment: Reply to Stone and Kennedy-Moore. In H.S. Friedman (Ed.) *Hostility, coping, and health*. Washington, D.C., American Psychological Association, 215-223.

Folkman, S. and Lazarus, R.S. (1980). An analysis of coping in a middle-aged community sample. *Journal of Health and Social Behavior*, *21*, 219-239.

Follick, M.J., Ahern, D.K., Laser-Wolston, N., Adams, A.E. and Molloy, A.J. (1985). Chronic pain: Electromechanical recording device for measuring patient's activity patterns. *Archives of Physical Medicine and Rehabilitation*, *66*, 75-79.

Fordyce, W.E. (1976). *Behavioral Methods for Chronic Pain and Illness*. St Louise: Mosby.

France, R.D., Krishnan, R.R. and Trainor, M. (1986). Study of depression and alcoholism in chronic low back pain patients. *Pain*, *24*, 185-190.

Franzoi, S.L. and Brewer, L.C. (1984). The experience of self-awareness and its relation to level of self-conciousness: An experiential sampling study. *Journal of Research in Personality, 18,* 522-540.

Freeman, M., Csikszentmihalyi, M. and Larson, R. (1986). Adolescence and its recollection: Toward an interpretive model of development. *Merrill-Palmer Quarterly*, *32,* 167-185.

Fries, J.F., Spitz, P.W. and Young, D.Y. (1982). The dimensions of health outcome: The Health Assessment Questionnaire, Disability and pain scales. *Journal of Rheumatology, 9,* 789-793.

Gamsa, A. (1994). The role of psychological factors in chronic pain: II. A critical appraisal. *Pain*, *57,* 17-29.

Garratt, A.M., Ruta, D.A., Abdalla, M.I., Buckingham, J.K. and Russell, I.T. (1993). The SF 36 Health Survey Questionnaire: An outcome measure suitable for routine use within the NHS? *British Medical Journal*, *306,* 1440-1444.

Geisser, M.E., Haig, A.J. and Theisen, M.E. (2000). Activity avoidance and function in persons with chronic back pain. *Journal of Occupational Rehabilitation*, *10*(*3*), 215-227.

Geisser, M.E., Robinson, M.E. and Henson, C.D. (1994*)*. The Coping Strategies Questionnaire and chronic pain adjustment: A conceptual and empirical reanalysis. *Clinical Journal of Pain*, *10*(*2*), 98-106.

Geraci, M.F. and Uhde, T.W. (1992). Diurnal rhythms and symptom severity in panic disorder: A preliminary study of 24-hour changes in panic attacks, generalised anxiety, and avoidance behaviour. *British Journal of Psychiatry*, *161,* 512-516.

Gibbons, F.X. (1983). Self-attention and self-report: The "veridicality" hypothesis. *Journal of Personality*, *51,* 517-542.

Gil, K.M., Carson, J.W., Porter, L., Ready, J., Valrie, C., Redding-Lallinger, R. and Daeschner, C.W. (2003). Daily stress and mood and their association with pain, health-care use, and school activity in adolescents with sickle cell disease. *Journal of Pediatric Psychology*, *28*(*5*), 363-373.

Goubert, L., Crombez, G., & De Bourdeauduij, I. (2004). Low back pain, disability, and back-pain myths in a community sample: Prevalence and interrelationships. *European Journal of Pain*, 8, p 385-394.

Gracely, R.H., McGrath, P. and Dubner, R. (1978). Ratio Scales of Sensory and Affective Verbal Pain Descriptors. *Pain*, *5*, 5-18.

Grant, L., Long, B.C. and Willms, J.D. (2002). Women's adaptation to chronic back pain: Daily appraisals and coping strategies, personal characteristics, and perceived spousal responses. *Journal of Health Psychology*, *7*(*5*), 545-563.

Grant, L.D. (1998). *The relationship between pain appraisals and coping strategy use and adaptation to chronic low back pain: A daily diary study*. PhD Thesis, University of British Columbia, Canada

Hadjistavropoulos, H.D. and Craig, K.D. (1994). Acute and chronic low back pain: Cognitive, affective, and behavioral dimensions. *Journal of Consulting and Clinical Psychology*, *62*(*2*), 341-349.

Hank, P. and Schwenkmezger, P. (1996). Computer-assisted versus paper-and-pencil-based self-monitoring. In J. Fahrenberg and M. Myrtek (Eds.) *Ambulatory Assessment*. Seattle, Hogrefe and Huber.

Hartwig, M.J. (2000). The diurnal rhythms of subjective wakefulness and anxiety. *Dissertation Abstracts International, Section B: The Sciences and Engineering*, *61*(*6-B*), 3278.

Hashemi, L., Webster, B.S., and Clancey, E.A. (1998). Trends in disability duration and cost of workers' compensation low back claims, *Journal of Occupational and Environmental Medicine*, *40*, 1110-1119

Haug, H. and Fahndrich, E. (1990). Diurnal variations in depressed patients in relation to severity of depression. *Journal of Affective Disorders, 19,* 37-41.

Haythornthwaite, J.A., Sieber, W.J. and Kerns, R.D. (1991). Depression and the chronic pain experience. *Pain, 46,* 177-184.

Hendler, N. (1984). Depression caused by chronic pain. *Journal of Clinical Psychiatry, 45*(*3*), 30 -36.

Hill, A. (1993). The use of pain coping strategies by patients with phantom limb pain. *Pain, 55*(*3*), 347-353.

Hitchcock, L.S., Ferrell, B.R. and McCaffery, M. (1994). The experience of chronic nonmalignant pain. *Journal of Pain and Symptom Management, 9*(*5*), 312-318.

Holmes, J.A. and Stevenson, C.A. (1990). Differential effects of avoidant and attentional coping strategies on adaptation to chronic and recent-onset pain. *Health Psychology, 9*(*5*), 577-584.

Holroyd, K.A. and Panzien, D.B. (1990). Pharmacological versus nonpharmacological prophylaxis of recurrent migraine headache: A meta-analytic review of clinical trials. *Pain, 42,* 1-13.

Hoodin, F., Brines, B.J., Lake, A.E.I., Wilson, J. and Saper, J.R. (2000). Behavioral self-management in an inpatient headache treatment unit: Increasing adherence and relationship to changes in affective distress. *Headache, 40*(*5*), 377-383.

Hopkins, M.B. (1995). Rhythms of reported anxiety of persons experiencing generalised anxiety disorder. *Dissertation Abstracts International, Section B: The Sciences and Engineering, 56*(*2-B*), 1109.

Hormuth, S.E. (1982). Self-focussed attention and the adherence to personal standards. In K. Obuchowski and A. Kossakowski (Eds.) *Progress in Psychology of Personality*. Berlin, VEB Deutscher Verlag der Wissenschaften, 95-105.

Hormuth, S.E. (1986). The sampling of experiences in situ. *Journal of Personality, 54*(*1*), 262-293.

Hormuth, S.E., Ed. (1984). *Transitions in commitments to roles and self-concept change: Recreation as a paradigm*. Role Transitions: Explorations and Explanations. New York, Plenum.

Hsieh, C., Phillips, R. and Adams, A. (1992). Functional outcomes of low back pain: Comparison of four treatment groups in a randomised controlled trial. *Journal of Manipulative Physiological Therapy, 15*, 4-9.

Hurlburt, R.T. (1979). Random sampling of cognitions and behavior. *Journal of Research in Personality, 13*, 103-111.

Jacob, M.C., Kerns, R.D., Rosenberg, R. and Haythornthwaite, J. (1993). Chronic Pain: Intrusion and accommodation. *Behaviour Research and Therapy, 31*(*5*), 519-527.

Jamison, R.N. and Brown, G.K. (1991). Validation of hourly pain intensity profiles with chronic pain patients. *Pain, 45*, 123-128.

Jarvikoski, A., Mellin, G. and Estlander, A.M. (1995). Outcome of two multimodal back treatment programmes with and without intensive physical training. *Journal of Spinal Disorders, 6*, 93-98.

Jensen, M.P. and Karoly, P. (1991). Control beliefs, coping efforts, and adjustment to chronic pain. *Journal of Consulting and Clinical Psychology, 59*(*3*), 431-438.

Jensen, M.P., Karoly, P. and Braver, S. (1986). The measurement of clinical pain intensity: A comparison of six methods. *Pain, 27*, 117-126.

Jensen, M.P., Karoly, P. and Huger, R. (1987). The development and preliminary validation of an instrument to assess patients' attitudes toward pain. *Journal of Psychosomatic Research, 31*(*3*), 393-400.

Jensen, M.P., Keefe, F., Lefebvre, J.C., Romano, J.M. and Turner, J.A. (2003). One- and two-item measures of pain beliefs and coping strategies. *Pain, 104*, 453-469.

Jensen, M.P., Turner, J.A. and Romano, J.M. (1991). Self-efficacy and outcome expectancies: Relationship to chronic pain coping strategies and adjustment. *Pain, 44*(*3*), 263-269.

Jensen, M.P., Turner, J.A. and Romano, J.M. (1992). Chronic pain coping measures: Individual vs. composite scores. *Pain, 51*(*3*), 273-280.

Jensen, M.P., Turner, J.A. and Romano, J.M. (1994*)*. Correlates of improvement in multidisciplinary treatment of chronic pain. *Journal of Consulting and Clinical Psychology, 62*(*1*), 172-179.

Jensen, M.P., Turner, J.A., Romano, J.M. and Karoly, P. (1991). Coping with chronic pain: A critical review of the literature. *Pain, 47*, 249-283.

Jensen, M.P., Turner, J.A., Romano, J.M. and Lawler, B.K. (1994*)*. Relationship of pain-specific beliefs to chronic pain adjustment. *Pain, 57*(*3*), 301-309.

Jensen, M.P., Turner, J.A., Romano, J.M. and Strom, S.E. (1995). The Chronic Pain Coping Inventory: Development and preliminary validation. *Pain, 60*(*2*), 203-216.

Johansson, E. and Lindberg, P. (1998). Subacute and chronic low back pain: reliability and validity of the Swedish version of the Roland and Morris Disability Questionnaire. *Scandinavian Journal of Rehabilitation Medicine, 30,* 139-143.

Kanfer, F.H. and Goldfoot, D.A. (1966). Self-Control and Tolerance of Noxious Stimulation. *Psychological Reports, 18,* 79-85.

Karoly, P. and Jensen, M.P. (1987). *Multimethod Assessment of Chronic Pain*. Oxford, Pergamon.

Katz, J., Ritvo, P., Irvine, M.J. and Jackson, M. (1996). Coping with chronic pain. In M. Zeidner and N.S. Endler (Eds.) *Handbook of Coping: Theory, Research, Applications*. New York, John Riley.

Keefe, F. (2000). Self-report of pain: Issues and opportunities. In A.A. Stone, J.S. Turkkan, C.A. Bachrach, J.B. Jobe, H.S. Kurtzman and V.S. Cain (Eds.) *The science of self report: Implications for research and practice,* 317-338.

Keefe, F., Affleck, G., Lefebvre, J.C., Underwood, L., Caldwell, D., Drew, J., Egert, J., Gibson, J. and Pargament, K.I. (2001). Living with rheumatoid arthritis: The role of daily spirituality and daily religious and spiritual coping. *The Journal of Pain*, *2*(*2*), 101-110.

Keefe, F.J., Affleck, G., Lefebvre, J.C., Starr, K., Caldwell, D. and Tennen, H. (1997). Pain coping strategies and coping efficacy in rheumatoid arthritis: A daily process analysis. *Pain*, *69*(*1-2*), 35-42.

Keefe, F.J., Brown, G.K., Wallston, K.A. and Caldwell, D.S. (1989). Coping with rheumatoid arthritis pain: Catastrophizing as a maladaptive strategy. *Pain, 37*(*1*), 51-56.

Keefe, F.J., Caldwell, D.S., Queen, K., Gil, K.M., Martinez, S., Crisson, J.E., Ogden, W. and Nunley, J. (1987). Osteoarthritic knee pain: A behavioral analysis. *Pain*, *28*(*3*), 309-321.

Keefe, F.J., Crisson, J.E., Urban, B.J. and Williams, D.A. (1990). Analyzing chronic low back pain: The relative contribution of pain coping strategies. *Pain*, *40*(*3*), 293-301.

Kenardy, J. and Adams, C. (1993). Computers in cognitive-behaviour therapy. *Australian Psychologist*, *28*, 189-194.

Kenardy, J., Fried, L., Taylor, C.B. and Kraemer, H.C. (1992). Psychological precursors of panic attacks. *British Journal of Psychiatry*, *160*, 668-673.

Kerns, R.D. and Haythornthwaite, J.A. (1988). Depression among chronic pain patients: Cognitive-Behavioral analysis and effect on rehabilitation outcome. *Journal of Consulting and Clinical Psychology*, *56*(*6*), 870-876.

Kerns, R.D. and Jacob, M.C. (1993). Psychological aspects of back pain. *Bailliere's Clinical Rheumatology*, *7*(*2*), 337-356.

Kerns, R.D., Turk, D.C. and Rudy, T.E. (1985). The West-Haven-Yale Multidimensional Pain Inventory (WHYMPI). *Pain*, *23*, 345-356.

Kihlstrom, J.F., Eich, E., Sandbrand, D. and Tobias, B.A. (2000). Emotion and memory: Implications for self-report. In A.A. Stone, J.S. Turkkan, C.A. Bachrach, J.B. Jobe, H.S. Kurtzman and V.S. Cain (Eds.) *The science of self report: Implications for research and practice*, 81-100.

Koltyn, K.F., Garvin, A.W., Gardiner, R.L. and Nelson, T.F. (1996). Perception of pain following aerobic exercise. *Medicine and Science in Sports and Exercise*, *28*, 1418-1421.

Kongstvedt, S.J. (1987). Cognitive approaches to pain control: Common factors underlying their effectiveness. *Journal of Counseling and Development*, *65*(*10*), 538-541.

Kopec, J.A., Esdaile, J.M., Abrahamowicz, M., Abenhaim, L., Wood-Dauphinee, S., Lamping, D.L. and Williams, J.I. (1995). The Quebec back pain disability scale: Measurment properties. *Spine*, *20*, 392-395.

Kraaimaat, F.W., Bakker, A. and Evers, A.W.M. (1997). Pijncoping-strategieen bij chronische pijnpatienten: De ontwikkeling van de Pijn-Coping-Inventarisatielijst (PCI). / Pain coping strategies in chronic pain patients: The development of the Pain Coping Inventory (PCI). *Gedragstherapie*, *30*(*3*), 185-201.

Kremer, E.F., Atkinson, J.H. and Ignelzi, R.J. (1982). Pain measurement: The affective dimensional measure of the McGill Pain Questionnaire with a cancer pain population. *Pain*, *12*, 153-163.

Kwekkeboom, K.L. (2000). The role of imaging ability in successful use of guided imagery for cancer related pain. *Dissertation Abstracts International, Section B: The Sciences and Engineering*, *61*(*2-B*), 779.

Labrecque, G. and Vanier, M.C. (1995). Biological rhythms in pain and in the effects of opioid analgesics. *Pharmacological Therapy*, *68*, 129-147.

Lackner, J.M., Carosella, A.M. and Feuerstein, M. (1996). Pain expectancies, pain, and functional self-efficacy expectancies as determinants of disability in patients with chronic low back disorders. *Journal of Consulting and Clinical Psychology*, *64*(*1*), 212-220.

Larsen, R.J. (1992). Neuroticism and bias in the encoding and recall of physical symptoms: Evidence from a combined prospective-retrospective study. *Journal of Personality and Social Psychology*, *62*, 480-488.

Lawson, K.C., Reesor, K.A., Keefe, F.J. and Turner, J.A. (1990). Dimensions of pain-related cognitive coping: Cross-validation of the factor structure of the Coping Strategy Questionnaire. *Pain*, *43*(*2*), 195-204.

Lazarus, R.S. (1991). Cognition and Motivation in Emotion. *American Psychologist*, *46*(4), 352-367.

Lazarus, R.S. (1993). Coping Theory and Research: Past Present, and Future. *Psychosomatic Medicine*, *55*, 234-247.

Lazarus, R.S. (1999). *Stress And Emotion: A new synthesis*. London, Free Association Books.

Lazarus, R.S. (2000). Toward Better Research on Stress and Coping. *American Psychologist*, *2000*(*55*), 6.

Lazarus, R.S. and Folkman, S. (1984). *Stress, Appraisal and Coping*. New York, Springer.

Leclaire, R., Blier, F. and Fortin, L. (1997). A cross-sectional study comparing the Oswestry and Roland-Morris functional disability scales in two populations of patients with low back pain of different levels of severity. *Spine*, *22*, 68-71.

Lefebvre, M.F. (1981). Cognitive distortion and cognitive errors in depressed psychiatric and low back pain patients. *Journal of Consulting and Clinical Psychology*, *49*(*4*), 517-525.

Leichter, J.L. (1988). The relationship of imagery ability to the efficacy of progressive muscle relaxation and visual imagery in the treatment of chronic migraine headache. *Dissertation Abstracts International, Section B: The Sciences and Engineering, 48*(*11-B*), 3418-3419.

Leino, P. and Magni, G. (1993). Depressive and distress symptoms as predictors of low-back pain, neck-shoulder pain, and other musculo-skeletal morbidity: A 10-year follow-up of metal industry employees. *Pain, 53,* 89-94.

Lethem, J., Slade, P.D., Troup, J.D. and Bentley, G. (1983). Outline of a fear-avoidance model of exaggerated pain perception: I. *Behaviour Research and Therapy, 21*(*4*), 401-408.

Leventhal, E.A., Leventhal, H., Shacham, S. and Easterling, D.V. (1989). Active coping reduces reports of pain from childbirth. *Journal of Consulting and Clinical Psychology, 57,* 365-371.

Levine, J.D., Newton, C.G., Smith, R. and Fields, H.L. (1982). Post-operative pain: effect of extent of injury and attention. *Brain Research, 234,* 500-504.

Lewinsohn, P.M. (1974). Clinical and theoretical aspects of depression. In K.S. Calhoun, H.E. Adams and K.M. Mitchell (Eds.) *Innovative Treatment Methods In Psychopathogy*. New York, Wiley, 121-143.

Lint, D.W., Taylor, C.B., Fried-Behar, L. and Kenardy, J. (1995). Does ischemia occur with panic attacks? *American Journal of Psychiatry, 152*(*11*), 1678-1680.

Linton, S.J., Melin, L., & Gotestam, K.G. (1984). *Behavioral analysis of chronic pain and its management*. Progress in Behavior Modification, volume 18. Academic Press, New York, NY.

Linton, S.L. (1985). The relationship between activity and chronic back pain. *Pain, 21,* 289-294.

Litt, M.D. (1988). Self-efficacy and perceived control: Cognitive mediators of pain tolerance. *Journal of Personality and Social Psychology, 54*(*1*), 149-160.

Lorig, K., Chastain, R.L., Ung, E., Shoor, S. and Holman, H.R. (1989). Development and evaluation of a scale to measure perceived self-efficacy in people with arthritis. *Arthritis And Rheumatism, 32,* 37-44.

Lousberg, R., Schmidt, A.J.M., Groenman, N.H., Vendrig, L. and Dijkman-Caes, C.I.M. (1997). Validating the MPI DLV using experience sampling data. *Journal of Behavioral Medicine, 20*(*2*), 195-206.

Love, A.W. (1987). Depression in chronic low back pain patients: Diagnostic efficacy of three self-report questionnaires. *Journal of Clinical Psychology, 43,* 84-89.

Madland, G., Feinmann, C. and Newman, S. (2000). Factors associated with anxiety and depression in facial arthromyalgia. *Pain, 84*(*2-3*), 225-232.

Magni, G. (1987). On the relationship between pain and depression when there is no organic lesion. *Pain, 31,* 1-21.

Magni, G., Moreschi, C., Rigatti-Luchini, S. and Merskey, H. (1994). Prospective study on the relationship between depressive symptoms and chronic musculoskeletal pain. *Pain, 56*(*289-297*).

Main, C.J. and Waddell, G. (1991). A comparison of cognitive measures in low back pain: Statistical structure and clinical validity at initial assessment. *Pain, 46*(*3*), 287-298.

Maniadakis, N., and Gray, A. (2000). The economic burden of back pain in the UK. *Pain, 84,* 95-103

Margolis, R.B., Tait, R. and Krause, S.J. (1986). A rating system for use with patient pain drawings. *Pain, 24*, 57-65.

Marino, J., Gwynn, M.I. and Spanos, N.P. (1989). Cognitive mediators in the reduction of pain: The role of expectancy, strategy use, and self-presentation. *Journal of Abnormal Psychology*, *98*(*3*), 256-262.

Maxwell, T.D., Gatchel, R.J. and Mayer, T.G. (1998). Cognitive predictors of depression in chronic low back pain: Toward an inclusive model. *Journal of Behavioral Medicine, 21*(*2*), 131-143.

Mayeux, R., Stern, Y., Cote, L. and Williams, J.B.W. (1984). Altered serotonin metabolism in depressed patients with Parkinson's disease. *Neurology, 34*, 642-646.

McHorney, C.A., Ware, J.E. and Raczek, A.E. (1993). The MOS 36-Item Short-Form Health Survey (SF-36), Part II: Psychometric and Clinical Tests of Validity in Measuring Physical and Mental Health Construct. *Medical Care, 31*(*3*), 247-263.

McNair, D.M., Lorr, M. and Droppleman, L.F. (1971). *Manual: Profile of mood states*. San Diego, CA, Educational and Industrial Testing Services.

Melzack, R. (1975). The McGill Pain Questionnaire: Major properties and scoring methods. *Pain, 1*, 277-299.

Melzack, R. and Wall, P.D. (1965). Pain mechanisms: A new theory. *Science, 150*, 971-979.

Menon, G. and Yorkston, E.A. (2000). The use of memory and contextual cues in the formation of behavioral frequency judgements. In A.A. Stone, J.S. Turkkan, C.A. Bachrach, J.B. Jobe, H.S. Kurtzman and V.S. Cain (Eds.) *The science of self report: Implications for research and practice*, 63-80.

Mercado, A.C., Carroll, L.J., Cassidy, J.D. and Cote, P. (2000). Coping with neck and low back pain in the general population. *Health Psychology*, *19*(*4*), 333-338.

Merskey, H. (1986). Classification of chronic pain: Descriptions of chronic pain syndromes and definitions of pain terms. *Pain, Suppl. 3*.

Merskey, H., & Bogduk, N., Eds. (1994). *Classification of Chronic Pain*. 2nd Ed, IASP Press, Seattle.

Merskey, H., Loeser, J.D., & Dubner, R. (2005). *The Paths of Pain: 1975-2005.* IASP Press, Seattle.

Mikail, S.F., Henderson, P.R. and Tasca, G.A. (1994). An interpersonally based model of chronic pain: An application of attachment theory. *Clinical Psychology Review, 14*(*1*), 1-16.

Morris, P.L.P., Robinson, R.G. and Raphael, B. (1990). Prevalence and course of depressive disorders in hospitalized stroke patients. *InternationalJournalof Psychiatry In Medicine, 20*, 349-364.

Murphy, D., Lindsay, S. and Williams, A.C.d.C. (1997). Chronic Low Back Pain: Predictions of pain and relationship to anxiety and avoidance. *Behaviour Research and Therapy*, *35*(*3*), 231-238.

Murphy, J.P. (1994). Partners in pain: The relationship between spousal locus-of-control and chronic pain patients' coping behavior. *Dissertation Abstracts International, Section B: The Sciences and Engineering*, *55*(*4-A*), 1115.

Newman, M., Consoli, A. and Taylor (1997). Computers in assessment and Cognitive Behavioral Treatment of Clinical Disorders: Anxiety as a case in point. *Behaviour Therapy*, *28*, 211-235.

Nicassio, P.M. and Wallston, K.A. (1992). Longitudinal relationships among pain, sleep problems, and depression in rheumatoid arthritis. *Journal of Abnormal Psychology, 101*(*3*), 514-520.

Nicassio, P.M., Schoenfeld-Smith, K., Radojevic, V., & Schuman, C. (1995). Pain coping mechanisms in fibromyalgia: Relationship to pain and functional outcomes. *Journal of Rheumatology, 22*(8),1552-1558.

Nicholas, M.K. (1988). *An evaluation of cognitive, behavioural and relaxation treatments for chronic low back pain*. PhD Thesis, University of Sydney, Sydney, Australia

Nicholas, M.K. (1989). Self-Efficacy and chronic pain. *Annual Conference of The British Psychological Society*, St. Andrews.

Nicholas, M.K., Wilson, P.H. and Goyen, J. (1991). Operant-behavioural and cognitive-behavioural treatment for chronic low back pain. *Behaviour Research and Therapy, 29*, 225-238.

Nicholas, M.K., Wilson, P.H. and Goyen, J. (1992). Comparison of cognitive-behavioral group treatment and an alternative non-psychological treatment for chronic low back pain. *Pain, 48*(*3*), 339-347.

O'Leary, A., Shoor, S., Lorig, K. and Holman, H.R. (1988). A cognitive-behavioral treatment for rheumatoid arthritis. *Health Psychology, 7*(*6*), 527-544.

Osman, A., Barrios, F.X., Gutierrez, P.M., Kopper, B.A., Merrifield, T. and Grittmann, L. (2000). The Pain Catastrophizing Scale: Further psychometric evaluation with adult samples. *Journal of Behavioral Medicine, 23*(*4*), 351-365.

Osman, A., Barrios, F.X., Kopper, B.A., Hauptmann, W., Jones, J. and O'Neill, E. (1997). Factor structure, reliability, and validity of the Pain Catastrophizing Scale. *Journal of Behavioral Medicine, 20*(*6*), 589-605.

Pawlik, K. (1996). Contributions to differential psychology from ambulatory assessment: A researcher's plaidoyer. In J. Fahrenberg and M. Myrtek (Eds.) *Ambulatory Assessment*. Seattle, Hogrefe and Huber.

Pawlik, K. and Buse, L. (1982). Computer-based behavior registration in the field: Description and first psychometric evaluation of a new recording method. *Zeitschrift fur Differentielle und Diagnostische Psychologie, 3*(*2*), 101-118.

Perrez, M. and Reicherts, M. (1992). *Stress, coping, and health: A situation behavior approach: Theory, methods, application*. Seattle, Hogrefe & Huber.

Pertovaara, A., Huopaniemi, T., Virtanen, A. and Johansson, G. (1984). The influence of exercise on dental pain thresholds and the release of stress hormones. *Physiology and Behavior, 33*, 923-926.

Pervin, L.A. (1985). Personality: Current controversies, issues and directions. *Annual Review of Psychology, 36*, 83-114.

Peters, M.L., Sorbi, M.J., Kruise, D.A., Kerssens, J.J., Verhaak, P.F.M. and Bensing, J.M. (2000). Electronic diary assessment of pain, disability and psychological adaptation in patients differing in duration of pain. *Pain, 84*(*2-3*), 181-192.

Philips, H.C. and Jahanshahi, M. (1986). The components of pain behaviour report. *Behaviour Research and Therapy, 24*(*2*), 117-125.

Philips, H.C. and Rachman, S.J. (1996). *The Psychological Management of Chronic Pain: A treatment manual*. New York, NY, US, Springer Publishing Co, Inc.

Pilowsky, I. and Spence, N. (1976). Pain, anger and illness behaviour. *Journal of Psychosomatic Research, 20,* 411-416.

Radloff, L. (1977). The CES-D scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement, 35,* 195-197.

Ramirez-Maestre, C., Martinez, A.E.L. and Zarazaga, R.E. (2004). Personality characteristics as differential variables of the pain experience. *Journal of Behavioral Medicine, 27*(*2*), 147-165.

Raudenbush, S.W. and Bryk, A.S. (2002). *Hierarchical Linear Models: Applications and Data Analysis Methods*. Thousand Oaks, Cal., Sage.

Raudenbush, S.W., Bryk, A.S. and Congdon, R. (2001). HLM for Windows: Heirarchical linear and non-linear modelling, Vers. 5.05. HLM Software.

Rejeski, W.J., Brawley, L.R., Ettinger, W.H., Morgan, T. and Thompson, C. (1997). Compliance to exercise therapy in older participants with knee osteoarthritis: Implications for treating disability. *Medicine and Science in Sports and Exercise*, *29*, 977-985.

Reneman, M.F., Jorritsma, W., Schellekens, J.M.H. and Goeken, L.N.H. (2002). Concurrent validity of questionnaire and performance-based disability measurements in patients with chronic non-specific low-back pain. *Journal of Occupational Rehabilitation, 12*(*3*), 119-129.

Riley, J.L., III and Robinson, M.E. (1997). CSQ: Five factors or fiction? *Clinical Journal of Pain, 13*(*2*), 156-162.

Robbins, P.R. and Tanck, R.H. (1987). A study of diurnal patterns of depressed mood. *Motivation and Emotion, 11,* 37-49.

Robinson, M.E., Riley, J.L., III, Myers, C.D., Sadller, I.J.M.A., Kvaal, S.A., Geisser, M.E. and Keefe, F. (1997). The Coping Strategies Questionnaire: A Large Sample, Item Level Factor Analysis. *Clinical Journal of Pain, 13*(*1*), 43-49.

Rokicki, L.A., Holroyd, K.A., France, C.R., Lipchik, G.I., France, J.L. and Kvaal, S.A. (1997). Change mechanisms associated with combined relaxation/EMG biofeedback training for chronic tension headache. *Applied Psychophysiology and Biofeedback, 22*(*1*), 21-41.

Rokke, P.D. and al' Absi, M. (1992). Matching pain coping strategies to the individual: A prospective validation of the Cognitive Coping Strategy Inventory. *Journal of Behavioral Medicine, 15*(*6*), 611-625.

Roland, M. and Fairbank, J. (2000). The Roland-Morris Disability Questionnaire and the Oswestry Disability Questionnaire. *Spine*, *25*(*24*), 3115-3124.

Roland, M. and Morris, R. (1983). A study of the natural history of back pain, Part 1: Development of a reliable and sensitive measure of disability in low-back pain. *Spine*, *8*(*2*), 141-144.

Rosenstiel, A.K. and Keefe, F.J. (1983). The use of coping strategies in chronic low back pain patients: Relationship to patient characteristics and current adjustment. *Pain*, *17*(*1*), 33-44.

Roy-Byrne, P., Smith, W.R., Goldberg, J., Afari, N. and Buchwald, D. (2004). Post-traumatic stress disorder among patients with chronic pain and chronic fatigue. *Psychological Medicine, 34*(*2*), 363-368.

Rudy, T.E., Kerns, R.D. and Turk, D.C. (1988). Chronic pain and depression: Toward a cognitive-behavioural mediation model. *Pain*, *35*, 129-140.

Rusting, C.L. and Larsen, R.J. (1998). Diurnal patterns of unpleasant mood: Associations with neuroticism, depression, and anxiety. *Journal of Personality, 66*(*1*), 85-103.

Rybstein Blinchik, E.D. (1979). Effects of Different Cognitive Strategies on Chronic Pain Experience. *Journal of Behavioural Medicine, 2*(*1*), 93-101.

Schiaffino, K.M. and Revenson, T.A. (1995). Relative contributions of spousal support and illness appraisals to depressed mood in arthritis patients. *Arthritis Care and Research, 8*(*2*), 80-87.

Schleifer, S.J., Slater, W.R., Macari-Hinson, M.M., Coyle, D.A., Kahn, M., Zucker, H.D. and Gorlin, R. (1991). Digitalis and beta-blocking agents: Effects on depression following myocardial infarction. *American Heart Journal, 121*, 1397-1402.

Schwartz, J.E. and Stone, A.A. (1998). Strategies for analyzing ecological momentary asessment data. *Health Psychology, 17*(*1*), 6-16.

Sedlak, K. (1985). Low-back pain: Perception and tolerance. *Spine, 10*(*440-444*).

Seligman, M.E.P. (1972). Learned helplessness. *Annual Review of Medicine, 23*, 407-412.

Sharp, T.J. and Harvey, A.G. (2001). Chronic pain and posttraumatic stress disorder: Mutual maintenance? *Clinical Psychology Review, 21*(*6*), 857-877.

Shiffman, S., Fischer, L.A., Paty, J.A., Gnys, M., Hickcox, M. and Kassel, J. (1994). Drinking and smoking: A field study of their association. *Annals of Behavioral Medicine, 16*(*3*), 203-209.

Sindrup, S.H., Anderson, G., Madsen, C., Smith, T., Kim, B. and Jensen, T.S. (1999). Tramadol relieves pain and allodynia in polyneuropathy: A randomised, double-blind, controlled trial. *Pain*, *83*(*1*), 85-90.

Smith, C.A. and Wallston, K.A. (1992). Adaptation in patients with chronic rheumatoid arthritis: Application of a general model. *Health Psychology*, *11*(*3*), 151-162.

Smith, R.E. (1970). Changes in locus of control as a function of life crisis resolution. *Journal of Abnormal Psychology, 75*(*3*), 328-332.

Smith, W.B. and Safer, M.A. (1993). Effects of present pain level on recall of chronic pain and medication use. *Pain*, *55*, 355-361.

Snijders, T.A.B. and Bosker, R.J. (1999). *Multilevel Analysis: An introduction to basic and advanced multilevel modelling*. London, Sage.

Snow Turek, A.L., Norris, M.P. and Tan, G. (1996). Active and passive coping strategies in chronic pain patients. *Pain*, *64*(*3*), 455-462.

Spanos, N.P., Horton, C. and Chaves, J.F. (1975). The effects of two cognitive strategies on pain threshold. *Journal of Abnormal Psychology, 84*(*6*), 677-681.

Spanos, N.P., Radtke Bodorik, H.L., Ferguson, J.D. and Jones, B. (1979). The effects of hypnotic susceptibility, suggestions for analgesia, and the utilization of cognitive strategies on the reduction of pain. *Journal of Abnormal Psychology, 88*(*3*), 282-292.

Spielberger, C.D., Gorsuch, R.L. and Lushene, R.E. (1970). *Manual for the State-Trait Anxiety Inventory*. Palo Alto, CA, Consulting Psychologists Press.

Spinhoven, P. and Linssen, A.C. (1991). Behavioral treatment of chronic low back pain: I. Relation of coping strategy use to outcome. *Pain*, *45*(*1*), 29-34.

Spitzer, W.O., LeBlanc, F.R., and Dupuis, M. (1987). Scientific approach to the assessment and management of activity-related spinal disorders: Report of the Quebec Task Force on spinal disorders. *Spine,* 12 (suppl. 7), 1-59.

Stallone, F., Huba, G.J., Lawlor, W.G. and Fieve, R.R. (1973). Longitudinal studies of diurnal variations in depression: A sample of 643 patient days. *British Journal of Psychiatry*, *123,* 311-318.

Stewart, M.W., Harvey, S.T. and Evans, I.M. (2001). Coping and catastrophizing in chronic pain: A psychometric analysis and comparison of two measures. *Journal of Clinical Psychology*, *57*(*1*), 131-138.

Stewart, W.F., Ricci, J.A., Chee, E., Morganstein, D., and Lipton, R. (2003). Lost productive time and cost due to common pain conditions in the US workforce. *Journal of the American Medical Association, 290,* 2443-2454

Stone, A.A. and Kennedy-Moore, E. (1992). Assessing Situational Coping: Conceptual and methodological considerations. In H.S. Friedman (Ed.) *Hostility, coping, and health*. Washington D.C., American Psychological Association, 203-214.

Stone, A.A. and Neale, J.M. (1982). Development of a methodology for assessing daily experiences. In A. Baum and J. Singer (Eds.) *Advances in environmental psychology, environment and health*. New York, Erlbaum. *4*, 49-83.

Stone, A.A. and Shiffman, S. (1994). Ecological momentary assessment (EMA) in behavorial medicine. *Annals of Behavioral Medicine, 16*(*3*), 199-202.

Stone, A.A., Broderick, J.E., Porter, L.S. and Kaell, A.T. (1997). The experience of rheumatoid arthritis pain and fatigue: Examining momentary reports and correlates over one week. *Arthritis Care and Research*, *10*(*3*), 185-193.

Stone, A.A., Broderick, J.E., Schwartz, J.E., Shiffman, S., Litcher-Kelly, L. and Calvanese, P. (2003). Intensive Momentary Reporting Of Pain With An Electronic Diary: reactivity, compliance, and patient satisfaction. *Pain*, *104*, 343-351.

Stone, A.A., Schwartz, J.E., Neale, J.M., Shiffman, S., Marco, C.A., Hickcox, M., Paty, J., Porter, L.S. and Cruise, L.J. (1998). A comparison of coping assessed by ecological momentary assessment and retrospective recall. *Journal of Personality and Social Psychology*, *74*(*6*), 1670-1680.

Stone, A.A., Shiffman, S., Schwartz, J.E., Broderick, J. and Hufford, M. (2002). Patient non-compliance with paper diaries. *British Medical Journal*, *324*, 1193-1194.

Stone, A.A., Smyth, J.M., Pickering, T. and Schwartz, J. (1996). Daily mood variability: Form of diurnal patterns and determininants of diurnal patterns. *Journal of Applied Social Psychology*, *26*(*14*), 1286-1305.

Strahl, C., Kleinknecht, R.A. and Dinnel, D.L. (2000). The role of pain anxiety, coping, and pain self-efficacy in rheumatoid arthritis patient functioning. *Behaviour Research and Therapy*, *38*(*9*), 863-873.

Strong, J., Ashton, R., Cramond, T. and Chant, D. (1990). Pain Intensity, Attitude and Function in Back Pain Patients. *Australian Occupational Therapy Journal*, *37*(*4*), 179-183.

Subramanian, K. (1986). Group training for the management of chronic pain in interpersonal situations. *Social Work with Groups*, *9*(*3*), 55-69.

Sullivan, M., Karlsson, J. and Ware, J.E. (1995). The Swedish SF-36 Health Survey, Part 1: Evaluation of data quality, scaling assumptions, reliability and construct validity across general populations in Sweden. *Social Science and Medicine*, *41*(*10*), 1349-1358.

Sullivan, M.J., Rodgers, W.M., Wilson, P.M., Bell, G.J., Murray, T.C. and Fraser, S.N. (2002). An experimental investigation of the relation between catastrophising and activity intolerance. *Pain*, *100*(*47-53*).

Sullivan, M.J.L., Bishop, S.R. and Pivik, J. (1995). The Pain Catastrophizing Scale: Development and validation. *Psychological Assessment*, *7*(*4*), 524-532.

Sullivan, M.J.L., Thorn, B., Haythornthwaite, J.A., Keefe, F., Martin, M., Bradley, L.A. and Lefebvre, J.C. (2001). Theoretical perspectives on the relation between catastrophising and pain. *Clinical Journal of Pain*, *17*, 52-64.

Sullivan, M.J.L., Tripp, D.A., Rodgers, W.M. and Stanish, W. (2000). Catastrophising and pain percpetion in sport participants. *Journal of Applied Sports Psychology*, *12*, 151-167.

Suls, J., Wan, C., & Blanchard, E.A. (1994). A multilevel data-analytic approach for evaluation of relationships between daily life stressors and symptomatology: Patients with irritable bowel syndrome. *Health Psychology*, *13*, 103-113.

Summers, J.D., Rapoff, M.A., Varghese, G., Porter, K. and Palmer, P. (1992). Psychological factors in chronic spinal cord injury pain. *Pain*, *47*, 183-189.

Swartzman, L.C., Gwadry, F.G., Shapiro, A.P. and Teasell, R.W. (1994). The factor structure of the Coping Strategies Questionnaire. *Pain*, *57*(*3*), 311-316.

Tait, R.C., Pollard, A., Margolis, R.B., Duckro, P.N. and Krause, S. (1987). The Pain Disability Index: Psychometric and validity data. *Archives of Physical Medicine and Rehabilitation*, *68*, 438-441.

Taub, J. and Berger, R. (1974). Acute shifts in the sleep-wakefulness cycle: Effects on performance and mood. *Psychosomatic Medicine*, *36*, 164-173.

Taylor, A.E., Lorentzen, L. and Blank, M. (1990). Psychologic distress of chronic pain sufferers and their spouses. *Journal of Pain and Symptom Management, 5,* 6-10.

Taylor, C.B., Fried, L. and Kenardy, J. (1990). The use of a real-time computer diary for data acquisition and processing. *Behavior Research and Therapy, 21,* 93-97.

Taylor, H. and Curran, N.M. (1985). *The Nuprin Pain Report*. New York, Louis Harris.

Teasdale, J.D. and Barnard, P.J. (1993). *Affect, cognition and change: Remodelling depressive thought*. Hove, Lawrence Erlbaum Associates.

Tennen, H. and Affleck, G. (1996). Daily processes in coping with chronic pain: Methods and analytic strategies. In M. Zeidner and N.S. Endler (Eds.) *Handbook of Coping: Theory, research, applications*. New York, NY, John Wiley & Sons, 151-177.

Tennen, H., Affleck, G., Armeli, S. and Carney, M.A. (2000). A daily process approach to coping: Linking theory, research, and practice. *American Psychologist, 55*(*6*), 626-636.

ter Kuile, M.M., Linssen, A.C.G. and Spinhoven, P. (1993). The development of the Multidimensional Locus of Pain Control questionnaire (MLPC): Factor structure, reliability, and validity. *Journal of Psychopathology and Behavioral Assessment, 15*(*4*), 387-404.

Tolle, R. and Goetze, U. (1987). On the daily rhythm of depression symptomatology. *Psychopathology, 20,* 237-249.

Toomey, T.C., Gover, V.F. and Jones, B.N. (1983). Spatial distribution of pain: A descriptive characteristic of chronic pain. *Pain, 17,* 289-300.

Torgangeau, R. (2000). Remebering what happened: Memory errors and survey reports. In A.A. Stone, J.S. Turkkan, C.A. Bachrach, J.B. Jobe, H.S. Kurtzman and V.S. Cain (Eds.) *The science of self report: Implications for research and practice*, 29-48.

Tschannen, T.A., Duckro, P.N., Margolis, R.B. and Tomazic, T.J. (1992). The relationship of anger, depression, and perceived disability among headache patients. *Headache, 32*, 501-503.

Tunks, E. (1996). Comorbidity of psychiatric disorder and chronic pain. In J.N. Campbell (Ed.) *Pain 1996 - An updated review*. Seattle, IASP Press, 287-296.

Turk, D.C. and Melzack, R., Eds. (1992). *Handbook of pain assessment*. New York, NY, USA, Guilford Press.

Turk, D.C. and Rudy, T.E. (1992). Cognitive factors and persistent pain: A glimpse into Pandora's box. *Cognitive Therapy and Research, 16*(*2*), 99-122.

Turk, D.C., & Okifuji, A. (2002). Psychological factors in chronic pain: Evolution and revolution. *Journal of Consulting and Clinical Psychology, 70*(3), 678-690.

Turk, D.C., Meichenbaum, D. and Genest, M. (1983). *Pain and Behavioural Medicine: A cognitive-behavioural approach*. New York, Guilford.

Turk, D.C., Okifuji, A. and Scharff, L. (1995). Chronic pain and depression: Role of perceived impact and perceived control in different age cohorts. *Pain, 61*(*1*), 93-101.

Turk, D.C., Rudy, T.E. and Salovey, P. (1985). The McGill Pain Questionnaire reconsidered: Confirming the factor structure and examining appropriate uses. *Pain, 21*, 385-397.

Turner, J.A. (1980). Evaluation of two behavioral interventions for chronic low back pain. *Dissertation Abstracts International, 40*(*10-B*), 5027-5028.

Turner, J.A. (1982). Comparison of group progressive-relaxation training and cognitive-behavioral group therapy for chronic low back pain. *Journal of Consulting and Clinical Psychology, 50*(*5*), 757-765.

Turner, J.A. and Clancy, S. (1986). Strategies for coping with chronic low back pain: Relationship to pain and disability. *Pain*, *24*(*3*), 355-364.

Turner, J.A. and Romano, J.M. (1984). Self-report screening measures for depression in chronic pain. *Journal of Clinical Psychology, 40*, 909-913.

Turner, J.A., Clancy, S. and Vitaliano, P.P. (1987). Relationships of stress, appraisal and coping, to chronic low back pain. *Behaviour Research and Therapy*, *25*(*4*), 281-288.

Turner, J.A., Jensen, M.P. and Romano, J.M. (2000). Do beliefs, coping, and catastrophizing independently predict functioning in patients with chronic pain? *Pain*, *85*(*1-2*), 115-125.

Tursky, B., Jamner, L.D. and Friedman, R. (1982). The Pain Perception Profile: A psychophysical approach to the assessment of pain report. *Behaviour Therapy*, *13*, 376-394.

Tuttle, D.H., Shutty, M.S. and DeGood, D.E. (1991). Empirical dimensions of coping in chronic pain patients: A factorial analysis. *Rehabilitation Psychology*, *36*(*3*), 179-188.

Van Damme, S., Crombez, G. and Eccleston, C. (2002). Retarded disengagement from pain cues: The effects of pain catastrophising and pain expectancy. *Pain*, *100*, 111-118.

Van Damme, S., Crombez, G. and Eccleston, C. (2004). Disengagement from pain: The role of catastrophic thinking about pain. *Pain*, *107*, 70-76.

Van Damme, S., Crombez, G., Bijttebier, P., Goubert, L. and Van Houdenhove, B. (2002). A Confirmatory Factor Analysis Of The Pain Catastrophising Scale: Invariant factor structure across clinical and non-clinical populations. *Pain, 96*, 319-324.

van Tulder, M.W., Koes, B.W., and Bouter, L.M. (1995). A cost-of-illness study of back pain in the Netherlands. *Pain, 32*, 173-183

Vendrig, A.A. and Lousberg, R. (1997). Within person relationships among pain intensity, mood and physical activity in chronic pain: A naturalistic approach. *Pain, 73*(*1*), 71-76.

Verhaak, P.F.M., Kerssens, J.J., Dekker, J., Sorbi, M.J. and Bensing, J.M. (1998). Prevalence of chronic benign pain disorder among adults: A review of the literature. *Pain, 77*, 231-239.

Vlaeyen, J.W.S., & Linton, S.J. (2000). Fear-avoidance and its consequences in chronic musculoskeletal pain: A state of the art. *Pain, 85*, 317-332.

Vlaeyen, J.W.S., Kole-Snijders, A.M.J., Rotteveel, A., Ruesink, R., &Heuts, P.H.T.G. (1995). The role of fear of movement/(re)injury in pain disability. *Journal of Occupational Rehabilitation, 5*, 235-252.

von Baeyer, C.L. (1994). Reactive effects of measurement of pain. *Clinical Journal of Pain, 10*, 18-21.

Von Korff, M. (1999). *Epidemiological Methods*. In I.K. Crombie's (Ed) Epidemiology of Pain. IASP Press, Seattle.

Von Korff, M. and LeResche, L. (2005). *Epidemiology of Pain*. In H. Merskey, J.D. Loeser, and R. Dubner's (Eds) The Paths Of Pain: 1975-2005, IASP Press, Seattle

Wade, J.B., Price, D.D., Hamer, R.M., Schwartz, S.M. and Hart, R.P. (1990). An Emotional Components Analysis Of Chronic Pain. *Pain, 40*, 303-310.

Ware, J.E. and Sherbourne, C.D. (1992). The MOS 36-Item Short-Form Health Survey (SF-36), Part 1: Conceptual framework and item selection. *Medical Care*, *30*(*6*), 473-483.

Watkins, K.W., Shifren, K., Park, D.C. and Morrell, R.W. (1999). Age, pain, and coping with rheumatoid arthritis. *Pain*, *82*(*3*), 217-228.

Watson, D., Clark, L.A. and Tellegen, A. (1988). Development and validation of of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology, 54,* 1063-1070.

Weber, H. (1997). Sometimes more complex, sometimes more simple. *Journal of Health Psychology, 2,* 171-172.

Wells, A. (1985). ESM and the measurement of self-concept. *Paper presented at the E.S.M. Workshop*, University of Chicago.

West, S., & Hepworth, J. (1991). Statistical issues in the study of temporal data. *Journal of Personality, 59,* 609-622.

Wicklund, R.A. (1975). Objective self-awareness. In L. Berkowitz (Ed.) *Advances in Experimental Social Psychology*. New York, Academic Press. *8,* 233-275.

Williams, D.A., Robinson, M.E. and Geisser, M.E. (1994). Pain beliefs: Assessment and utility. *Pain*, *59*(*1*), 71-78.

Williams, E.J. (1959). The comparison of regression variables. *Journal of the Royal Statistical Society (Series B),* 21, 396-399.

Winterowd, C., Beck, A.T. and Gruener, D. (2003). *Cognitive Therapy With Chronic Pain Patients*. New York, Springer.

Wood, C. and Magnello, M. (1992). Diurnal changes in perceptions of energy and mood. *Journal of the Royal Society of Medicine, 85*, 191-194.

Zautra, A., Marbach, J.J., Raphael, K., Dohrenwend, B.P., Lennon, M. and Kenny, D. (1995). The examination of myofascial face pain and its relationship to psychological distress among women. *Health Psychology, 14*, 223-231.

Zautra, A.J., Burleson, M.H., Smith, C.A., Blalock, S.J., Wallston, K.A., & Devellis, R.F. (1995). Arthritis and perceptions of quality of life: An examination of positive and negative affect in rheumatoid arthritis patients. *Health Psychology, 14*, 399-408.

Zigmond, A.S. and Snaith, R.P. (1983). The Hospital Anxiety and Depression Scale. *Acta Psychiatrica Scandinavica, 67*, 361-370.

APPENDIX A

Table A.1 Comparison between PAMS Emotional Distress Items and Items from Established Scales

PAMS items	Source items
Right now I feel calm and peaceful	SF-36, q9d: “Have you felt calm and peaceful?”
How down do I feel right now?	SF-36, q9f: “Have you felt down?”
I am depressed at this moment	Peters, et al. (2000):”Right now I feel depressed”
How anxious do I feel right now?	MPI: q28 “During the past week how tense or anxious have you been?”
How irritable do I feel right now?	MPI: q26 “In the past week how irritable have you been?”
I feel tense or 'wound up' right now	MPI: q28 “During the past week how tense or anxious have you been?”; HADS: “I feel tense or ‘wound up’”
I feel cheerful right now	HADS: “I feel cheerful”

Table A.2 Comparison between PAMS Pain Appraisal Items and Items from Established Scales

PAMS items	Source items
Pain Self-Efficacy	
At the moment I am able to cope with the pain without medication	PSEQ: “I can cope with my pain without medication”
I'm capable of controlling the amount of pain I experience (without medication)	CSQ: “Based on all the things you do to cope, or deal with, your pain, on an average day, how much control do you feel you have over it?”
Right now I feel I'm capable of decreasing the pain without using medication	CSQ: “Based on all the things you do to cope, or deal with, your pain, on an average day, how much are you able to decrease it?
At this moment I believe I am able to do the things I need to do today	PSEQ: “I can still do many of the things I enjoy doing, such as hobbies or leisure activities, despite the pain”, “I can do most of the household chores (eg. tidying-up, washing dishes etc), despite the pain”, “I can do some form of work, despite the pain (“work” included housework, paid and unpaid work)”, “I can gradually become more active, despite the pain”
I believe I'm capable of engaging in physical activity (eg, work, chores, shopping)	
Catastrophising	
Right now I think that having the pain is terrible and I can't stand it anymore	PCS: q3 “Its terrible and I think its never going to get any better”, q5 “I feel I can’t stand it anymore”
Right now I wonder whether something serious may happen because of the pain	PCS: q11 “I wonder whether something serious may happen”
Perceived Pain Interference	
At the moment I am accomplishing less than I would like because of the pain	SF-36, 4a: “Accomplished less than you would like”
Right now I am finding it difficult to perform day-to-day activities because of the pain	SF-36, 4d: “Had difficulty performing the work or other activities (for example, it took extra effort)
Right now I feel I'm limited in the kinds of activities I can perform, because of the pain	SF-36, 4c: “Were limited in the kind of work or other activities”

Table A.3 Comparison between PAMS Function Items and Items from Established Scales

PAMS items	Source items
	Activity Engagement
Sit down	DQ: "I sit down for most of the day because of my pain"
Lie down	PBQ: "Lie down/rest/sleep"; DQ: "Because of my pain I lie down to rest more often"
Stand up	PBQ: "Avoid standing"; Peters, et al. (2000): Right now I am capable of standing"; DQ "I only stand up for short periods of time because of my pain"
Nap or rest	PBQ: "Lie down/rest/sleep"
Dress or bathe myself	SF-36, 3j: "Bathing or dressing yourself"
Bend, kneel or stoop	SF-36, 3f: "Bending, kneeling, or stooping"; DQ "Because of my pain, I try not to bend or kneel down"
Carry or push an object	SF-36, 3c: "Lifting or carrying groceries"
Lift an object	SF-36, 3c: "Lifting or carrying groceries"
Walked 100 meters	SF-36, 3i: "Walking 100 meters"
Walked half a kilometer	SF-36, 3h: "Walking half a kilometer"
Walked more than 1km	SF-36, 3g: "Walking more than a kilometer"
Climbed 1 flight of steps	SF-36, 3e: "Climbing one flight of stairs"
Climbed several flights	SF-36, 3e: "Climbing several flights of stairs"
	Activity Avoidance
Housework/chores	PBQ: "Avoid housework", "Avoid odd jobs in house"; MPI "How much has your pain changed your ability to do household chores"
Yardwork/gardening	PBQ: "Avoid gardening"; DQ: "Because of my pain, I am not doing any of the jobs that I usually do around the house", "I avoid heavy jobs around the house because of my pain"
Work (paid or unpaid)	PBQ: "Avoid going to work"
Shopping	PBQ: "Avoid shopping"
Cooking	PBQ: "Avoid cooking"
Visiting	PBQ: "Avoid visiting"
Dress or bathe myself	DQ "I get dressed more slowly than usual because of my pain", "I have trouble putting on socks (or stockings) because of my pain", "Because of my pain, I get dressed with help from someone else"
Driving	PBQ: "Avoid travel in cars"

Table A.4 Comparison between PAMS Pain Coping Items and Items from Established Scales

PAMS items	Source items
	Coping Behaviours & Relaxation
Did an activity/stretched	CSQ: "I do something active, like household chores or projects
	Divert Attention
Did something I enjoy	CSQ: "I think of things I enjoy doing"
Think of pleasant things	CSQ: "I try to think of something pleasant"
Distract myself from pain	CSE: "Distract myself from the pain"
Kept myself busy	CSE: "Keep busy to deal with the pain"
	Ignore
Ignore the pain	CSQ: "I ignore it"; CSE: "Ignore the pain"
Pretend it isn't there	CSQ: "I pretend it is not there"
Tell myself it doesn't hurt	CSQ: "I tell myself it doesn't hurt"
	Reinterpret
Try to feel distant from it	CSQ: "I try to feel distant from the pain, almost as if the pain was in somebody else's body"
I don't think of it as pain	CSQ: "I don't think of it as pain but rather a dull or warm feeling"
	Substance Use
Drank alcohol	PBQ: "Have alcohol"
Taken pain medication as part of a regular schedule	PBQ: "Take prescribed medication", "Take unprescribed medication"
Taken pain medications that were not part of a regular schedule	
	Communication
Talked to partner/friend	PBS: "Tell friend", "Tell someone in family"

Table A.5 Frequency Counts of Demographic Variables According To Gender and Sample Source

		Gender		Sample			Total
		Male	Female	Clinical	Comm.	Student	
	N	53	70	33	63	27	124
Sample Source	Clinical	19	14	-	-	-	33
	Community	24	39	-	-	-	63
	Student	10	17	-	-	-	27
Marital Status	Single	15	21	8	11	18	37
	Married	26	35	19	39	3	61
	Separated	3	1	2	1	1	4
	Divorced	2	7	3	6	0	9
	De Facto	6	5	1	5	5	11
	Widow/er	0	1	0	1	0	1
Education	Primary	6	2	4	4	0	8
	Junior Secondary	12	16	12	15	1	28
	Senior Secondary	12	23	11	11	14	36
	Certificate/Diploma	16	15	5	21	5	31
	Bachelor Degree	5	12	2	8	7	17
	Higher Degree	2	1	0	3	0	3
Employment Status	Full-time	10	9	3	15	1	19
	Part-time	8	9	1	10	6	17
	Casual	2	4	0	3	3	6
	Voluntary	0	7	2	5	0	7
	Home duties	10	14	11	13	0	24
	Retraining	2	0	1	1	0	2
	Student	7	14	1	3	17	21
	Unemployed	5	5	8	3	0	11
	Retired	9	8	7	10	0	17
Profession	Manager/Administrator	6	3	1	5	3	9
	Professional	4	6	4	6	0	10
	Para-professional	3	11	4	9	1	14
	Tradesperson	12	4	8	6	2	16
	Administrative Assistant	3	13	5	7	4	16
	Sales and Personal Services	7	10	3	8	6	17
	Machine Operator or Driver	3	5	2	6	0	8
	Manual Worker	7	2	1	7	1	9
	Never Had A Job	2	7	0	0	9	9
	Other	6	9	5	9	1	15

Table A.5 continued…

		Gender		Sample			Total
		Male	Female	Clinical	Comm.	Student	
Source Of Income	Worker's Comp	2	1	2	1	0	3
	Age Pension	2	2	2	2	0	4
	Wages/Salary	20	23	4	24	15	43
	Unemployment benefits	3	4	3	3	1	7
	Superannuation	2	0	1	1	0	2
	Sickness benefits	4	3	5	3	0	8
	Invalid Pension	12	18	16	13	1	30
	Partner's Income	6	14	3	14	3	20
	Supporting Parent's	1	5	1	0	5	6
	Savings/Investments	7	6	1	6	6	13
	Other	4	10	3	7	4	14

Table A.6 Frequency Counts of Pain Variables According To Gender and Sample Source

		Gender		Sample			Total
		Male	Female	Clinical	Comm.	Student	
	N	53	70	33	63	27	124
Pain Topography	Always present, same intensity	2	1	3	0	0	3
	Always present, varied intensity	37	42	28	42	10	79
	Usually present but short pain-free periods	2	10	0	11	1	12
	Often present, but pain-free periods of up to several hours	5	8	2	6	5	13
	Often present, but pain-free much of the day	3	4	1	3	3	7
	Occasionally present, but not every day	4	3	0	1	6	7
	Rarely present - days or weeks between pain episodes	0	2	0	0	2	2
Pain Cause	Work Accident	10	7	9	8	1	17
	Work - other	4	3	1	6	0	7
	Home Accident	3	6	3	5	1	9
	Car Accident	8	14	4	17	1	22
	Post-surgical	7	6	9	2	2	13
	After an illness	2	5	2	3	2	7
	No clear reason	10	22	5	14	13	32
	Other	9	7	1	8	7	16
Pain Locations	Head	17	23	6	25	9	40
	Jaw	2	1	2	0	1	3
	Facial	7	15	6	11	5	22
	Neck	7	15	13	40	9	22
	Shoulders	12	18	8	17	5	30
	Upper back	6	19	6	15	4	25
	Lower back	19	32	11	29	11	51
	Chest	2	5	2	2	3	7
	Arms	5	21	5	18	3	26
	Hands	5	21	6	13	1	26
	Abdomen	4	10	2	8	4	14
	Genitals	4	1	0	5	0	5
	Buttocks	9	17	7	16	3	26
	Upper Leg	13	24	9	22	6	37
	Lower Leg	6	10	5	9	2	16
	Feet	9	11	4	12	4	20

Table A.6 continued…

		Gender		Sample			Total
		Male	Female	Clinical	Comm.	Student	
Medication usage	Sedatives, hypnotics	5	8	2	9	2	13
	Anti-anxiety	5	8	3	6	1	13
	Antidepressant – Tricyclic	8	11	9	10	0	19
	Antidepressant - SSRI	3	15	8	8	2	18
	Antidepressant - other	8	4	5	6	1	12
	Anti-migraine	0	1	0	1	0	1
	Anticonvulsants	6	7	11	2	0	13
	Narcotics	20	37	19	32	6	57
	Simple analgesics	21	25	20	19	7	46
	Combination analgesics	6	7	0	9	4	13
	NSAIDS	4	15	1	13	5	19
	Anti-rheumatoid	1	3	1	2	1	4
	Topical Analgesics	0	2	0	2	0	2
Pain-related treatments	Acupuncturist	24	34	22	28	9	58
	Anesthetist	11	18	14	12	3	29
	Chiropractor	20	32	13	32	8	52
	Homeopath	6	17	6	13	4	23
	Hypnotherapist	3	5	3	2	3	8
	Neurologist	20	31	17	29	5	51
	Neurosurgeon	21	16	13	25	0	37
	OT	22	26	26	21	2	48
	Orthopedic Surgeon	28	32	22	32	6	60
	Physiotherapist	43	53	30	52	15	96
	Psychologist	24	28	25	24	4	52
	Psychiatrist	22	25	24	20	4	47
	Rheumatologist	22	25	5	18	2	47
	Pain Clinic	27	31	31	23	5	58
	GP	27	31	32	57	18	58
	Other	14	17	3	20	8	31
Current pain- or injury-related litigation	None	44	60	29	49	27	104
	Worker's Compensation	1	2	2	1	0	3
	Third-party compensation	5	7	2	10	0	12
	Other	3	1	1	3	0	4
Previous pain- or injury- related litigation	None	38	53	23	44	25	91
	Worker's Compensation	9	7	5	11	0	16
	Third-party compensation	1	8	2	5	2	9
	Other	4	2	3	3	0	6
Outcome of previous litigation	Successful	10	11	5	14	2	21
	Unsuccessful	4	6	5	5	0	10

Table A.7 Descriptive statistics for the total sample.

	N	Min.	Max.	M	SD	Skew	Std. Skew	Kurt.	Std. Kurt.
Time taken to complete PAMS	115	5	680	39.25	76.76	6.10	26.99	45.19	101.11
Age	123	14	78	42.17	15.34	-0.08	-0.37	-0.87	-2.01
Pain Duration	122	0.17	58.17	10.12	11.66	2.26	10.33	5.74	13.20
Total Pain Sites	123	1	50	12.44	10.20	1.69	7.77	3.04	7.01
Regular Sites	123	0	50	6.61	7.10	2.47	11.33	10.53	24.33
Primary Sites	123	0	50	5.01	6.64	3.33	15.26	16.95	39.15
Radiating sites	123	0	41	5.83	7.73	2.07	9.48	4.82	11.12
McGill PRI – Total	123	0.01	0.89	0.41	0.18	0.00	0.00	-0.64	-1.49
MPI - Pain Severity	121	0.67	6	3.83	1.15	-0.81	-3.66	0.18	0.42
MPI - Affective Distress	121	0.67	6	3.21	1.21	-0.11	-0.48	-0.51	-1.17
MPI - Interfere	121	0.09	6	3.91	1.34	-0.72	-3.25	-0.04	-0.10
MPI - Support	112	0	6	4.19	1.51	-1.03	-4.50	0.40	0.87
MPI - Life-Control	121	0	6	3.21	1.21	-0.32	-1.43	-0.21	-0.47
PCS - Rumination	121	0	16	7.82	4.37	0.13	0.60	-0.76	-1.75
PCS - Magnification	121	0	12	4.07	3.15	0.57	2.59	-0.24	-0.54
PCS - Helplessness	121	0	24	10.06	5.61	0.36	1.64	-0.26	-0.60
PSEQ	121	3	58	32.66	13.31	-0.29	-1.32	-0.66	-1.52
CSQ - Catastrophising	118	0	36	12.40	8.70	0.59	2.64	-0.25	-0.57
CSQ - Control over Pain	120	0	5	2.73	1.43	-0.39	-1.77	-0.37	-0.85
CSQ - Ability to Decrease Pain	120	0	5	2.33	1.32	-0.19	-0.84	-0.54	-1.24
CSQ - Divert Attention	118	0	62	14.89	9.89	0.95	4.26	3.20	7.23
CSQ - Reinterpret Pain Sensation	118	0	34	7.95	6.84	1.07	4.78	1.38	3.11
CSQ - Ignoring Sensations	118	0	34	13.89	7.64	0.16	0.73	-0.64	-1.44
CSQ - Praying or Hoping	118	0	36	11.88	8.82	0.45	2.00	-0.56	-1.27
CSQ - Coping Self Statements	118	3	36	21.14	7.17	-0.16	-0.71	-0.44	-1.00
CSQ - Increased Beh.Activities	118	0	35	16.03	6.92	-0.15	-0.67	0.12	0.27
HADS - Anxiety	122	1	20	9.51	4.39	0.14	0.63	-0.60	-1.39
HADS - Depression	122	0	20	7.25	4.35	0.53	2.40	-0.32	-0.74
SF36 - Phy Funct	121	10	30	20.50	5.47	0.15	0.69	-1.01	-2.31
SF36 - Phy Role Funct	120	4	8	4.80	1.27	1.39	6.30	0.65	1.47
SF36 - Bodily Pain	118	2	10.4	5.11	1.76	0.62	2.77	-0.08	-0.19
SF36 - General Health	119	6	25	15.66	5.13	-0.06	-0.28	-1.15	-2.62
SF36 - Vitality	118	4	21	11.44	4.21	0.16	0.70	-0.89	-2.01
SF36 - Social Funct	118	4	24	15.98	4.36	-0.10	-0.43	-0.46	-1.05
SF36 - Em Role Funct	118	3	6	4.21	1.21	0.41	1.82	-1.42	-3.22
SF36 - Men Health	118	10	29	19.81	5.08	-0.23	-1.03	-0.93	-2.10
SF36 - Health Transition	120	1	5	3.18	1.09	-0.06	-0.26	-0.52	-1.19
DQ	121	0	23	10.69	5.95	0.24	1.10	-1.05	-2.41

Table A.8 Descriptive statistics according to gender and source: M (SD)

		Gender		Source		
		Male	Female	Clinical	Community	Student
Time taken to complete PAMS		43.73 (102.34)	35.56 (46.77)	37.37 (58.71)	49.78 (96.75)	17.54 (19.99)
Age		43.34 (15.64)	41.29 (15.16)	48.61 (11.85)	46.17 (13.28)	25 (10.65)
Pain Duration		10.38 (12.27)	9.92 (11.25)	11.84 (12.23)	11.05 (12.76)	5.87 (6.5)
Total Pain Sites		11.17 (9.39)	13.4 (10.75)	11.48 (7.94)	15.24 (11.84)	7.07 (5.17)
Regular Sites		5.55 (6.21)	7.41 (7.65)	5.3 (6.16)	8.11 (8.25)	4.7 (4.04)
Primary Sites		4.74 (6.15)	5.21 (7.02)	4.61 (6.07)	5.92 (7.86)	3.37 (3.04)
Radiating sites		5.62 (7.47)	5.99 (7.98)	6.18 (6.74)	7.13 (9.16)	2.37 (2.8)
McGill	PRI - Total	0.41 (0.2)	0.41 (0.18)	0.4 (0.19)	0.44 (0.17)	0.36 (0.19)
MPI	Pain Severity	3.57 (1.21)	4 (1.06)	4.15 (1.04)	4.04 (0.93)	2.95 (1.3)
	Affective Distress	2.99 (1.31)	3.36 (1.12)	3.11 (1.22)	3.23 (1.18)	3.27 (1.31)
	Interfere	3.88 (1.45)	3.93 (1.26)	4.26 (0.96)	4.22 (1.23)	2.78 (1.38)
	Support	4.31 (1.58)	4.07 (1.45)	4.28 (1.8)	4.41 (1.21)	3.62 (1.61)
	Life-Control	3.34 (1.17)	3.13 (1.25)	3.4 (1.41)	3.26 (1.07)	2.86 (1.24)
PCS	Rumination	7.96 (4.68)	7.6 (4.05)	9.04 (4.83)	7.81 (4.29)	6.41 (3.62)
	Magnification	3.98 (3.2)	4.03 (3)	4.31 (3.71)	4.15 (2.86)	3.63 (3.15)
	Helplessness	10.12 (6.39)	9.96 (5.01)	11.53 (5.66)	10.37 (5.45)	7.59 (5.32)
PSEQ		33.15 (14.55)	32.62 (12.18)	28.5 (12.74)	30.95 (13)	41.54 (10.84)
CSQ	Catastrophising	10.98 (9)	13.39 (8.4)	13.45 (9.14)	11.87 (9)	12.39 (7.66)
	Control over Pain	2.85 (1.38)	2.63 (1.48)	2.52 (1.46)	2.8 (1.38)	2.81 (1.52)
	Ability to Decrease Pain	2.45 (1.23)	2.23 (1.4)	2.19 (1.35)	2.43 (1.22)	2.24 (1.53)
	Divert Attention	13.86 (9.71)	15.73 (10.09)	15.97 (9.95)	15.53 (10.84)	12.24 (7.06)
	Reinterpret Pain Sens.	7.71 (6.52)	8.26 (7.11)	7.55 (6.81)	7.67 (7.63)	9.04 (4.87)
	Ignoring Sensations	15.08 (6.81)	13.18 (8.05)	12.45 (7.92)	14 (7.45)	15.3 (7.73)
	Praying or Hoping	10.85 (8.63)	12.69 (9.02)	11.96 (9.82)	11.55 (8.68)	12.52 (8.21)
	Coping Self Statements	20.85 (7.64)	21.55 (6.73)	20.06 (8.19)	22.01 (6.48)	20.44 (7.44)
	Increased Beh. Activities	15.45 (7.11)	16.53 (6.83)	18.39 (7.45)	16.21 (6.27)	12.94 (6.75)
HADS	Anxiety	8.48 (4.49)	10.23 (4.19)	10.44 (4.63)	9.07 (4.19)	9.44 (4.56)
	Depression	7 (4.46)	7.39 (4.3)	8.63 (4.39)	7.41 (4.44)	5.22 (3.37)
SF-36	Physical Functioning	21.4 (5.71)	19.92 (5.21)	19.36 (4.9)	19.13 (5.28)	25 (4.11)
	Role Functioning - Phy	5.06 (1.49)	4.62 (1.05)	4.55 (1.31)	4.6 (1.11)	5.56 (1.31)
	Bodily Pain	5.17 (1.92)	5.08 (1.66)	4.61 (1.46)	4.82 (1.55)	6.32 (1.98)
	General Health	16.43 (4.97)	15.15 (5.23)	14.73 (5.56)	15.96 (5.18)	16.06 (4.45)
	Vitality	12.33 (4.5)	10.83 (3.93)	11.82 (4.27)	10.96 (4.28)	12.15 (4)
	Social Functioning	15.67 (5.07)	16.24 (3.81)	14.4 (3.62)	15.48 (4.54)	19 (3.21)
	Role Functioning – Em.	4.45 (1.24)	4.06 (1.17)	3.9 (1.08)	4.31 (1.3)	4.33 (1.11)
	Mental Health	20.63 (5.5)	19.24 (4.75)	19.41 (5.15)	19.9 (5.26)	20.04 (4.75)
	Health Transition	3.35 (1.18)	3.04 (1.01)	3.32 (1.19)	3.29 (1.05)	2.78 (1.01)
DQ		9.92 (5.78)	11.09 (5.95)	12.41 (5.73)	11.38 (5.9)	6.88 (4.76)

APPENDIX B

Demographics and Pain History Questionnaire

BACKGROUND QUESTIONNAIRE

In this questionnaire we would like to get some background information about you and about the pain that you experience. You may have had a number of painful conditions in your life, but in this questionnaire we are interested in the pain that you currently experience.

1. Today's Date: _____

2. Your Gender: ☐ Male 1 ☐ Female 2

3. Your Date of Birth (day/month/year): _____/_____/_____

4. Your Age (in years): _____

5. What is your current employment status? (please tick ONE)
   - ☐ Full-time work 1
   - ☐ Part-time work 2
   - ☐ Casual work 3
   - ☐ Voluntary work 4
   - ☐ Home duties 5
   - ☐ Retraining 6
   - ☐ Student 7
   - ☐ Unemployed 8
   - ☐ Retired 9

6. How would you describe your current profession (or, if unemployed, your previous profession)?
   - ☐ Manager or administrator (eg personnel manager, managing supervisor) 1
   - ☐ Professional (eg teacher, social worker, doctor, artist) 2
   - ☐ Para-professional (eg welfare worker, technical officer, registered nurse, police) 3
   - ☐ Tradesperson (eg. Cook, hairdresser, mechanic, carpenter) 4
   - ☐ Administrative Assistant (eg secretary, telephonist) 5
   - ☐ Sales and personal service worker (eg sales assistant, bar attendant, child care worker, enrolled nurse) 6
   - ☐ Machine operator or driver (eg courier, sewing machinist, fork-lift or bobcat operator) 7
   - ☐ Manual worker (eg labourer, cleaner, kitchenhand) 8
   - ☐ Never had a job 9
   - ☐ Other (please specify) _____ 10

7. What is your current source of income? (you may tick more than one)
   - ☐ Workers Compensation insurance 1
   - ☐ Age pension 2
   - ☐ Wages/salary 3
   - ☐ Unemployment benefits 4
   - ☐ Superannuation payments 5
   - ☐ Sickness benefits 6
   - ☐ Invalid pension 7

☐ Partner's/wife's/husband's earnings 8
☐ Supporting Parent's Benefits 9
☐ Savings/investments 10
☐ Other (please specify) _____ 11

8. What is you highest level of education? (please tick only one)
☐ Primary School 1 ☐ Junior H.S. 2 ☐ Senior H.S. 3
☐ Certificate/Diploma 4 ☐ Bachelor Degree/Honours 5 ☐ Higher Degree 6

9. What is your current marital status? (please select only one)
☐ Single 1 ☐ Married 2 ☐ Separated 3 ☐ Divorced 4
☐ De Facto 5 ☐ Widow/er 6 ☐ Other _____ 7

10. When did the pain you currently have first start? Please be as exact as possible.

Day _____ Month:_____ Year:_____

11. How did your current pain begin? (Tick ONE: if more than one applies, tick the one that applies BEST)
☐ Accident at work 1
☐ At work, but not involving an accident 2
☐ Accident at home 3
☐ Car accident 4
☐ After surgery 5
☐ After an illness 6
☐ Pain just began, no clear reason 7
☐ Other (please specify) _____ 8

12. What medical diagnoses have you received in relation to the pain you currently experience?

_____

_____

13. Are you currently involved in any of the following, relating to the pain condition you currently have? (tick each one that applies to you)
☐ A Worker's Compensation claim 1
☐ A Third Party Accident Compensation claim 2
☐ Some other legal case (please specify) _____ 3

14. Have you previously been involved in any of the following, relating to the pain condition you currently have? (tick each one that applies to you)

    ☐ A Worker's Compensation claim 1

    ☐ A Third Party Accident Compensation claim 2

    ☐ Some other legal case (please specify) _____ 3

15. If you have made a previous compensation claim relating to the pain condition you currently have, was you claim successful?

    ☐ Yes 1

    ☐ No 2

16. Which statement best describes your current pain? (If none is exactly like your pain, please tick the closest statement)

    ☐ Always present, always the same intensity 1

    ☐ Always present, intensity varies 2

    ☐ Usually present, but have short periods without pain 3

    ☐ Often present, but have pain-free periods lasting up to several hours 4

    ☐ Often present, but I am pain-free for much of the day5

    ☐ Occasionally present for brief periods, but not every day 6

    ☐ Rarely present – have pain episodes every now and then, with days or weeks in between 7

17. Since your pain began, which of the following people have you seen about it?

    ☐ Acupuncturist 1

    ☐ Anaesthetist 2

    ☐ Chiropractor 3

    ☐ Homeopath 4

    ☐ Hypnotherapist 5

    ☐ Neurologist 6

    ☐ Neurosurgeon 7

    ☐ Occupational therapist 8

    ☐ Orthopaedic surgeon 9

    ☐ Physiotherapist 10

    ☐ Psychologist 11

    ☐ Psychiatrist 12

    ☐ Rheumatologist 13

    ☐ Pain clinic 14

    ☐ General practitioner 15

    ☐ Other (please specify) _____ 16

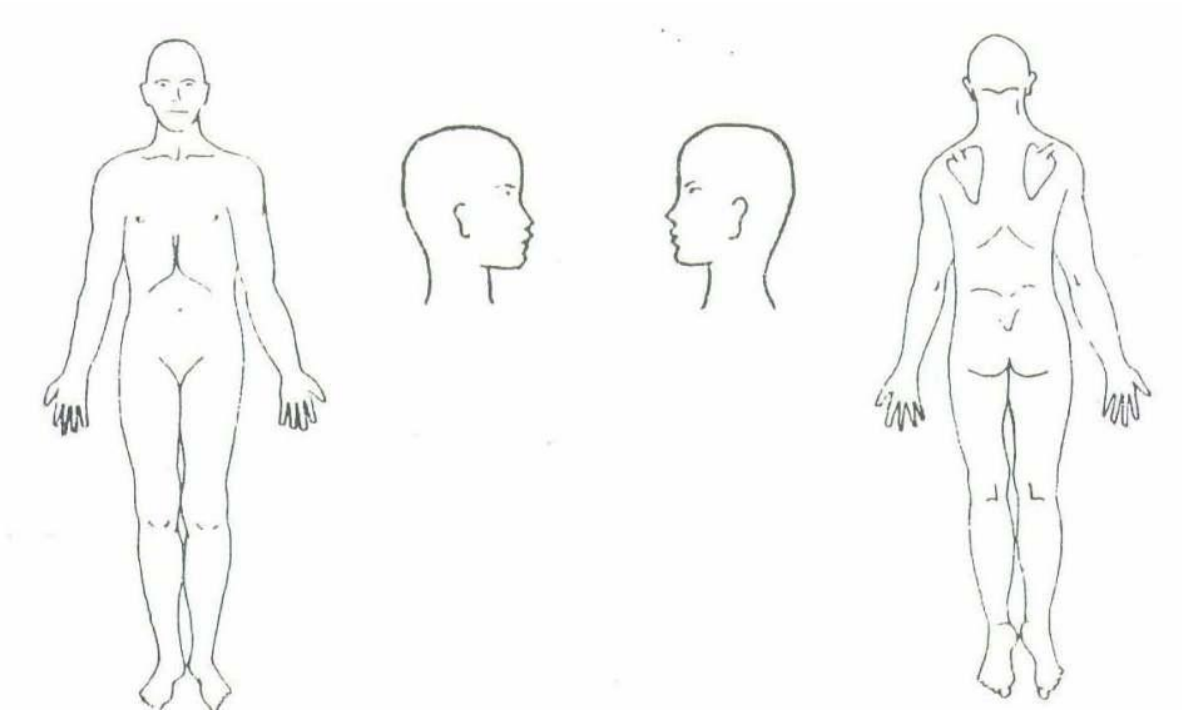
18. Please list the surgical operations you have had for the pain you are currently experiencing.

Surgery	Date

19. Please name the medications you are currently taking for pain, depression, anxiety or sleep, it's/their strength and the schedule on which you are taking them.

Medication Name	Dose	Schedule
		☐ I take ____ tablets, ____ times a day ☐ I take ____ tablets when I feel I need them
		☐ I take ____ tablets, ____ times a day ☐ I take ____ tablets when I feel I need them
		☐ I take ____ tablets, ____ times a day ☐ I take ____ tablets when I feel I need them
		☐ I take ____ tablets, ____ times a day ☐ I take ____ tablets when I feel I need them
		☐ I take ____ tablets, ____ times a day ☐ I take ____ tablets when I feel I need them
		☐ I take ____ tablets, ____ times a day ☐ I take ____ tablets when I feel I need them
		☐ I take ____ tablets, ____ times a day ☐ I take ____ tablets when I feel I need them

20. Please indicate with an X on these figures where your main pain is. Shade any area where your pain spreads. Please number (2,3,4 etc) any other areas where you have pain.



APPENDIX C

Table C.1. Frequency counts of demographic variables according to gender and sample source

		Total	Sample			Gender		Cohort	
			Clin.	Comm.	Student	Male	Female	Old	New
	N	53	11	20	22	16	37	28	25
Sex	Female	37	6	16	15			21	16
	Male	16	5	4	7			8	8
Sample Source	Clinical	11				5	6	6	5
	Community	20				4	16	17	3
	Student	22				7	15	5	17
Marital Status	Single	18	1	2	15	4	14	8	10
	Married	19	6	12	1	8	11	13	6
	Separated	2	0	1	1	2	0	1	1
	Divorced	2	1	1	0	0	2	2	0
	De Facto	6	2	2	2	1	5	2	4
	Widow/er	1	1	0	0	0	1	1	0
Education	Primary	4	2	2	0	2	2	2	2
	Junior Secondary	9	3	6	0	1	8	7	2
	Senior Secondary	15	1	3	11	3	12	8	7
	Certificate/Diploma	11	2	5	4	4	7	6	5
	Bachelor Degree	5	1	2	2	3	2	3	2
	Higher Degree	3	1	0	2	2	1	0	3
Employment Status	Full-time	5	1	3	1	2	3	5	0
	Part-time	6	0	2	4	2	4	2	4
	Casual	4	0	2	2	1	3	3	1
	Voluntary	2	1	1	0	0	2	1	1
	Home duties	4	1	2	1	0	4	3	1
	Retraining	1	0	0	1	0	1	1	0
	Student	11	1	2	8	3	8	4	7
	Unemployed	8	4	2	2	5	3	4	4
	Retired	6	3	3	0	2	4	3	3

Table C.1 continued…

		Total	Sample			Gender		Cohort	
			Clin.	Comm.	Student	Male	Female	Old	New
Profession	Manager/Administrator	6	1	3	2	3	3	3	3
	Professional	4	2	1	1	1	3	2	2
	Para-professional	6	1	5	0	0	6	5	1
	Tradesperson	2	2	0	0	2	0	1	1
	Administrative Assistant	5	0	1	4	0	5	2	3
	Sales and Personal Services	6	0	2	4	2	4	3	3
	Machine Operator or Driver	4	1	2	1	1	3	3	1
	Manual Worker	3	0	1	2	3	0	1	2
	Never Had A Job	2	1	0	1	1	1	1	1
	Other	10	3	3	4	2	8	6	4
Source Of Income	Worker's Comp	0	0	0	0	0	0	0	0
	Age Pension	3	2	1	0	1	2	2	1
	Wages/Salary	18	1	5	12	6	12	9	9
	Unemployment benefits	1	1	0	0	1	0	1	0
	Superannuation	1	0	1	0	0	1	0	1
	Sickness benefits	3	0	2	1	1	2	3	0
	Invalid Pension	13	5	7	1	3	10	9	4
	Partner's Income	9	3	3	3	3	6	3	6
	Supporting Parent's	4	0	0	4	3	1	0	4
	Savings/Investments	6	0	2	4	1	5	3	3
	Other	4	0	1	3	1	3	2	2

Table C.2 Frequency counts of pain variables according to gender, sample source, and cohort

			Sample			Gender		Cohort	
		Total	Clin.	Comm.	Student	Male	Female	Old	New
Pain Topography	Always present, same intensity	2	1	0	1	1	1	0	2
	Always present, varied intensity	29	8	18	3	8	21	23	6
	Usually present but short pain-free periods	6	1	0	5	3	3	1	5
	Often present, but pain-free periods of up to several hours	6	1	0	5	0	6	3	3
	Often present, but pain-free much of the day	4	0	0	4	3	1	0	4
	Occasionally present, but not every day	0	0	0	0	0	0	0	0
	Rarely present - days or weeks between pain episodes	1	0	0	1	0	1	0	1
Pain Cause	Work Accident	7	1	4	2	3	4	5	2
	Work - other	5	1	3	1	2	3	3	2
	Home Accident	3	1	1	1	1	2	1	2
	Car Accident	3	1	1	1	1	2	3	0
	Post-surgical	4	3	1	0	2	2	3	1
	After an illness	2	1	0	1	0	2	0	2
	No clear reason	15	2	6	7	3	12	8	7
	Other	9	1	2	6	3	6	4	5
Pain Locations	Head	15	2	5	8	5	10	8	7
	Jaw	1	0	1	0	0	1	1	0
	Facial	11	1	4	6	3	8	7	4
	Neck	20	6	9	5	7	13	12	8
	Shoulders	10	1	6	3	2	8	6	4
	Upper back	6	3	1	2	2	4	3	3
	Lower back	27	7	12	8	8	19	18	9
	Chest	2	2	0	0	2	0	1	1
	Arms	11	4	7	0	3	8	9	2
	Hands	7	1	6	0	2	5	6	1
	Abdomen	6	3	3	0	2	4	6	0
	Genitals	1	1	0	0	1	0	1	0
	Buttocks	11	3	4	4	2	9	6	5
	Upper Leg	20	4	12	4	6	14	13	7
	Lower Leg	5	2	2	1	3	2	4	1
	Feet	8	0	8	0	2	6	6	2

Table C.2 continued…

			Sample			Gender		Cohort	
		Total	Clin.	Comm.	Student	Male	Female	Old	New
Medication usage	Sedatives, hypnotics	5	1	3	1	0	5	5	0
	Anti-anxiety	2	1	1	0	1	1	1	1
	Antidepressant – Tricyclic	6	4	2	0	2	4	5	1
	Antidepressant - SSRI	5	0	2	3	0	5	4	1
	Antidepressant - other	2	0	1	1	1	1	1	1
	Anti-migraine	0	0	0	0	0	0	0	0
	Anticonvulsants	2	1	1	0	1	1	2	0
	Narcotics	19	7	8	4	3	16	11	8
	Simple analgesics	19	4	8	7	7	12	9	10
	Combination analgesics	4	0	2	2	1	3	2	2
	NSAIDS	8	1	5	2	1	7	5	3
	Anti-rheumatoid	1	0	1	0	0	1	1	0
	Topical Analgesics	0	0	0	0	0	0	0	0
Pain-related treatments	Acupuncturist	18	3	9	6	7	11	12	6
	Anaesthetist	11	4	4	3	5	6	7	4
	Chiropractor	16	3	6	7	8	8	8	8
	Homeopath	7	1	4	2	2	5	5	2
	Hypnotherapist	5	1	2	2	2	3	4	1
	Neurologist	19	7	7	5	7	12	13	6
	Neurosurgeon	6	3	2	1	4	2	5	1
	OT	16	7	7	2	8	8	12	4
	Orthopaedic Surg	20	5	10	5	6	14	15	5
	Physio	34	7	15	12	12	22	20	14
	Psychologist	14	4	6	4	5	9	12	2
	Psychiatrist	15	5	7	3	6	9	11	4
	Rheumatologist	12	2	9	1	2	10	8	4
	Pain Clinic	20	10	8	2	7	13	14	6
	GP	39	9	18	12	12	27	24	15
	Other	14	2	6	6	5	9	8	6
Current pain- or injury- related litigation	Worker's Compensation	1	1	0	0	1	0	1	0
	Third-party compensation	0	0	0	0	0	0	0	0
	Other	1	1	0	0	1	0	0	1
Previous pain- or injury- related litigation	Worker's Compensation	5	0	3	2	2	3	3	2
	Third-party compensation	4	0	2	2	1	3	3	1
	Other	0	0	0	0	0	0	0	0
Successful outcome of previous litigation		8		5	3	2	6	6	2

Table C.3 Descriptive statistics for the total sample.

	Min.	Max.	M	SD	Skew	Std. Skew	Kurt.	Std. Kurt.
Age	17	74	39.10	17.68	0.16	0.47	-1.39	-2.06
Pain Duration	0.58	40.75	9.27	8.82	1.72	4.92	3.31	4.81
Total Pain Sites	1	36	10.65	8.97	1.27	3.71	1.00	1.49
Regular Sites	0	18	5.73	4.82	1.03	3.00	0.22	0.33
Primary Sites	0	18	4.13	3.98	1.67	4.88	2.80	4.15
Radiating sites	0	36	7.71	9.29	1.65	4.81	2.17	3.22
McGill PRI – Total	0	0.84	0.40	0.20	0.20	0.59	-0.65	-0.96
MPI - Pain Severity	1.33	5.67	3.77	1.02	-0.42	-1.23	-0.31	-0.45
MPI - Affective Distress	0	5.67	2.90	1.32	-0.28	-0.82	-0.75	-1.11
MPI - Interfere	0	5.82	3.59	1.45	-0.55	-1.60	-0.20	-0.29
MPI - Support	0	6	3.97	1.60	-0.94	-2.66	0.38	0.54
MPI - Life-Control	0	5.5	3.42	1.19	-0.40	-1.16	0.18	0.27
PCS - Rumination	0	16	6.42	4.02	0.23	0.68	-0.78	-1.15
PCS - Magnification	0	12	3.10	2.79	1.23	3.58	1.72	2.55
PCS - Helplessness	0	23	8.13	5.52	0.70	2.03	0.18	0.26
PSEQ	10.5	60	37.40	12.75	-0.20	-0.57	-0.73	-1.08
CSQ - Catastrophising	0	33	9.29	8.12	0.97	2.83	0.93	1.37
CSQ - Control over Pain	0	6	3.03	1.61	-0.29	-0.84	-0.42	-0.62
CSQ - Ability to Decrease Pain	0	6	2.10	1.30	0.41	1.20	0.78	1.16
CSQ - Divert Attention	0	32	14.14	9.56	0.28	0.83	-1.16	-1.72
CSQ - Reinterpret Pain Sens.	0	28	7.23	8.00	1.16	3.39	0.41	0.60
CSQ - Ignoring Sensations	0	36	19.06	8.56	-0.09	-0.26	-0.67	-1.00
CSQ - Praying or Hoping	0	27	10.52	7.55	0.31	0.89	-0.75	-1.11
CSQ - Coping Self Statements	6	36	22.89	7.28	-0.35	-1.01	-0.15	-0.23
CSQ - Increased Beh.Activities	3	32	16.54	7.29	0.08	0.24	-0.93	-1.38
HADS - Anxiety	0	19	8.29	4.37	0.26	0.76	-0.23	-0.34
HADS - Depression	0	18	5.75	4.31	1.08	3.13	0.85	1.27
SF36 - Phy Funct	10	30	21.49	5.72	-0.25	-0.72	-0.79	-1.18
SF36 - Phy Role Funct	4	8	4.85	1.43	1.45	4.24	0.58	0.86
SF36 - Bodily Pain	3	10.4	5.79	1.80	0.61	1.77	0.20	0.30
SF36 - General Health	5	25	15.12	5.03	0.17	0.48	-0.75	-1.12
SF36 - Vitality	4	21	12.08	4.00	0.07	0.19	-0.51	-0.75
SF36 - Social Funct	8	24	16.50	4.43	-0.23	-0.68	-0.66	-0.98
SF36 - Em Role Funct	3	6	4.46	1.24	0.03	0.08	-1.63	-2.41
SF36 - Men Health	10	29	20.50	5.15	-0.34	-0.98	-0.96	-1.43
SF36 - Health Transition	1	5	3.00	1.11	0.00	0.00	-0.76	-1.12
SF36 – Mental Health Factor	4.58	20.69	13.43	3.95	-0.26	-0.76	-0.59	-0.88
SF36 – Physical Health Factor	3.38	18.1	10.33	3.67	0.06	0.16	-0.44	-0.65
DQ	0	20	9.29	5.14	0.27	0.80	-0.35	-0.52

n=48 for all variables, except MPI – Support (n=45) and Pain Duration (n=46)

Table C.4 Descriptive statistics of PAMS and PAMS-R for the total sample.

	Min.	Max.	M	SD	Skew	Std. Skew	Kurt.	Std. Kurt.
			PAMS-R					
Average Pain	24	83	55.85	14.73	-0.32	-0.94	-0.37	-0.54
Minimum Pain	0	101	28.46	22.00	0.85	2.48	0.91	1.36
Maximum Pain	28	97	74.04	13.56	-1.15	-3.36	1.83	2.71
Distress	6.5	83.38	42.81	17.59	-0.16	-0.45	-0.38	-0.57
Self-Efficacy	2.67	100	48.98	28.28	-0.14	-0.41	-1.19	-1.77
Perceived Interference	1	100	58.52	24.74	-0.81	-2.36	0.36	0.53
Catastrophising	6	88.67	36.47	20.77	0.44	1.28	-0.85	-1.27
Passive Coping	0.29	4	2.20	0.99	-0.13	-0.36	-1.01	-1.45
Active Coping	0.38	5.75	3.16	1.34	-0.29	-0.81	-0.50	-0.73
Function	0.6	5.85	3.63	1.28	-0.40	-1.15	-0.45	-0.65
Average Activity	10	78	47.71	14.85	-0.72	-2.09	0.35	0.52
Minimum Activity	0	56	17.10	15.10	1.06	3.10	0.32	0.47
Maximum Activity	23	99	67.88	18.55	-0.60	-1.76	0.21	0.31
			PAMS – Average Scores					
Pain	12.36	82	46.06	16.29	0.03	0.08	-0.15	-0.23
Distress	9.45	81.13	38.03	15.83	0.09	0.28	-0.19	-0.29
Self-Efficacy	4.4	100	57.45	21.85	0.11	0.32	-0.31	-0.47
Catastrophising	4.95	69.48	29.53	15.70	0.39	1.16	-0.62	-0.94
Pain Expectancy	10.5	70.95	45.95	15.11	-0.56	-1.66	-0.35	-0.53
Perceived Interference	1.73	90.35	49.57	22.63	-0.53	-1.58	-0.35	-0.53
Passive Coping	0	38.31	15.80	11.28	0.52	1.59	-0.86	-1.33
Active Coping	0	67.95	25.92	19.10	0.38	1.11	-0.92	-1.37
Functioning	13.19	85.97	60.93	16.38	-0.89	-2.64	0.47	0.71
Activity-Level	6	66.92	35.81	13.27	-0.05	-0.15	-0.62	-0.93
			PAMS – Standard Deviation of Scores					
Pain	0.96	38.4	14.67	7.36	1.25	3.76	2.36	3.60
Distress	0.74	31.65	12.74	6.18	1.14	3.42	1.65	2.51
Self-Efficacy	0	37.92	13.18	7.56	0.90	2.64	1.59	2.38
Catastrophising	0	29.8	12.49	7.18	0.77	2.26	0.17	0.25
Pain Expectancy	0.82	30.76	11.03	6.32	1.14	3.33	1.52	2.26
Perceived Interference	1.14	33.58	14.26	7.66	0.58	1.70	0.15	0.23
Passive Coping	0	20.12	12.26	4.68	-0.59	-1.76	0.12	0.18
Active Coping	5.58	33.73	15.27	6.50	0.78	2.25	0.74	1.09
Functioning	0	28.12	13.72	6.13	0.57	1.65	0.03	0.04
Activity-Level	0.9	31.05	16.61	6.30	-0.26	-0.75	0.30	0.45

Table C.5 Descriptive statistics according to sample, gender and cohort groups: M (SD)

	Sample			Gender		Cohort	
	Clinical	Comm.	Student	Male	Female	Old	New
Age	49.55	50.78	22	38.73	39.27	44.48	32.19
	(15.76)	(10.26)	(8.17)	(17.61)	(17.98)	(15.97)	(17.72)
Pain Duration	12.3	12.13	5.13	9.02	9.4	11.61	6.24
	(11.98)	(8.9)	(4.99)	(10.66)	(7.97)	(9.09)	(7.63)
Total Pain Sites	10.82	14.17	7.21	9.6	11.12	13.44	7.05
	(9.63)	(8.25)	(8.34)	(9.7)	(8.74)	(9.21)	(7.4)
Regular Sites	5.45	8.33	3.42	5.53	5.82	6.96	4.14
	(4.28)	(5.73)	(2.67)	(5.14)	(4.75)	(5.65)	(2.9)
Primary Sites	3.73	5.11	3.42	4.2	4.09	4.44	3.71
	(3.1)	(5.38)	(2.67)	(4.59)	(3.75)	(4.69)	(2.88)
Radiating sites	8.82	9.33	5.53	6.67	8.18	9.59	5.29
	(10.1)	(10.06)	(8.04)	(9.63)	(9.25)	(10.17)	(7.59)
McGill PRI – Total	0.44	0.38	0.41	0.41	0.4	0.42	0.38
	(0.22)	(0.22)	(0.17)	(0.21)	(0.2)	(0.22)	(0.16)
MPI - Pain Severity	4.06	3.98	3.4	3.4	3.94	3.93	3.57
	(0.87)	(1.09)	(0.98)	(1.3)	(0.84)	(0.96)	(1.09)
MPI - Affective Distress	2.79	3	2.86	3.11	2.8	2.81	3
	(1.73)	(1.3)	(1.14)	(1.41)	(1.29)	(1.35)	(1.31)
MPI - Interfere	4.03	3.94	3.01	3.18	3.78	3.89	3.22
	(1.35)	(1.37)	(1.44)	(2.02)	(1.08)	(1.23)	(1.64)
MPI - Support	4.9	3.71	3.71	4.07	3.93	4.01	3.93
	(1.32)	(1.79)	(1.45)	(1.77)	(1.54)	(1.73)	(1.48)
MPI - Life-Control	3.34	3.63	3.28	3.27	3.49	3.44	3.39
	(1.7)	(0.97)	(1.06)	(1.24)	(1.18)	(1.25)	(1.13)
PCS - Rumination	5.91	6.5	6.63	6.8	6.24	6	6.95
	(4.25)	(4.38)	(3.7)	(3.3)	(4.34)	(4.09)	(3.96)
PCS - Magnification	2.55	3.39	3.16	2.47	3.39	2.7	3.62
	(2.3)	(3.85)	(1.77)	(2.26)	(2.99)	(2.97)	(2.52)
PCS - Helplessness	8.36	8	8.11	8.47	7.97	7.37	9.1
	(5.59)	(6.44)	(4.79)	(4.88)	(5.85)	(5.21)	(5.87)
PSEQ	29.46	38.31	41.13	38.51	36.89	36.76	38.21
	(10.55)	(12.54)	(12.66)	(17.25)	(10.39)	(11.05)	(14.91)
CSQ - Catastrophising	7.82	9.89	9.58	7	10.33	9.52	9
	(6.52)	(10.76)	(6.1)	(7.23)	(8.39)	(8.54)	(7.74)
CSQ - Control over Pain	2.45	3.61	2.82	3.5	2.82	3	3.07
	(1.69)	(1.5)	(1.56)	(1.55)	(1.61)	(1.75)	(1.43)
CSQ - Ability to Decrease Pain	1.73	2.22	2.21	2.4	1.97	1.81	2.48
	(1.27)	(1.17)	(1.45)	(1.51)	(1.19)	(1.21)	(1.34)
CSQ - Divert Attention	17.36	13.42	12.95	12.13	15.05	14.99	13.05
	(11.62)	(9.89)	(7.92)	(9.09)	(9.76)	(9.45)	(9.81)
CSQ - Reinterpret Pain Sensation	7	6	8.53	8	6.88	7.52	6.86
	(8.72)	(6.89)	(8.75)	(7.68)	(8.23)	(7.95)	(8.24)
CSQ - Ignoring Sensations	14.73	17.78	22.79	21.27	18.06	18.11	20.29
	(8.99)	(8.69)	(6.89)	(10.02)	(7.77)	(8.37)	(8.86)
CSQ - Praying or Hoping	8.91	11.06	10.95	8.87	11.27	11.04	9.86
	(7.23)	(8.74)	(6.75)	(5.72)	(8.22)	(7.11)	(8.22)
CSQ - Coping Self Statements	21.27	22.44	24.24	23.63	22.55	23.85	21.64
	(9.54)	(6.1)	(7.01)	(7.67)	(7.2)	(6.69)	(7.98)
CSQ - Increased Beh. Activities	17.82	16.11	16.21	13.8	17.79	17.3	15.57
	(6.82)	(6.22)	(8.66)	(7.05)	(7.15)	(6.91)	(7.81)

Table C.5 continued…

	Sample			Gender		Cohort	
	Clinical	Comm.	Student	Male	Female	Old	New
HADS – Anxiety	14.8	16.72	11.05	14.13	13.99	15.25	12.48
	(9.48)	(7.44)	(5.74)	(8.96)	(7.1)	(8.18)	(6.74)
HADS - Depression	7.53	9.33	7.74	8.07	8.39	8.77	7.67
	(4.79)	(4.61)	(3.91)	(4.08)	(4.56)	(4.74)	(3.88)
SF36 - Phy Funct	7.27	7.39	3.32	6.07	5.61	6.48	4.81
	(5.1)	(4.34)	(2.45)	(5.24)	(3.9)	(4.72)	(3.63)
SF36 - Phy Role Funct	18.06	19.09	25.74	22.47	21.04	20.07	23.3
	(4.69)	(5.43)	(3.67)	(6.01)	(5.63)	(5.4)	(5.74)
SF36 - Bodily Pain	4.36	4.89	5.11	5.4	4.61	4.89	4.81
	(1.21)	(1.53)	(1.45)	(1.72)	(1.22)	(1.45)	(1.44)
SF36 - General Health	4.85	5.48	6.63	6.37	5.52	5.36	6.34
	(1.29)	(1.45)	(2.03)	(2.47)	(1.36)	(1.37)	(2.14)
SF36 - Vitality	12.53	15.55	16.22	16.43	14.53	15.41	14.76
	(3.6)	(5.88)	(4.52)	(5.91)	(4.55)	(4.8)	(5.4)
SF36 - Social Funct	11.82	11.5	12.79	11.87	12.18	12.07	12.1
	(3.49)	(4.46)	(3.92)	(4.66)	(3.75)	(4.46)	(3.43)
SF36 - Em Role Funct	14	16.44	18	16.53	16.48	16	17.14
	(4.0)	(4.83)	(3.77)	(5.63)	(3.87)	(4.15)	(4.8)
SF36 - Men Health	4	4.5	4.68	4.33	4.52	4.48	4.43
	(1.26)	(1.29)	(1.16)	(1.4)	(1.18)	(1.25)	(1.25)
SF36 - Health Transition	21.27	19.56	20.95	19.67	20.88	20.59	20.38
	(5.92)	(4.87)	(5.09)	(5.94)	(4.8)	(5.23)	(5.17)
SF36 – Mental Health Factor	3.64	3.11	2.53	2.93	3.03	3.22	2.71
	(1.03)	(1.08)	(1.02)	(1.16)	(1.1)	(1.15)	(1.01)
SF36 – Physical Health Factor	13.79	13.45	13.2	12.61	13.8	13.76	13.01
	(4.49)	(3.72)	(4.05)	(4.69)	(3.59)	(3.83)	(4.16)
DQ	7.58	9.44	12.77	11.72	9.7	9.55	11.34
	(3.24)	(3.26)	(2.75)	(4.48)	(3.11)	(3.16)	(4.09)

Table C.6 Descriptive statistics for PAMS-R scales according to sample, gender and cohort groups: M (SD)

PAMS-R Scale	Sample			Gender		Cohort	
	Clin.	Comm.	Student	Male	Female	Old	New
Average Pain	12.27 (6.05)	10.11 (4.99)	6.79 (3.51)	8.8 (5.86)	9.52 (4.85)	9.89 (5.24)	8.52 (5.02)
Minimum Pain	60.45 (13.6)	54.67 (15.85)	54.32 (14.48)	54.47 (16.25)	56.48 (14.21)	57.93 (15.22)	53.19 (13.99)
Maximum Pain	44.36 (17.64)	27.67 (16.71)	20 (24.41)	29.53 (20.13)	27.97 (23.08)	35.74 (23.93)	19.1 (15.14)
Distress	31.73 (19.63)	26.44 (19.79)	20.26 (26.72)	37.93 (29.13)	19.42 (16.69)	26.96 (22.18)	22.95 (23.82)
Self Efficacy	39.72 (24.49)	44.77 (14.66)	42.74 (16.2)	45.7 (21.09)	41.5 (15.95)	43.57 (17.24)	41.83 (18.42)
Perceived Interference	34.88 (30.76)	51.78 (27.88)	54.49 (25.82)	59.58 (31.62)	44.16 (25.7)	45.73 (28.41)	53.16 (28.23)
Catastrophising	61.82 (25.61)	59.13 (23.06)	56.04 (26.81)	54.96 (29.89)	60.14 (22.35)	63.64 (22.08)	51.94 (26.91)
Passive Coping	36.67 (20.41)	33.31 (24.39)	39.33 (17.73)	34.69 (18.96)	37.27 (21.77)	36.83 (22.1)	36 (19.44)
Active Coping	1.94 (1.05)	2.22 (1.12)	2.35 (0.85)	1.89 (1)	2.35 (0.97)	2.15 (1.05)	2.27 (0.93)
Function	3.6 (1.51)	3.19 (1.42)	2.85 (1.13)	3.11 (1.52)	3.18 (1.27)	3.39 (1.45)	2.84 (1.13)
Average Activity	3.28 (1.18)	3.56 (1.48)	3.92 (1.12)	4.14 (1.32)	3.41 (1.21)	3.59 (1.26)	3.69 (1.33)
Minimum Activity	44.82 (15.99)	46.78 (16.39)	50.26 (12.93)	49.47 (16.32)	46.91 (14.33)	46.67 (15.43)	49.05 (14.33)
Maximum Activity	28.36 (18.54)	17.28 (14.34)	10.42 (9.23)	13.53 (11.45)	18.73 (16.39)	19.74 (16.1)	13.71 (13.31)

APPENDIX D

Table D.1 Correlates of entry rates, and alarm response

	Entries			Alarms		Proportion of Alarms:		
	Days	Number	Per Day	Days	Opened	Dismiss	Opened	Time-out
Pain history	0.033	0.265	0.356*	0.056	0.274	-0.158	0.276	-0.201
Pain always present	-0.02	0.188	0.146	0.028	0.203	0.1	0.211	-0.316*
Total Pain Sites	-0.036	0.097	0.153	-0.096	0.098	-0.22	0.048	0.131
Female	-0.2	-0.002	-0.006	-0.18	-0.042	0.092	0.129	-0.204
Age	-0.404**	-0.116	-0.064	-0.374**	-0.126	0.16	0.018	-0.142
Partner	0.107	0.128	0.118	0.026	0.117	-0.143	0.109	-0.027
Senior HS or above	0.073	0.048	0.116	0.105	0.028	-0.071	-0.008	0.051
Work (FT,PT, Casual, voluntary)	0.233	0.073	0.049	0.29*	0.013	0.136	-0.068	-0.023
MPI - Pain Severity	-0.203	-0.004	0.018	-0.274	0.013	-0.076	0.13	-0.094
MPI - Affective Distress	-0.025	-0.138	-0.166	0.024	-0.13	0.106	-0.115	0.042
HADS - Anx	-0.103	-0.032	0.007	-0.124	-0.056	0.003	0.024	-0.031
HADS - Dep	-0.151	0.073	0.072	-0.145	0.086	-0.04	0.198	-0.218
SF36 - Bodily Pain	0.14	-0.12	-0.128	0.239	-0.075	0.037	-0.217	0.228
DQ	-0.178	0.022	0.004	-0.139	0.008	0.131	0.174	-0.318*
PAMS Pain (average)	-0.111	0.042	-0.031	-0.074	0.061	0.055	0.121	-0.182
PAMS Distress (average)	-0.047	-0.1	-0.123	-0.031	-0.088	0.057	-0.128	0.101
PAMS Function (average)	0.18	-0.018	-0.152	0.083	-0.022	-0.093	-0.109	0.205
PAMS Activity (average)	-0.019	-0.074	-0.156	-0.049	0.003	0.164	0.033	-0.149

* p<.05 ** p<.01 *** p<.001

Table D.2 Compliance-related correlates of attributions for dismissed entries

	Endorsement	Entries			Alarms		Proportion of Alarms:		
	Rate (%)	Days	Number	Per Day	Days	Opened	Dismiss	Opened	Time-out
Location was not safe for the PDA	18	0.342*	0.224	0.112	0.309*	0.181	-0.047	0.004	0.017
Physically impossible for at-least 30mins	10	0.091	0.212	0.157	0.061	0.134	0.026	0.042	-0.061
Physically impossible at that time	18	-0.069	-0.151	-0.211	0.018	-0.221	0.278	-0.104	-0.097
Inconvenient for at-least 30 mins	10	0.302*	-0.043	-0.074	0.257	-0.02	0.029	-0.091	0.068
Inconvenient at that time	18	0.041	-0.05	-0.068	0.037	-0.052	-0.03	-0.035	0.078
Physically exhausted	10	-0.049	-0.088	-0.212	0.11	-0.161	0.395**	-0.135	-0.148
Psychologically distressed eg. tense, stressed, down	6	-0.7***	-0.66***	-0.75***	-0.46**	-0.64***	0.81***	-0.55***	0.019
Pain was too bad	4	0.077	0.138	0.096	-0.041	0.045	0.014	0.184	-0.23
Other	16	0.108	0.184	0.092	0.036	0.137	-0.164	0.165	-0.059

* p<.05 ** p<.01 *** p<.001

No participants endorsed the item “I just couldn’t be bothered”.

Table D.3 Pain-related and psychological correlates of attributions for dismissed entires

	Pain History	Total Pain Sites	Age	MPI Pain Severity	MPI Affective Distress	HADS Anx	HADS Dep	SF36 Bodily Pain	SF36 DQ	PAMS Pain	PAMS Dist.	PAMS Funct.	PAMS Act.
Location was not safe for the PDA	-0.045	0.068	-0.19	0.08	0.104	0.17	-0.14	-0.178	-0.055	0.12	0.176	0.04	0.03
Physically impossible for at-least 30mins	0.079	0.005	0.049	0.104	0.017	0.028	-0.11	-0.2	0.087	0.1	0.024	0.124	0.051
Physically impossible at that time	-0.211	-0.049	-0.15	0.01	0.198	0.078	0.004	-0.151	-0.04	0.01	0.066	0.076	0.069
Inconvenient for at-least 30 mins	-0.079	-0.144	-0.011	-0.25	0.034	-0.05	-0.07	0.251	-0.11	-0.19	0.03	0.151	-0.017
Inconvenient at that time	0.036	-0.125	-0.09	-0.19	0.024	0.03	-0.14	0.238	-0.27	0.07	0.15	0.3*	0.29*
Physically exhausted	-0.158	-0.264	-0.19	-0.12	0.222	-0.02	-0.03	0.049	0.1	0.13	0.155	-0.103	-0.07
Psychologically distressed eg. tense, stressed, down	-0.201	-0.055	0.23	0.09	0.229	0.205	0.087	-0.06	0.13	0.03	0.176	-0.032	0.126
Pain was too bad	-0.044	-0.132	-0.08	0.05	0.089	0.06	0.087	-0.317*	0.26	0.07	0.1	-0.176	-0.173
Other	0.018	0.171	0.021	0.162	0.008	0.05	-0.048	-0.136	0.29*	0.18	-0.03	-0.179	-0.066

* p<.05 ** p<.01 *** p<.001

Table D.4 Compliance-related correlates of attributions for missed entires

	Endorsement Rate (%)	Entries Days	Entries Number	Alarms Per Day	Alarms Days	Alarms Opened	Proportion of Alarms: Dismiss	Proportion of Alarms: Opened	Proportion of Alarms: Time-out
Location was not safe for the PDA	24	0.04	0.00	-0.06	0.21	0.02	0.2	-0.12	0.01
Physically impossible at that time	10	0.02	-0.03	0.11	-0.04	-0.15	-0.09	-0.15	0.24
Inconvenient at that time	20	0.14	0.13	0.17	0.15	0.15	-0.16	0.07	0.06
Physically exhausted	8	0.11	0.02	0.09	0.04	-0.07	-0.11	-0.1	0.29
Psychologically distressed eg. tense, stressed, down	8	-0.39**	-0.3*	-0.32*	-0.3*	-0.42**	0.62***	-0.34*	-0.08
Pain was too bad	4	0.08	0.01	0.1	-0.04	-0.16	-0.06	-0.17	0.25
PDA in the room & not loud enough	36	-0.04	0.11	0.04	-0.11	0.16	-0.12	0.14	-0.05
PDA not in the room & didn't hear it	42	-0.06	-0.15	-0.05	0.03	-0.15	0.06	-0.14	0.13
Out & not carrying the PDA	40	0.03	-0.09	-0.01	0.01	-0.09	-0.03	-0.12	0.18
Did not ring for long enough	16	0.11	0.01	-0.13	0.3*	-0.03	0.27	-0.19	0.00
Other	16	0.05	0.11	0.17	0.02	0.1	-0.18	0.11	0.02

* p<.05 ** p<.01 *** p<.001

The items "I just couldn't be bothered" and "It was too embarrassing to answer it, so I ignored it" were not endorsed
Columns refer to the endorsement rate for the item, the number of days on which an entry was made, the total number of entries, the average number of entries per day, the total number of days on which an alarm was signalled, the number of alarms that were opened, and the proportion of alarms dismissed, opened and that timed-out.

Table D.5 Pain-related and psychological correlates of attributions for missed entires

				MPI		HADS		SF36		PAMS			
	Pain History	Total Pain Sites	Age	Pain Severity	Affective Distress	Anx	Dep	Bodily Pain	DQ	Pain	Dist.	Funct.	Act.
Location was not safe for the PDA	-0.01	-0.01	-0.18	-0.19	0.09	0.02	-0.11	0.16	-0.08	0.03	0.07	0.05	-0.04
Physically impossible at that time	0.17	-0.05	-0.04	-0.05	0.239	0.14	0.09	-0.01	0.1	-0.09	0.17	-0.01	-0.32*
Inconvenient at that time	0.25	-0.02	-0.1	-0.33*	0.013	0.01	-0.05	0.32*	-0.23	-0.02	0.13	0.07	-0.19
Physically exhausted	-0.19	-0.03	-0.13	-0.22	0.166	0.09	-0.12	0.178	-0.04	-0.23	0.01	-0.01	-0.18
Psychologically distressed eg. tense, stressed, down	-0.20	0.05	0.15	0.17	0.28*	0.4**	0.18	-0.24	0.22	0.07	0.21	-0.07	-0.09
Pain was too bad	-0.15	-0.03	-0.16	-0.09	0.14	0.11	-0.01	-0.014	0.01	-0.24	0.08	0.06	-0.14
PDA in the room & not loud enough	-0.12	0.118	-0.17	-0.18	-0.17	-0.2	-0.04	0.141	-0.01	-0.13	-0.19	0.17	0.01
PDA not in the room & didn't hear it	-0.09	-0.07	-0.2	-0.38**	0.1	0.03	-0.18	0.35*	-0.13	-0.26	-0.1	0.13	0.05
Out & not carrying the PDA	0.01	0.03	-0.03	0.02	0.18	0.2	0.105	0	-0.12	-0.14	0.12	0.02	-0.1
Did not ring for long enough	-0.15	0.03	-0.07	-0.31*	-0.01	0.03	-0.01	0.08	-0.02	-0.01	-0.07	-0.02	-0.08
Other	-0.06	0.1	-0.16	-0.04	-0.05	-0.08	-0.14	0.17	0.11	-0.15	-0.16	-0.12	-0.21

* p<.05 ** p<.01 *** p<.001

Table D.6 Relationship between average PAMS scales and standard questionnaires

Scale		Pain	Distress	PSE.	Catas.	PI	Passive Cope	Active Cope	Funct.	Activity
McGill	Pain Rating Index	0.37**	0.29*	-0.29*	0.33*	0.37**	0.37**	0.43**	-0.09	0.04
MPI	Pain Severity	0.56***	0.37**	-0.29*	0.46**	0.59***	0.26	0.42**	-0.20	0.25
SF36	Bodily Pain	-0.58***	-0.34*	0.39**	-0.47**	-0.67***	-0.4**	-0.43**	0.33*	-0.07
HADS	Anxiety	0.29*	0.69***	-0.23	0.5***	0.41**	0.29*	0.19	-0.21	0.19
	Depression	0.39**	0.62***	-0.12	0.53***	0.48**	0.4**	0.20	-0.46**	0.00
MPI	Affective Distress	0.26	0.85***	-0.11	0.49***	0.4**	0.34*	0.08	-0.18	0.13
SF-36	Mental Health	-0.22	-0.7***	0.05	-0.36*	-0.26	-0.36*	-0.04	0.20	0.04
	Emotional Role Funct	-0.31*	-0.44**	0.28*	-0.44**	-0.42**	-0.37**	-0.3*	0.45**	-0.07
MPI	Interference	0.36*	0.4**	-0.17	0.39**	0.72***	0.42**	0.28*	-0.55***	-0.07
	Life-Control	-0.18	-0.49***	0.22	-0.33*	-0.18	-0.18	0.03	0.18	0.10
PCS	Rumination	0.17	0.62***	-0.16	0.51***	0.27	0.18	0.05	-0.16	0.27
	Magnification	0.18	0.51***	-0.15	0.58***	0.27	0.22	0.14	-0.16	0.21
	Helplessness	0.32*	0.75***	-0.17	0.61***	0.31*	0.22	0.10	-0.18	0.25
PSEQ		-0.33*	-0.44**	0.34*	-0.32*	-0.43**	-0.37**	-0.14	0.48***	0.08
CSQ	Catastrophising	0.21	0.54***	-0.24	0.56***	0.28	0.26	0.15	-0.21	0.01
	Control over Pain	-0.08	-0.29*	0.13	-0.29*	-0.13	-0.11	0.02	0.16	0.29*
	Ability to Dec. Pain	-0.21	0.02	0.23	-0.11	0.01	0.02	-0.01	-0.05	-0.12
CSQ	Divert Attention	0.3*	0.04	-0.41**	0.14	0.24	0.3*	0.57***	-0.11	0.01
	Rein. Pain Sens.	-0.08	-0.35*	-0.07	-0.25	-0.13	0.10	0.33*	0.04	-0.19
	Ignoring Sensations	0.02	0.04	0.08	-0.11	-0.14	0.20	0.02	0.13	-0.09
	Praying or Hoping	0.20	0.19	-0.24	0.36*	0.36*	0.29*	0.3*	-0.38**	-0.14
	Coping Self Statements	0.01	-0.34*	-0.01	-0.28	-0.12	-0.11	0.14	0.24	-0.06
	Increased Beh. Act.	0.38**	-0.08	-0.48***	0.07	0.25	0.13	0.4**	0.01	0.08
SF-36	Physical Funct	-0.35*	-0.19	0.36*	-0.44**	-0.54***	-0.11	-0.38**	0.46**	-0.07
	Physical Role Funct	-0.3*	-0.22	0.17	-0.39**	-0.51***	-0.42**	-0.53***	0.28*	-0.09
	General Health	-0.22	-0.39**	0.35*	-0.48***	-0.38**	-0.32*	-0.38**	0.36*	-0.06
	Vitality	-0.07	-0.46**	0.07	-0.18	-0.33*	-0.27	-0.22	0.15	-0.02
	Social Funct	-0.45**	-0.56***	0.37**	-0.45**	-0.61***	-0.6***	-0.46**	0.46**	-0.03
	Health Transition	0.55***	0.3*	-0.31*	0.57***	0.5***	0.20	0.48***	-0.15	0.28*
DQ		0.47**	0.24	-0.38**	0.51***	0.63***	0.31*	0.35*	-0.69***	-0.04

* p<.05 ** p<.01 *** p<.001

Funct.= Functioning; PSE= Pain Self Efficacy; Catas.= Catastrophising; PE= Pain Expectancy; PI= Perceived Interference

Table D.7 Descriptive statistics for dataset of 3-hour adjacent entries

	Min	Max	M	SD	Skew	Std. Skew	Kurtosis	Std. Kurt
Evening	0	1	0.30	0.46	0.87	13.23	-1.24	-9.39
Work Hrs	0	1	0.62	0.48	-0.51	-7.74	-1.74	-13.20
Pain	0	100	46.25	22.43	-0.24	-3.59	-0.50	-3.81
Distress	0	100	37.18	20.32	0.12	1.74	-0.57	-4.34
Self Efficacy	0	100	56.29	25.01	-0.14	-2.17	-0.43	-3.25
Catastrophising	0	100	29.22	20.17	0.49	7.39	-0.53	-3.98
Expectancy	0	100	45.03	19.51	-0.52	-7.86	-0.13	-0.98
Perceived Interference	0	100	50.86	26.81	-0.35	-5.26	-0.58	-4.35
Passive Coping	0	71.43	16.82	16.90	0.81	12.23	-0.11	-0.84
Active Coping	0	100	26.55	25.02	0.77	11.68	-0.22	-1.66
Function	0	100	60.58	21.51	-0.83	-12.61	0.62	4.63
Function^2	0	10000	4132	2312	0.21	3.17	-0.55	-4.10
Activity-Level	0	100	35.45	22.06	0.19	2.94	-0.49	-3.68
Lag2 Evening	0	1	0.42	0.49	0.34	5.08	-1.89	-14.32
Lag2 Work Hrs.	0	1	0.55	0.50	-0.21	-3.15	-1.96	-14.85
Lag2 Pain-Intensity	0	100	45.98	22.31	-0.23	-3.45	-0.50	-3.75
Lag2 Distress	0	100	36.82	20.46	0.11	1.71	-0.63	-4.74
Lag2 Self Efficacy	0	100	56.22	24.80	-0.11	-1.73	-0.46	-3.46
Lag2 Catastrophising	0	100	29.08	20.15	0.46	6.89	-0.65	-4.92
Lag2 Expectancy	0	100	44.59	19.87	-0.46	-6.98	-0.21	-1.55
Lag2 Perc. Interference	0	100	50.88	26.90	-0.36	-5.48	-0.60	-4.54
Lag2 Passive Coping	0	71.43	16.55	16.60	0.83	12.61	0.02	0.17
Lag2 Active Coping	0	100	26.18	24.95	0.76	11.48	-0.30	-2.26
Lag2 Function	0	100	60.32	21.22	-0.86	-13.03	0.73	5.47
Lag2 Function^2	0	10000	4088	2264	0.22	3.32	-0.44	-3.33
Lag2 Activity-level	0	100	34.37	21.78	0.25	3.77	-0.45	-3.37
Δ Self Efficacy	-70	73	-0.08	16.07	0.10	1.44	2.41	18.08
Δ Catastrophising	-62.67	70	-0.13	14.01	-0.14	-2.11	3.56	26.74
Δ Expectancy	-78	80	-0.43	14.29	-0.08	-1.20	4.77	35.86
Δ Perc. Interference	-73	73	0.07	16.35	0.00	0.00	2.81	21.11
Δ Passive Coping	-71.43	57.14	-0.23	15.38	-0.10	-1.50	1.21	9.20
Δ Active Coping	-100	75	-0.42	18.14	-0.05	-0.73	1.78	13.35
Alcohol	0	1	0.02	0.12	7.86	119.12	59.91	450.43
Medication	0	1	0.12	0.32	2.40	36.30	3.75	28.16
Sedative	0	1	0.01	0.12	8.07	122.21	63.15	474.83
Lay/Rest	0	1	0.36	0.48	0.57	8.64	-1.68	-12.61
Avoid Activity	0	1	0.22	0.41	1.39	21.05	-0.07	-0.53
Hope/Pray	0	1	0.33	0.47	0.71	10.82	-1.49	-11.23
Tell self it doesn't hurt	0	1	0.12	0.33	2.33	35.30	3.44	25.83

Table D.8 First-order relationships between key predictors and lag 2 outcomes: standardized coefficient (percentage within-person variance accounted for)

Fixed Effects	Outcome Distress	Function	Activity-Level
	Lag 1 Predictors		
Pain	0.206 (4.65%)***	-0.057 (0.22%)*	0 (0%)ns
Distress	0.42 (18.31%)***	-0.064 (0.28%)*	0.032 (0.07%)ns
Function	-0.041 (0.2%)ns	0.333 (10.82%)***	0.123 (1.11%)***
Activity-Level	0.025 (0.1%)ns	0.144 (2.75%)***	0.221 (4.9%)***
Pain Self Efficacy	-0.238 (4.95%)***	0.043 (0.06%)ns	-0.057 (0.18%)ns
Catastrophising	0.242 (5.93%)***	-0.099 (0.77%)**	-0.002 (0%)ns
Pain Expectancy	0.17 (3.13%)***	0.021 (-0.04%)ns	0.092 (0.57%)**
Perceived Interference	0.307 (8.35%)***	-0.105 (0.74%)**	-0.052 (0.15%)ns
Passive Cope	0.161 (3.62%)***	-0.153 (2.72%)***	-0.083 (0.6%)**
Active Cope	0.012 (0.01%)ns	-0.086 (0.58%)**	-0.066 (0.28%)ns
	Lag 2 Predictors		
Pain	0.525 (30.01%)***	-0.028 (-0.01%)ns	0.197 (2.63%)***
Distress		-0.076 (0.42%)*	0.146 (1.33%)***
Function	-0.065 (0.49%)*		0.276 (5.6%)***
Activity-Level	0.091 (1.33%)***	0.203 (5.53%)***	
Pain Self Efficacy	-0.484 (19.84%)***	0.123 (1%)***	-0.024 (0.03%)ns
Catastrophising	0.589 (32.93%)***	-0.151 (1.76%)***	0.128 (0.97%)**
Pain Expectancy	0.459 (22.58%)***	-0.061 (0.26%)*	0.221 (3.27%)***
Perceived Interference	0.576 (29.05%)***	-0.15 (1.6%)***	0.075 (0.31%)*
Passive Cope	0.209 (6.22%)***	-0.219 (5.74%)***	-0.077 (0.53%)**
Active Cope	0.05 (0.24%)ns	-0.068 (0.3%)*	0.084 (0.42%)*

* p<.05 ** p<.01 *** p<.001

Table D.9 First-order relationships between key predictors at lag 1: standardized coefficient

	Lag-1 Outcome									
Fixed Effects	Pain	Distress	Funct.	Activity-Level	PSE	Catas.	PE	PI	Passive Cope	Active Cope
Entry-number	.039ns	-.015ns	.036ns	.021ns	-.064ns	-.027ns	.003ns	.002ns	-.002ns	.001ns
Pain		.496***	-.032ns	.158**	-.452***	.601***	.552***	.51***	.269***	.052*
Distress	.516***		-.124***	.098*	-.409***	.558***	.45***	.515***	.291***	.045ns
Function	-.019ns	-.11***		.32***	.095***	-.14***	-.036ns	-.17***	-.263***	-.021ns
Activity-Level	.104***	.064**	.226***		-.016ns	.036ns	.121***	.004ns	.05ns	.047*
PSE	-.559***	-.49***	.124***	-.028ns		-.551***	-.436***	-.494***	-.308***	-.068*
Catas.	.646***	.567***	-.157***	.058ns	-.473***		.576***	.583***	.327***	.06*
PE	.544***	.431***	-.038ns	.18***	-.354***	.544***		.488***	.257***	.062*
PI	.622***	.607***	-.218***	.007ns	-.489***	.67***	.595***		.408***	.1**
Passive Cope	.212***	.213***	-.214***	-.057ns	-.192***	.236***	.197***	.257***		.206***
Active Cope	.049ns	.047ns	-.024ns	.073*	-.057*	.058***	.063*	.084**	.277***	

* p<.05 ** p<.01 ** p<.001

Funct.= Functioning; PSE= Pain Self Efficacy; Catas.= Catastrophising; PE= Pain Expectancy; PI= Perceived Interference

Table D.10 First-order relationships of key predictors at both lags with lag 2 predictors: standardized coefficients

	Lag 2 Outcome						
Fixed Effects	Pain	PSE	Catas.	PE	PI	Passive Cope	Active Cope
	Lag 1 Predictors						
Pain	.46***	-.232***	.296***	.326***	.27***	.182***	.059**
Distress	.34***	-.193***	.308***	.258***	.321***	.187***	.074**
Function	-.017ns	.069**	-.073**	-.017ns	-.103***	-.143***	-.091**
Activity-Level	.073**	-.003ns	.035ns	.067**	-.014ns	-.033ns	.008ns
Pain Self Efficacy	-.328***	.414***	-.285***	-.272***	-.292***	-.262***	-.096**
Catastrophising	.391***	-.23***	.397***	.295***	.322***	.242***	.07**
Pain Expectancy	.37***	-.203***	.252***	.406***	.294***	.168***	.046ns
PI	.422***	-.269***	.341***	.335***	.495***	.32***	.057*
Passive Cope	.168***	-.158***	.179***	.142***	.195***	.29***	.106***
Active Cope	.02ns	-.067**	.065*	.039ns	.075**	.169***	.353***
	Lag 2 Predictors						
Entry-number	.023ns	-.064ns	-.02ns	.017ns	.014ns	.018ns	-.006ns
Pain		-.452***	.581***	.586***	.495***	.317***	.05ns
Pain Self Efficacy	-.581***		-.538***	-.483***	-.531***	-.418***	-.071*
Catastrophising	.667***	-.479***		.627***	.592***	.361***	.056*
Pain Expectancy	.596***	-.381***	.555***		.502***	.293***	.058*
PI	.616***	-.512***	.643***	.615***		.452***	.086**
Passive Cope	.241***	-.247***	.24***	.22***	.276***		.189***
Active Cope	.057ns	-.062*	.056*	.065*	.079**	.284***	
Distress	.571***	-.409***	.558***	.492***	.504***	.296***	.048ns
Function	-.032ns	.1***	-.126***	-.066*	-.114***	-.285***	-.06*
Activity-Level	.134***	-.013ns	.076**	.148***	.041*	-.068**	.05*

* p<.05 ** p<.01 ** p<.001

PSE= Pain Self Efficacy; Catas= Catastrophising; PE= Pain Expectancy; PI= Perceived Interference

APPENDIX E

The Pain Ambulatory Monitoring Scale (PAMS) – Study 1

PAIN ASSESSMENT & MONITORING SURVEY – A1

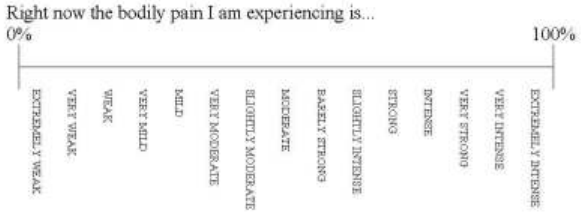
IMPORTANT: Please complete this questionnaire between 8:00am and 9:45am

Today's Date: _____

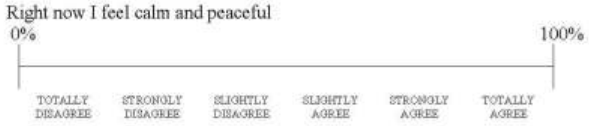
Time you began this questionnaire: _____

We would like to ask you some questions about the pain. In some questions you will be asked to make ratings by placing a single vertical line along a 10cm line. Please place only a single line. In these questions your response is guided by labels found underneath the line. Remember, you can place a mark anywhere along the line.
In other questions you will be asked to select from a range of responses by ticking one or more boxes. In these questions, feel free to tick one box, a number of boxes, or no boxes at all. Please complete all questions.

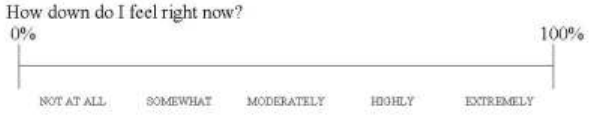
1. Right now the bodily pain I am experiencing is...



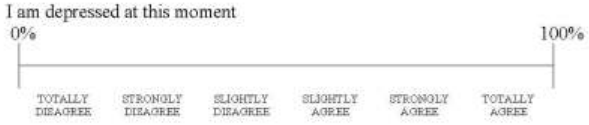
2. Right now I feel calm and peaceful



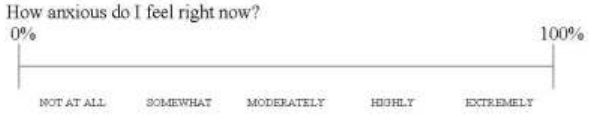
3. How down do I feel right now?



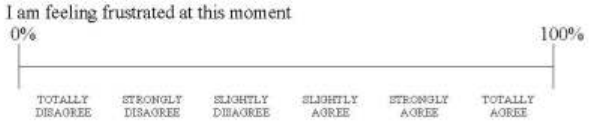
4. I am depressed at this moment



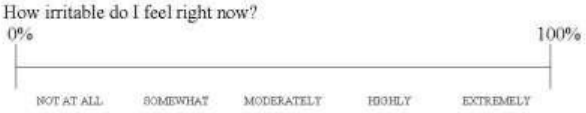
5. How anxious do I feel right now?



6. I am feeling frustrated at this moment



7. How irritable do I feel right now?



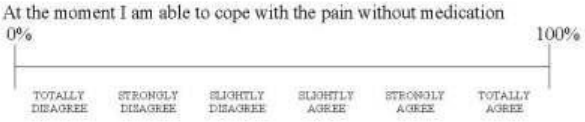
8. I feel tense or 'wound up' right now

9. I feel cheerful right now

We'd like to get your thoughts about the pain
REMEMBER: Answer these questions based on how you feel RIGHT now

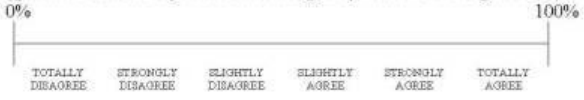
10. At the moment I can tolerate pain without medication

11. At the moment I am able to cope with the pain without medication

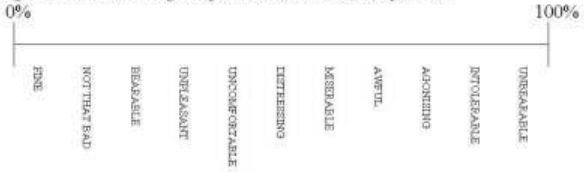


12. I'm capable of controlling the amount of pain I experience (without medication)

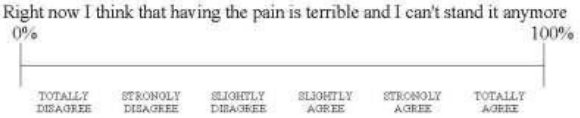
13. Right now I feel I'm capable of decreasing the pain without using medication



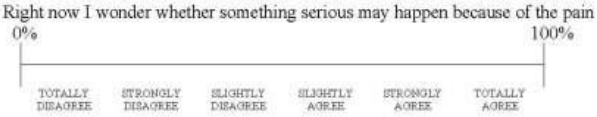
14. Right now the suffering I experience because of the pain is...



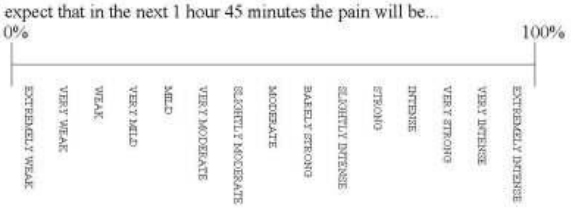
15. Right now I think that having the pain is terrible and I can't stand it anymore



16. Right now I wonder whether something serious may happen because of the pain



17. I expect that in the next 1 hour 45 minutes the pain will be...

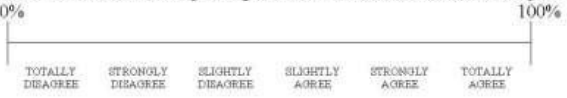


18. At this moment I believe I am able to do the things I need to do today

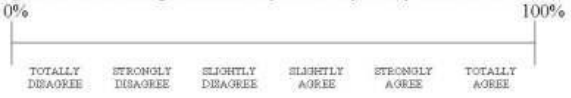
REMEMBER: Answer these questions based on how you feel RIGHT now

19. I believe I'm capable of engaging in physical activity (eg, work, chores, shopping)

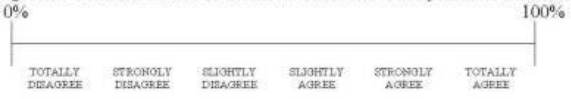
20. At the moment I am accomplishing less than I would like because of the pain



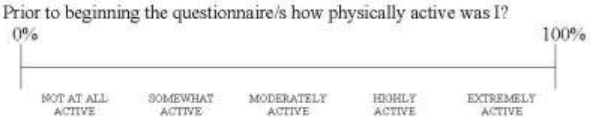
21. Right now I am finding it difficult to perform day-to-day activities because of the pain



22. Right now I feel I'm limited in the kinds of activities I can perform, because of the pain



23. Prior to beginning the questionnaire/s how physically active was I?



PLEASE NOTE: As you answer the following questions think back over the last 1 hour 45 minutes

24. What was my highest activity level over the last 1 hour 45 minutes?

25. Which of these activities have I done for over 10 MINUTES in total (tick as many boxes as you need to)?
- ☐ Housework/chores
- ☐ Yardwork/gardening
- ☐ Work - paid or unpaid
- ☐ Shopping
- ☐ Cooking/prepare a meal

26. Which of these activities have I done for over 10 MINUTES in total (tick as many boxes as you need to)?
- ☐ Leant on something
- ☐ Visiting
- ☐ Watching TV
- ☐ A sport
- ☐ A hobby

27. Which of these things have I done continuously for at least 10 MINUTES (tick as many boxes as you need to)?
- ☐ Drive
- ☐ Sit down
- ☐ Lie down
- ☐ Stand up
- ☐ Nap or rest

28. Which of these activities have I done over the last 1 hour 45 minutes (tick as many boxes as you need to)?
- ☐ Dress or bathe myself
- ☐ Bend, kneel or stoop
- ☐ Carry or push an object
- ☐ Lift an object

29. Which of these activities have I done over the last 1 hour 45 minutes?
- ☐ Walked 100 meters
- ☐ Walked half a kilometer
- ☐ Walked more than 1km
- ☐ Climbed 1 flight of steps
- ☐ Climbed several flights

REMEMBER: As you answer the following questions think back over the last 1 hour 45 minutes

30. Which of these things have I avoided because of the pain, or fear of it getting worse (tick as many boxes as you need to)?
- ☐ Housework/chores
- ☐ Yardwork/gardening
- ☐ Work (paid or unpaid)
- ☐ Shopping
- ☐ A sport

31. Which of these things have I avoided because of the pain, or fear of it getting worse (tick as many boxes as you need to)?
- ☐ Cooking
- ☐ Visiting
- ☐ Dress or bath myself
- ☐ A hobby
- ☐ Driving

32. Which of these things have I tried to help myself cope with the pain (tick as many boxes as you need to)?
- ☐ Try to feel distant from it
- ☐ Drank alcohol
- ☐ Did an activity/stretched
- ☐ Did something I enjoy
- ☐ Hope/wish it'd go away

33. Which of these things have I tried to help myself cope with the pain (tick as many boxes as you need to)?
- ☐ Ignore the pain
- ☐ Talked to partner/friend
- ☐ Talk sense to myself
- ☐ Think of pleasant things
- ☐ Distract myself from pain

34. Which of these things have I tried to help myself cope with the pain (tick as many boxes as you need to)?
- ☐ Taken pain medication as part of a regular schedule
- ☐ Taken pain medications that were not part of a regular schedule
- ☐ Taken sleeping tablets
- ☐ Lay down/rested/slept
- ☐ Pretend it isn't there
- ☐ Use positive thinking

35. Which of these things have I tried to help myself cope with the pain (tick as many boxes as you need to)?
- ☐ Tell myself it doesn't hurt
- ☐ Kept myself busy
- ☐ Relaxed/breathed deeply
- ☐ I don't think of it as pain
- ☐ Pray/Rely on spirituality

36. In relation to my tasks/activities over the last 1 hour 45 minutes, at times I have: (tick as many boxes as you need to)
- ☐ Avoided doing a task/s
- ☐ Given up during a task/s
- ☐ Persisted despite pain
- ☐ Taken breaks to rest
- ☐ Switched between tasks

37. In relation to my tasks/activities over the last 1 hour 45 minutes, at times I have: (tick as many boxes as you need to)
- ☐ Refused help from others
- ☐ Sought help from others
- ☐ Accepted their help

Time you finished this questionnaire: _____

Thanks for your help!

APPENDIX F

Participant's Information Sheet – Study 1

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

School of Psychology

The University of Queensland
Brisbane Qld 4072 Australia
Telephone + 61 7 3365 6230
Facsimile + 61 7 3365 4466
Internet www.uq.edu.au

Office Use Only
Confidential ID:

Source:

Schedule: 1

The Pain Monitoring Project

Researchers: Ben Chadwick & Dr Justin Kenardy

Thank you for your interest in the Pain Monitoring Project!

What is this project about?

We are interested in the everyday lives of people who have ongoing pain. Specifically, we would like to gain a better understanding of how pain influences and is influenced by everyday things such as the activities we do, the way we feel and the way we think about pain. To investigate this, we are asking people to fill out a range of questionnaires during a normal day. This should give us clues about what things contribute to pain and effect people's quality of life.

What will I be asked to do?

We will give you a booklet of ten questionnaires to complete in your own time. Each questionnaire has its own instructions. Please complete the entire questionnaire package on the same day. However, feel free to take breaks between the questionnaires – we realize there a quite a few to get through! While completing the package you may feel you are repeating yourself sometimes – we apologize for this, but ask that you complete *all* questions. If you're not sure about a question, just try to give your best answer.

One thing that presumably influences pain is the time of day, so we are asking you to complete the first questionnaire, entitled "*Pain Assessment And Monitoring Survey – A*", in a specific timeframe. It is important that you complete *that* questionnaire between **8:00am and 9:45am**. You can fill in the rest of the booklet any time on the same day.

When you've completed all questionnaires, please place them in the return envelope to return them to us within a week.

Involvement in the project is purely voluntary and you can withdraw at any time without any implications for your future medical care. All the information you will provide is confidential - your name and personal contact details, including your signed "Consent Form", will not be linked to any of the data. So, it is impossible for us to link you to any data even if we wanted to.

This study has been cleared in accordance with the ethical review processes of the University of Queensland and within the guidelines of the National Health and Medical Research Council. You are, of course, free to discuss your participation with project staff (contactable on 0409 628 311). If you would like to speak to an officer of the University not involved in the study, you may contact the School of Psychology Ethics Review Officer on 3365 6394 (message on 3365 6230) or contact the University of Queensland Ethics Officer on 3365 3924.

If you have any comments of queries please contact the Research Officer, Ben Chadwick on **(07) 3346 9297**

Participant's Consent Form – Study 1

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

School of Psychology

The University of Queensland
Brisbane Qld 4072 Australia
Telephone + 61 7 3365 6230
Facsimile + 61 7 3365 4466
Internet www.uq.edu.au

PARTICIPANT'S CONSENT FORM

The Pain Monitoring Project

Research Team: Ben Chadwick, Dr Justin Kenardy

This project aims to find out what strategies you use to assist you in coping with chronic pain. We are asking you to complete a range of questionnaires designed to evaluate your pain, how you feel and just what you do throughout the day. We hope this will help you to develop your own pain-control strategies after the project. The project will be explained to you and you will be given the opportunity to ask questions of the research team. You will be advised of progress and results after the project has been completed.

We hope this will result in better understanding and control of your pain, though even if this does not happen, you will help us to know a bit more about how to help others manage chronic pain.

You may of course decide not to participate in the project at all, or to withdraw at any time without prejudice to any future treatment – this is your right. All results will remain confidential.

This study has been cleared in accordance with the ethical review processes of the University of Queensland and within the guidelines of the National Health and Medical Research Council. You are, of course, free to discuss your participation with project staff (contactable on 0409 628 311). If you would like to speak to an officer of the University not involved in the study, you may contact the School of Psychology Ethics Review Officer on 3365 6394 (message on 3365 6230) or contact the University of Queensland Ethics Officer on 3365 3924.

I, _____ have read the patient information sheet and consent form and have been given the opportunity to ask questions. I have been advised that my confidentiality will be preserved in all analyses of the results and all associated publications. I acknowledge that I may withdraw at any time without prejudice to any future treatment.

PARTICIPANT NAME:

PARTICIPANT ADDRESS:

PHONE NUMBER

SIGNATURE _____ DATE: _____

Research Officer: Ben Chadwick 3346 9297

APPENDIX G

Participant Feedback System – Study Two

An automatic feedback form based on the participant's own data was provided to all participants who provided 20 or more entries. Feedback was provided regarding all PAMS scales except activity-level. Feedback forms gave a descriptive report rather than a numerical report in order to maximize readability and comprehension. An outline of the feedback provided and the methods used to derive feedback is presented below. An example report is provided in the following pages.

Feedback forms were generated by transferring the participant's raw data, as a text file, into a Microsoft Excel spreadsheet template. Formulas contained in adjoining sheets on the same template performed all necessary calculations and converted numerical data into verbal descriptors, as outlined below.

Participant's average, maximum and minimum pain intensity, distress, and function ratings were calculated. Their tendency towards each of the four appraisal factors (pain self-efficacy, catastrophising, pain expectancy, and perceived interference) and the two coping factors (passive and active) were also reported for average, maximum, and minimum ratings. Scores were categorised according to the following cut-offs:

0 to 20 = "Minimal"
20 to 39 = "Mild"
40 to 59 = "Moderate"
60 to 79 = "High"
80 to 100 = "Severe"

Average ratings were also expressed normatively relative to the mean and standard deviation of PAMS scores of 124 of the participants from Study One. Percentile ranks

were categorised according to the following cut-offs (corresponding to z-scores of -2, -1, 0, 1, and 2 on the normal distribution):

below 2.28% = "significantly lower than the ratings of other participants”
to 15.87% = “somewhat lower than the ratings of other participants”
to 84.13% = “similar to the ratings of other participants”
to 97.72% = “somewhat higher than the ratings of other participants”
above 97.72% = “significantly higher than the ratings of other participants”

For pain intensity, distress and function ratings, participants were given feedback regarding times of the day when their ratings were notable higher and lower than their mean ratings. Separate feedback was given for weekdays and weekends for each outcome variable. For the weekday profile, an average score was calculated from weekday entries for each of the eight daily time-slots during which alarms were scheduled. These averages were standardized like z-scores via comparison with the mean and standard deviation of the relevant outcome variable. A timeslot was considered to be below the mean on a certain outcome variable if the average score for that timeslot was equal to or more than one standard deviation below the grand mean for the outcome. A score equal to or greater than one standard deviation above the mean was considered above the mean on a certain outcome variable. A similar procedure was used to calculate daily profiles for weekend entries.

Each of the three outcome variables, pain intensity, distress, and function, were correlated with a range of scales to provide the participant with an indication of the degree to which different aspects of their pain experience were related. Pain intensity was correlated with distress, function, previous-lag distress, previous-lag pain-intensity, the four appraisal factors, and the two coping factors. Distress was correlated with pain-intensity, previous-

lag pain-intensity, function, previous-lag distress, the four appraisal variables, and the two coping factors. Function was correlated with previous-lag distress, previous-lag function, previous-lag pain intensity, and the appraisal and coping factors from the previous lag. In the feedback, correlations were expressed as a likelihood, with the interpretation differing depending upon the direction of the correlation. That is, relationships between factors were expressed as the likelihood that prior to or during periods of higher pain or distress or poorer function a certain thinking style was being engaged in, a certain coping strategy was being used, or that a state of high pain, high distress or poor function was being experienced. These likelihoods were expressed by categorising correlations according to the following cut-offs:

> less than –0.75 or greater than 0.75 = "You were highly likely to…."
> –0.5 to –0.75 or 0.5 to 0.75 = "You were moderately likely to…"
> –0.25 to –0.5 or 0.25 to 0.5 = "You were mildly likely to…"
> between –0.25 and 0.25 = "There appeared to be no relationship between…"

The effect of individual coping and functional behaviours on each of the three outcome variables was also described. To do so, entries were identified during which the behaviour commenced during that entry (an "onset" entry). That is, an entry was identified as being an "onset" entry if the participant indicated that the behaviour was engaged in the period preceding that entry and that the behaviour was not engaged in in the period prior to the previous entry. Change in the outcome between the entries was calculated by subtracting the value of the outcome variable in the "onset" entry from the value in the previous entry. This difference was expressed as a proportion of the standard deviation of the outcome variable in question. The standardised change-values were averaged across each "onset" entry. Coping strategies or functional behaviours were

considered to have been influential if the onset of the behaviour was associated with an average change in the outcome variable equal to or greater than one standard deviation. Thus, a behaviour was considered beneficial if, on average, it was associated with at-least a one standard-deviation decrease in pain or distress or increase in function, and detrimental if it was associated with at-least a one standard-deviation increase in pain or distress or decrease in function.

The frequency of coping strategy usage was also reported. The proportion of entries in which the strategy was reported as being engaged-in was calculated. Strategies that were not used were reported. The remainder of the strategies were rank ordered according to their frequency of use. The five most used strategies were reported, as were the five least used strategies.

Participants were given an indication as to whether their most used strategies were in any way beneficial. That is, any of the five most frequently used coping strategies that were also associated with a significant beneficial change in pain, distress or function were listed.

Participants were given an indication of the nature and accuracy of their pain expectancies relative to the pain-intensity rating in the next entry. For each entry, pain expectancies were subtracted from next-lag pain-intensity ratings. Participants were informed regarding the proportion of over-estimates (where the pain expectancy exceeded the subsequent pain intensity) and under-estimates (where the expectancy was less than the subsequent pain-intensity). A distinction was also made between mild and "significant" over- and under-estimates. An estimate was judged "significantly" inaccurate if the over- or under-estimate was equal to or greater than one standard

deviation in the pain-intensity ratings. Participants were informed of the proportion of their over-estimates that were “significant”, and likewise for under-estimates. Finally, the accuracy of their predictions was noted by reporting the average amount by which their over-predictions exceeded their subsequent pain intensity ratings and by which their under-predictions fell below their subsequent pain ratings. Inaccuracy was reported as a percentage of the 0-100 pain rating scale, for example “you tended to be out by approximately 15%”.

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

School of Psychology

Ben Chadwick
School of Psychology
The University of Queensland
St Lucia, QLD, 4072

PAIN ASSESSMENT AND MONITORING STUDY

Participant's initials: GN
Commencement date: 17/01/04

Below is an analysis of your electronic Pain Assessment & Monitoring Survey data.
Please note that the data on this feedback sheet is intended for your information only. The procedures used in the Project are not intended as a diagnostic test or clinical assessment tool, and the researchers take no responsibility for any such uses the data may be put to.

During the week of monitoring you completed 50 entries.

PAIN INTENSITY

Firstly we asked you to rate the intensity of the pain you were experiencing.
Your average pain intensity over the course of the week was in the high range. This score was similar to the ratings of other participants. Your maximum score was in the severe range and your minimum score was in the moderate range.

Were there "good times of the day" or "bad times of the day" during the week or on weekends?
The pain appeared to be at its best during the following times on weekdays: 06:30pm to 08:15pm; On weekends the pain appeared to be at its best during these times: 04:45pm to 06:30pm.
On average, there did not appear to be specific times on weekdays when the pain was reliably bad. On weekends the pain appeared to be at its worst during these times: 03:00pm to 04:45pm.

What things appeared to influence the pain?
You were mildly likely to have more intense pain when your pain had been intense in previous hours.
There appeared to be no relationship between how emotionally distressed you were at any one point in time and how intense the pain became in subsequent hours.
There did not appear to be a relationship between how emotionally distressed you were and how intense the pain was at the same time.
There appeared to be no relationship between how well you were functioning at any one point in time and how intense the pain became in subsequent hours.

Was the way you thought about the pain related to your perception of the intensity of the pain?
At the same time you were experiencing more intense pain you were:
- no more likely to be thinking that you could cope with your pain
- no more likely to be thinking that the pain was terrible
- no more likely to be thinking that the pain was interfering badly with your life
- somewhat likely to expect that the pain was going to get worse

Was your use of coping strategies related to the intensity of your pain?
In the hours before your pain became more intense, you were:
- no more likely to have been coping with the pain by doing positive activities and by thinking positively
- no more likely to have been coping with the pain by avoiding activity, using alcohol or drugs, and denying the existence of the pain

In terms of the specific coping strategies you reported using:
There were no specific coping strategies you used that appeared to make your pain worse.
After using the following specific coping strategies the pain appeared to reduce: Think about something you enjoy; Hope or wish the pain would go away; Tell yourself the pain doesn't hurt; Refuse help with doing your activities.

Did your activities influence the intensity of the pain?
There were no specific activities you did that appeared to make the pain worse.
After doing the following things the pain appeared to reduce: play sport; avoid doing yardwork; avoiding paid or unpaid work; avoiding shopping; avoiding driving.

EMOTIONAL DISTRESS
Emotional distress refers to how upset participants were, or their "emotional well-being". People who are more emotionally distressed tend to be more anxious, irritable, depressed, and unhappy.
Your average emotional distress over the week was in the mild range. This score was similar to the ratings of other participants. Your maximum distress was in the moderate range and your minimum distress was in the minimal range.

Were there "good times of the day" or "bad times of the day" during the week or on weekends?
On average, there did not appear to be specific times on weekdays when your mood was reliably lower. On weekends your emotional state appeared to be worse during these times: 11:30am to 01:15pm.
On average, there did not appear to be specific times on weekdays when your mood was at its best. There did not appear to be specific times on weekends when your mood was at its best.

What things appeared to influence your emotional wellbeing?
There didn't appear to be a relationship between how much pain you were experiencing and your emotional state at the same time.
There appeared to be no relationship between how much pain you had at any one point in time and how emotionally distressed you became in subsequent hours.
There appeared to be no relationship between how emotionally distressed you were at any one point in time and how emotionally distressed you became in subsequent hours.
There appeared to be no relationship between how well you were functioning at any one point in time and how emotionally distressed you became in subsequent hours.

Was the way you thought about the pain related to your emotional wellbeing?
At the same time as you were feeling more emotionally distressed you were:
- slightly more likely to be thinking that you couldn't cope with the pain
- slightly more likely to be thinking that the pain was terrible
- no more likely to be thinking that the pain was interfering badly with your life
- somewhat likely to expect that the pain was going to get better

Was your use of coping strategies related to your emotional wellbeing?
In the hours before you became more emotionally distressed, you were:
- no more likely to have been coping with the pain by doing positive activities and by thinking positively
- no more likely to have been coping with the pain by avoiding activity, using alcohol or drugs, and denying the existence of the pain

In terms of the specific coping strategies you reported using:
There were no specific coping strategies you used that appeared to make your mood worse.
After using the following specific coping strategies your mood appeared to improve: Think about something you enjoy.

Did your activities influence your emotional well-being?
After doing the following things you appeared to become more emotionally distressed: avoid doing yardwork; avoiding paid or unpaid work; avoiding shopping.
After doing the following things you appeared to become less emotionally distressed: avoiding driving.

FUNCTION AND PHYSICAL ACTIVITY

Function refers to how well people are able to do the things they need to do on a day-to-day basis. Those who function less well could be described as being more "disabled". They are less likely to be physically active, and less likely to do things such as go to work, do chores around home, visit friends, or look after their appearance.

Your average level of functioning over the course of the week was in the high range. This score was somewhat higher than the ratings of other participants. Your maximum level of functioning was in the very high range and your minimum level of functioning was in the mild range.

Were there "good times of the day" or "bad times of the day" during the week or on weekends?

There did not appear to be certain times on weekdays when, on average, you were more active. On weekends you appeared to be more active during these times: 03:00pm to 04:45pm.

There did not appear to be any regular times on weekdays when you were less active, on average. On weekends you appeared to be less active during these times: 08:15pm to 10:00pm.

What things appeared to influence your ability to function?

There appeared to be no relationship between how much pain you had at any one point in time and how well you were able to function in subsequent hours.

There appeared to be no relationship between how emotionally distressed you were at any one point in time and how well you were able to function in subsequent hours.

You were mildly likely to be able to function better when you had been active in previous hours.

Was the way you thought about the pain related to your capacity to function?

In the hours before you functioned well you were:

- no more likely to be thinking that you could cope with your pain
- no more likely to be thinking that the pain was terrible
- no more likely to be thinking that the pain was interfering badly with your life
- somewhat likely to expect that the pain was going to get worse

Were your use of coping strategies related to your capacity to function and your level of physical activity?

In the hours before you were able to function well, you were:

- no more likely to have been coping with the pain by doing positive activities and by thinking positively
- no more likely to have been coping with the pain by avoiding activity, using alcohol or drugs, and denying the existence of the pain

In terms of the specific coping strategies you reported using:

After using the following specific coping strategies you appeared to increase your level of physical activity: Think about something you enjoy; Hope or wish the pain would go away; Relax or breathe deeply; Ignore the pain; Think pleasant thoughts; Tell yourself the pain doesn't hurt; Pretend the pain isn't there; Persist with activities despite pain; Switch between activities.

There were no specific coping strategies you used that appeared to make you less active.

Did your activities influence your level of physical activity?

After doing the following things you appeared to increase your level of physical activity: paid or unpaid work; bend over; carry an object; lift an object; play sport; walk a kilometre; climb several flights of stairs;

There were no specific activities you recorded that appeared to decrease your activity level.

PAIN COGNITIONS

Pain Cognitions are simply thoughts people have about pain. People may be aware of these thoughts, or they may just "sit at the back of the mind". In The Project we asked you about four broad categories of pain cognitions:

1. Pain Coping Cognitions: These are the thoughts people may have about how capable they are of coping with or tolerating the pain. These thoughts also appear to involve whether they feel capable of controlling or influencing the pain without the use of medications.
Your tendency to think that you were capable of coping with the pain over the course of the week was in the moderate range. This score was similar to the ratings of other participants. Your maximum score was in the high range and your minimum score was in the mild range.

2. Pain Catastrophising Cognitions: These thoughts relate to just how bad (or unpleasant) a person thinks the pain is. They also appear to be related to whether they think something bad (such as an injury) may happen because of the pain.
Your tendency to think of the pain as being terrible, or to imagine that something bad might happen because of it, fell within the mild range. This score was similar to the ratings of other participants. Your maximum score was in the moderate range and your minimum score was in the minimal range.

3. Pain Interference Cognitions: These thoughts involve the degree to which people feel the pain has had a negative impact on their life and interferes with their ability to do everyday things.
Your tendency to think that the pain was interfering with your life over the course of the week was in the high range. This score was similar to the ratings of other participants. Your maximum score was in the high range and your minimum score was in the moderate range.

4. Pain Expectancy Cognitions: These are expectations about how intense the pain will be in the future. In The Project, this was your expectation of what the pain would be like at the time of the next beep (approximately 1 hour 45 minutes).
Over the course of the week you tended to expect that in the following hours the pain would be in the moderate range. This expectation was similar to the ratings of other participants. Your worst expectation was that the pain would be in the very high range and your best expectation was that it would be in the mild range.

Were your expectations about the pain accurate?
You tended to under-predict how bad the pain would be more often than you over-predicted it. On 68% of entries you expected that the pain would be better in the following hours than it actually turned out to be. 59% of these under-predictions were fairly mild, but 41% of them were significantly inaccurate. When you under-predicted the pain, you tended to be out by approximately 8%. On 26% of entries you expected that the pain would be worse in the following hours than it actually turned out to be. 77% of these over-predictions were fairly mild, but 23% of them were significantly inaccurate. When you over-predicted the pain, you tended to be out by approximately 7%.

COPING STRATEGIES

Pain Coping Strategies are things people deliberately do to try to either reduce the pain, or reduce the unpleasant feelings they may have because of the pain. These strategies aren't necessarily overt things people do – they also include ways of thinking that may help people cope with pain.

In The Project we asked you about two general ways of coping:

1. Active Coping: These kinds of coping strategies involved attempts to promote positive emotions by doing such things as relaxing, doing pleasant activities, thinking about pleasant things, and "talking sense" to one-self. This kind of coping also involves persisting with activities, and using clever "pacing" strategies like taking breaks and switching between activities.

Over the course of the week, your tendency to use active pain coping was in the high range. This score was similar to the ratings of other participants. Your maximum usage of these coping strategies was in the very high range and your minimum usage was in the minimal range.

2. Passive Coping: This kind of coping involves attempts to avoid feeling pain by using substances such as pain medications, sedatives and alcohol. This kind of coping is also related to increasing resting and sleeping, avoiding activity, asking people to do tasks, and passively wishing or hoping the pain would go away.

Your tendency to use these kinds of strategies fell within the minimal range. This score was similar to the ratings of other participants. Your maximum usage of these coping strategies was in the moderate range and your minimum usage was in the minimal range.

What coping strategies did you tend to use?

Your most commonly used coping strategies were (in order from most common): Refuse help with doing your activities; Think about something you enjoy; Distract yourself; Think pleasant thoughts; Do an activity, or stretch.

The following coping strategies that you used most frequently actually appeared to either reduce the pain, improve your mood, or increase your activity level: Refuse help with doing your activities; Think about something you enjoy; Think pleasant thoughts.

Your least frequently used coping strategies were (in order from least common): Take a sedative; Drink alcohol; Accept help with doing your activities; Seek help with doing your activities; Take pain medication (not including medications taken on a regular basis).

You never used the following coping strategies: Accept help with doing your activities; Drink alcohol; Take a sedative; Seek help with doing your activities.

Naturally, because you never used these strategies during the monitoring week, it is impossible to determine whether they had a beneficial or adverse effect on your pain, mood, or capacity to function. If the strategies you did tend to use did not seem to be particularly helpful, it might be worth thinking about other strategies you may be able to take on-board. "Active Coping" strategies tend to be ones that people find helpful in managing their pain most effectively in the long term. "Passive Coping" strategies, on the other hand, tend to be associated with more distress and greater disability over the long term - especially if one becomes reliant upon alcohol or sedatives, or overly reliant on medication, for pain management.

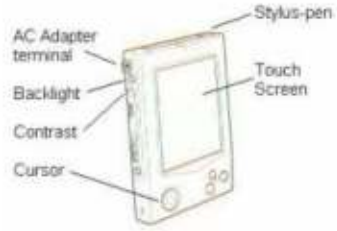
APPENDIX H

The Pain Monitoring Project

Research Officer	Project Supervisor	Hospital Staff
Ben Chadwick	**Dr Justin Kenardy**	**Professor Tess Cramond**
The School of Psychology, University of Queensland, St Lucia	The School of Psychology, University of Queensland, St Lucia	**Dr Bronwyn Williams** *The Royal Brisbane Hospital, Herston*

GUIDELINES FOR OPERATION AND CARE OF YOUR PALM-TOP COMPUTER

Using the Palm-Top Computer (PTC)



Using the Stylus-Pen

Every operation you will need to perform on the PTC involves the stylus-pen, which is housed inside the stylus-holder in the upper right corner of the PTC (see diagram above). You can use the stylus-pen in a number of ways:

- Tap: Tap on the touch-screen lightly with the stylus-pen. You will use this for pressing on-screen buttons (eg the "Next" button) and making selections in "Option Screens" or "Check-box Screens". (see below)
- Press: Keep the stylus-pen pressed lightly against the screen. You may use this in "Sliding Scale" items to move the rating-bar by pressing an arrow. (see below)
- Drag: Keeping the stylus-pen pressed lightly against the screen, move the stylus-pen to another location. You may use this for dragging the rating-bars that are used in "Sliding Scale" items. (see below)

IMPORTANT: Take care not to misplace the stylus-pen. Take care to avoid breaking the tip of the stylus-pen. Use only the stylus pen to touch the screen -- DO NOT use a pen, pencil or other sharp implements.

Responding To Beeps

The computer is programmed to alert (or beep) you eight times a day. When you hear the beep it is the signal for you to make a diary entry. You will be given three minutes only to respond to a beep before the PTC switches itself off. Entries may take between about 3 to 7 minutes. The computer has been programmed to beep at random times, so don't expect a beep at the same times every day. It may beep any time from 8:00 in the morning until 10:00 at night.

The PTC only operates when it beeps you - it will not function in-between these times.

When the PTC beeps you, it will automatically start by giving you a range of options. Choose the option you want by tapping it with the stylus-pen.

- Open: Choose this option unless it is highly inconvenient or unsafe to do so. This will begin the normal monitoring entry.

- Postpone: Use this option only if it would be unsafe or highly inconvenient for you or the PTC if you responded at the present time (eg whilst driving). Choose a time to reschedule the entry by taping on the arrow-button and selecting how long you will need before the PTC should beep you again. Select the shortest time possible. IMPORTANT: Over-use of this option will make your data less useful to the researchers - please avoid it if possible. Use of this option will also drain your PTC's batteries unless you are using the AC Adapter (see below).
- Dismiss: This will cancel the current entry. IMPORTANT: Avoid using this option. Do so only if it is impossible to postpone the entry for the maximum time-limit. Over-use of this option will make it difficult for the researchers to use your data because of too many missing entries.

How To Make An Entry

Whilst making an entry you will come across a variety of screen-types, namely:

- Message Screens: These screens are there simply to give you a message. You can go on by tapping on the "OK" button with the stylus-pen. The entry will start and end with a message screen.
- Option Screens: These screens ask you a question and give you a range of options to select from. You are able to select only one option, and can do so by tapping the round-button next to the option you have chosen. Once you have selected the option most relevant to you, you can go on by tapping on the "Next" button. The PTC will not allow you to proceed until you have selected an option.
- Check-box Screens: These screens ask you a question and give you a selection of items to respond with. You are able to select any number of the available items, including none or all of them. Select an item by tapping the check-box next to the item. Move on by tapping the "Next" button. If none of the items are relevant to you, feel free to go on without selecting any.
- Sliding Scales: These screens display a question and give you a sliding-scale to make a rating on. You make a rating by moving a rating-bar. Move the rating-bar by either tapping on and dragging the rating-bar directly, or by pressing the stylus-pen on the sliding scale or the arrows at either end of the sliding-scale. As the bar moves the PTC will give you feedback about your rating. Once you have chosen the rating you think is relevant, simply tap on the "Next" button.

At the end of the entry, the PTC will thank you for your participation and switch itself off. We ask you to complete every entry - only stopping when the computer switches itself off.

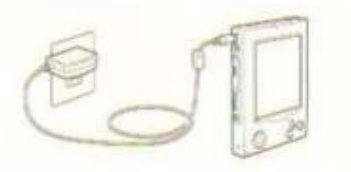
Attention Alarms

If, during an entry, you haven't done anything for 1 minute the PTC will remind you to finish the entry by beeping (this is a different beep to the regular one). After four minutes the PTC will shut itself down. Unfortunately, this means that the data from the current entry will be lost. Make every attempt to avoid this by working through your entries in one sitting.

Powering The Palm-Top Computer

Whenever possible, use the AC Adapter supplied with your PTC. You can use the AC Adapter whilst at home, work, or visiting. Plug one end of the AC Adapter into the PTC's AC Adapter terminal and the other end into your

wall socket (see the diagram below). While the PTC is using the AC Adapter it will not use battery power - thus it is an important way of saving battery power. IMPORTANT: Use only the AC Adapter provided with the PTC. The PTC also runs off two AAA alkaline batteries. These are located behind a panel at the bottom on the back of the PTC (see below for replacement instructions). IMPORTANT: Never mix an old battery with a new one, and never mix two batteries of different types



Using the Backlight in Low-Light Conditions

You can use the backlight to illuminate the display in areas where available lighting is dim. While the PTC is on, hold down the [Backlight] button for about one second to turn on the backlight. The backlight turns off automatically if you do not use the PTC for a set amount of time. The backlight may suddenly turn off or fail to light when battery power is low. IMPORTANT: Leaving the backlight on consumes large amounts of power - try to use it only when the AC Adapter is connected.

Adjusting Contrast

You can adjust the contrast of the screen by holding down the [Contrast] button and pressing the top of the [Cursor] button to make contrast darker, and the bottom of the [Cursor] button to make it lighter.

Care of the Palm-Top Computer

Use the PTC only under the following conditions:

- Temperature: 0°C to 40°C (32°F to 104°F)
- No condensation

Avoid using the PTC in areas subjected to the following conditions:

- Static electricity
- Extreme heat or cold
- High humidity
- Sudden temperature changes
- Large amounts of dust

IMPORTANT:

- If you drop the PTC and damage it, cease using it immediately and call the research officer (see below)
- Never place heavy objects on top of the PTC
- Never try to take the PTC apart
- Never insert foreign objects into connectors, slots or other openings
- Take care to avoid spilling water or drinks on the PTC

- Use ONLY a dry soft cloth or a soft cloth moistened with a weak solution of water if you need to clean the exterior of the PTC
- Be sure to use the soft case provided whilst carrying the PTC

We recommend that you be careful with the PTC whilst children are about. We also recommend that you avoid carrying the PTC with you:

- At nightclubs
- In dirty, dusty or wet work environments
- Near swimming pools
- During very active sporting activities, such as whilst playing football

Saving Battery Power

Conserving battery power is important, especially when you are on the go. If power should run out completely, ALL the information you have given in your entries will be lost.

At the beginning of your monitoring week your PTC will have a fully charged battery. Under normal conditions, a fully charged battery will supply enough power for many hours of use. Here are a few tips to make it last longer:

- Plug the PTC into its AC Adapter whenever possible. See the diagram on the first page to identify the AC Adapter terminal. IMPORTANT: Use only the AC Adapter provided with the PTC.
- Avoid using the backlight unless the AC Adapter is connected. The backlight will drain large amounts of battery power.
- Avoid postponing entries when the PTC beeps you, or pausing for prolonged period of time in the middle of making an entry - unless you are using the AC Adapter. By postponing or pausing whilst using batteries the PTC will be wasting power and it will use more power-draining beeps than it needs to.

Replacing Batteries

If your batteries are running low the PTC will display the following message on the screen: *"Prevent possible data loss by promptly replacing or recharging you main batteries according to your hardware manufacturer's instructions"*.

Your PTC is powered by two non-rechargeable AAA-size alkaline batteries. As soon as you have finished making an entry replace the batteries by following this procedure (see diagram above):

1. Make sure the power is off (wait until your entry is finished and your PTC has turned itself off)
2. Turn the PTC over
3. Slide the battery cover lock to "FREE", and then slide the cover downwards to remove it
4. Remove the AAA batteries and then load two new ones (these are provided)
5. IMPORTANT: Make sure the (+) and (-) ends of the batteries are facing correctly

6. IMPORTANT: Never mix an old battery with a new one, and never mix two batteries of different types
7. Replace the battery cover
8. Slide the battery cover lock back to "LOCK"

Frequently Asked Questions

Can I Use The Palm-Top Computer For Other Applications?

No. The PTC has been set-up so that things such as personal organizers, calculators and note-takers cannot be accessed.

Do I have to complete an Entry at the time of the Beep?

No, you can postpone an entry but we ask you to avoid doing this whenever possible as it detracts from the quality of the data you provide us. When the computer beeps you, you may postpone by tapping on the "Postpone" button, then scrolling down the menu using the "arrow button" to select a postponement period. Try to select the shortest possible period of postponement.

Can I have a break during an Entry

Yes - but the PTC will remind you to complete the entry by beeping every minute. If you take longer than 5 minutes the PTC will shut itself down to save power and the data from that entry will be lost. Please prevent this from happening by trying to finish your entries in one sitting.

What should I do if things aren't working?

If the PTC stops operating (eg no beeps for a few hours), firstly check that the battery cover is set to 'lock' and that it isn't out of power. Try plugging in the AC Adapter or replacing the two AAA batteries. Remember that the PTC will only operate when it beeps you - it will not function between these times.

If this does not work, contact the researcher officer.

If the PTC freezes during an entry so that nothing you do seems to work, contact the research officer.

Who to Contact If You Have Questions Or Problems

For any information or problems relating to the operation of the PTCs or the procedures of the project, please call the research officer, Ben Chadwick (3365 6834 office hours, 0418 985 765 after hours).

Research Officer:	3365 6834 (office hours),	0418 985 765 (after hours)
Hospital Staff:	3636 7130 (office hours),	3636 8111(after hours - Hospital Switchboard)

APPENDIX I

Participant's Information Sheet – Study Two

SCHOOL OF PSYCHOLOGY

PARTICIPANT'S INFORMATION SHEET

The Pain Monitoring Project

Research Team: Ben Chadwick, Dr Justin Kenardy

THE UNIVERSITY OF QUEENSLAND
Brisbane Qld 4072 Australia
Telephone (07) 3365 6230
International +61 7 3365 6230
Facsimile (07) 3365 4466

Thank you for your interest in the Pain Monitoring Project!

What is this project about?

We are interested in the everyday lives of people who have ongoing pain. Specifically, we would like to gain a better understanding of how pain influences and is influenced by everyday things such as the activities we do, the way we feel and the way we think about the pain. To collect this information we are asking people to fill out a range of questionnaires and complete questions on an electronic diary (referred to as a palm-top computer, or PTC) over the course of one week. This should give us clues about what things contribute to pain and impact on people's quality of life. Importantly, the information we hope to get from the electronic diaries should be more true-to-life than information that can be collected via questionnaires or interviews.

What will I be asked to do?

1. Take the PTC home with you for one week
2. Complete a set of questionnaires at the end of the week.
3. We will agree to meet you again after one week to collect the PTC and questionnaires

What will having the computer at home involve?

The PTC is programmed to beep you eight times a day. This beep is the signal for you to make a diary entry. Entries may take between about 3 to 7 minutes. The PTC has been programmed to beep at random times during the day.

What is involved in completing the questionnaires?

Each questionnaire has its own instructions. Please complete the entire questionnaire package *on the same day*. However, feel free to take breaks between the questionnaires – we realize there a quite a few to get through! While completing the package you may feel you are repeating yourself sometimes – we apologize for this, but ask that you complete *all* questions. If you're not sure about a question, just try to give your best answer.

Involvement in the project is purely voluntary and you can withdraw at any time without any implications for your future medical care. All the information you will provide is confidential - your name and personal contact details will not be linked to any of the data.

This study has been cleared in accordance with the ethical review processes of the University of Queensland and within the guidelines of the National Health and Medical Research Council. You are, of course, free to discuss your participation with project staff (contactable on 0409 628 311). If you would like to speak to an officer of the University not involved in the study, you may contact the School of Psychology Ethics Review Officer on 3365 6394 (message on 3365 6230) or contact the University of Queensland Ethics Officer on 3365 3924.

Once again, thank-you for your involvement.

***If you have any comments of queries please contact the Research Officer, Ben Chadwick on* 0409 628 311**

Participant's Consent Form – Study Two

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

School of Psychology

The University of Queensland
Brisbane Qld 4072 Australia
Telephone + 61 7 3365 6230
Facsimile + 61 7 3365 4466
Internet www.uq.edu.au

PARTICIPANT'S CONSENT FORM

The Pain Monitoring Project

Research Team: Ben Chadwick, Dr Justin Kenardy

People with chronic pain may benefit from the help of many health professionals to improve the quality of their lives. One of the most important factors in living with chronic pain is the ability to develop and apply strategies to manage it.

This project aims to find out what strategies you use to assist you in coping with chronic pain. We plan to show you how to use a palm-top computer to monitor just what you do throughout the day. We hope this will help you to develop your own pain-control strategies after the project. This will be explained to you and you will be given the opportunity to ask questions of the research team. You will be advised of progress and results after the project has been completed.

We hope this will result in better understanding and control of your pain. Even if this does not happen, you will help us to assess the role of this small hand-held computer in pain management.

You may of course decide not to participate in the project at all, or to withdraw at any time without prejudice to any future treatment – this is your right. All results will remain confidential.

This study has been cleared in accordance with the ethical review processes of the University of Queensland and within the guidelines of the National Health and Medical Research Council. You are, of course, free to discuss your participation with project staff (contactable on 0409 628 311). If you would like to speak to an officer of the University not involved in the study, you may contact the School of Psychology Ethics Review Officer on 3365 6394 (message on 3365 6230) or contact the University of Queensland Ethics Officer on 3365 3924.

I, _____ have read the patient information sheet and consent form and have been given the opportunity to ask questions. I have been advised that my confidentiality will be preserved in all analyses of the results and any publications that may result from the research. I acknowledge that I may withdraw at any time without prejudice to any future treatment.

PATIENT NAME:	WITNESS NAME:
PATIENT ADDRESS:	WITNESS ADDRESS:
SIGNATURE:	SIGNATURE:
DATE:	DATE:

Research Officer: Ben Chadwick 0409 628 311

APPENDIX J

The Pain Monitoring Project

Research Officer
Ben Chadwick
The School of Psychology, University of Queensland, St Lucia

Project Supervisor
Dr Justin Kenardy
The School of Psychology, University of Queensland, St Lucia

Hospital Staff
Professor Tess Cramond
Dr Bronwyn Williams
The Royal Brisbane Hospital, Herston

COMPUTER RESPONSIBILITY FORM

The Cassiopeia E-15 Palm-Size computer you will be using for this project is worth $700. We therefore ask that you take good care of it while it is in your possession.

We ask that you ensure that the only people you give the computer to are members of the Pain Monitoring Project, and if you need the computer checked or changed for another at any time, give it directly to a member of the Pain Monitoring Project. Do not drop give it to receptionists, nurses or hospital or university staff who are not directly involved in the project.

Should you be unable to return your computer (in a workable condition) at the completion of the project, you will be required to pay the costs for a replacement. We recommend that you carefully read the "Guidelines for Operation and Care of Your Palm-Top Computer" leaflets you will be given at the beginning of the project.

I understand the material written above and understand and agree that I am liable for the cost of the Cassiopeia E-15 Palm-Size computer if I am unable to return it in good condition at the end of the project.

PATIENT NAME:
PATIENT ADDRESS:

SIGNATURE:
DATE:

WITNESS NAME:
WITNESS ADDRESS:

SIGNATURE
DATE:

Research Officer: 3365 6834 (office hours); 0418 985 765 (after hours)
Hospital Staff: 3636 7130 (office hours); 3636 8111(after hours - Hospital Switchboard)

APPENDIX K

PAMS Monitoring Protocol

The following pages display a flowchart composed of screen-shots from the PAMS electronic diary, illustrating the sequence of the PAMS protocol. Note that screen 32 was only displayed if the “Medication” item on screen 31 was checked. Otherwise, PAMS proceeded directly to screen 33. No other forms of “branching logic” were employed in the PAMS protocol.

Responses on each GRS item were accompanied by verbal descriptors that were anchored at equal intervals to a range of values along the scale. These descriptors were displayed in the space below the sliding-scale, as illustrated in Figure K.1.

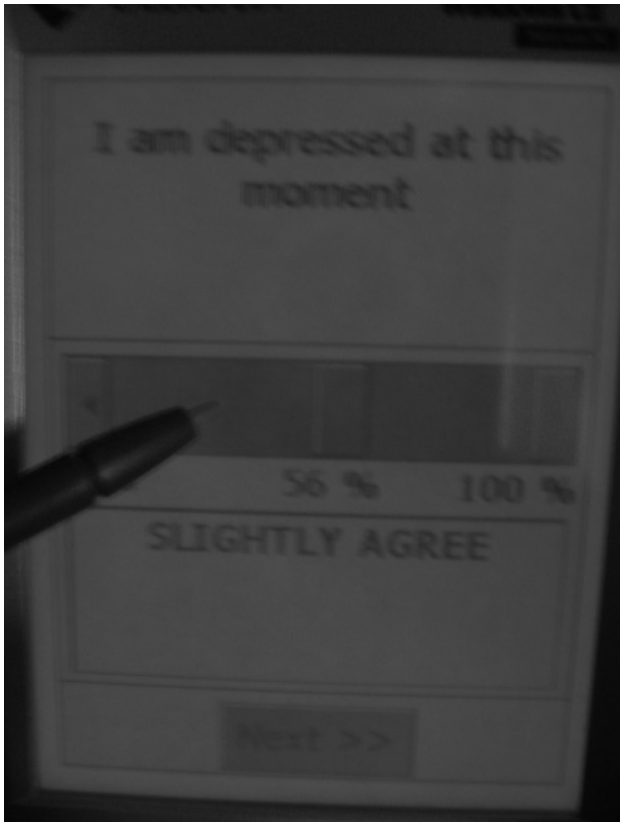
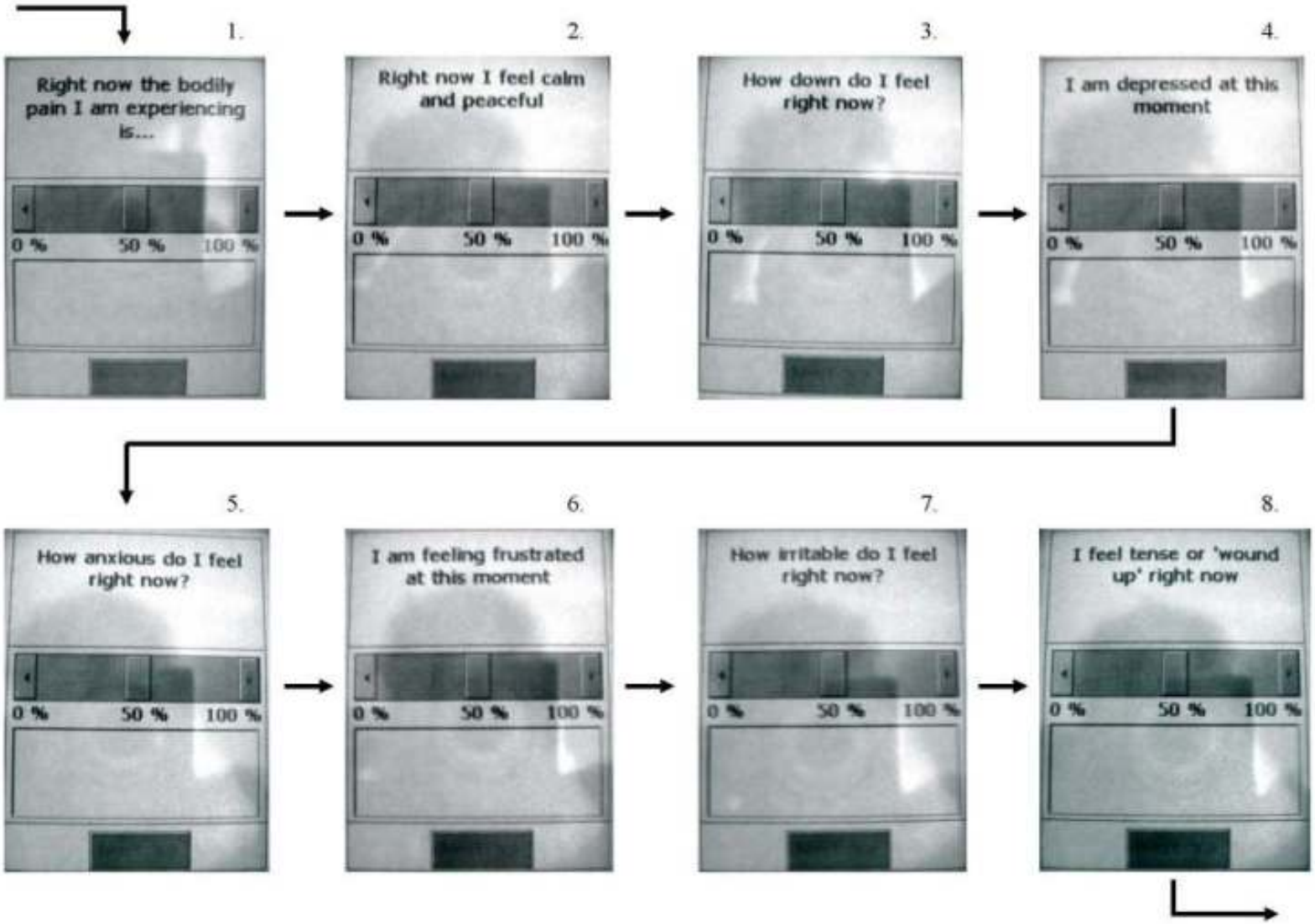


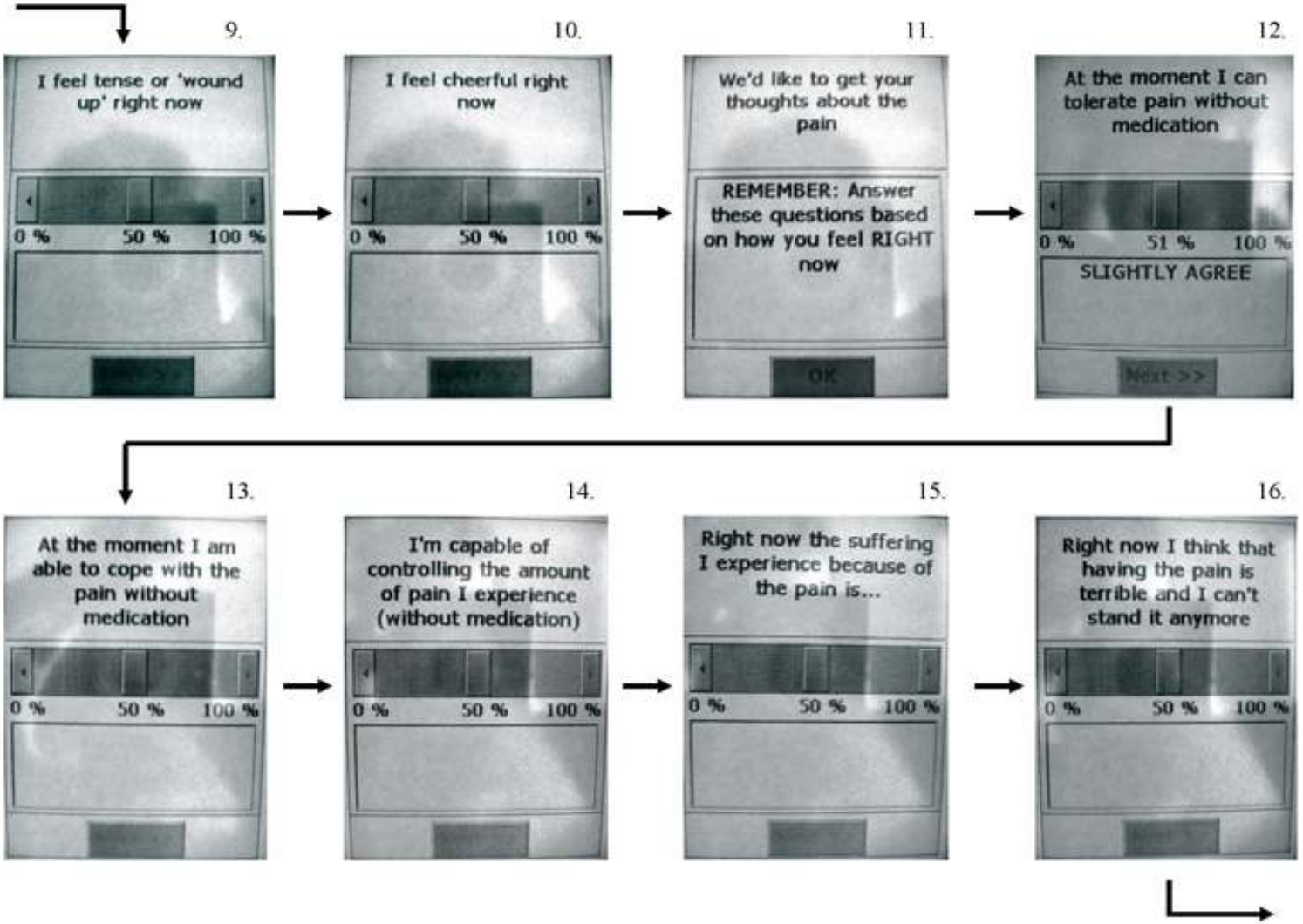
Figure K.1 Example of PAMS GRS item

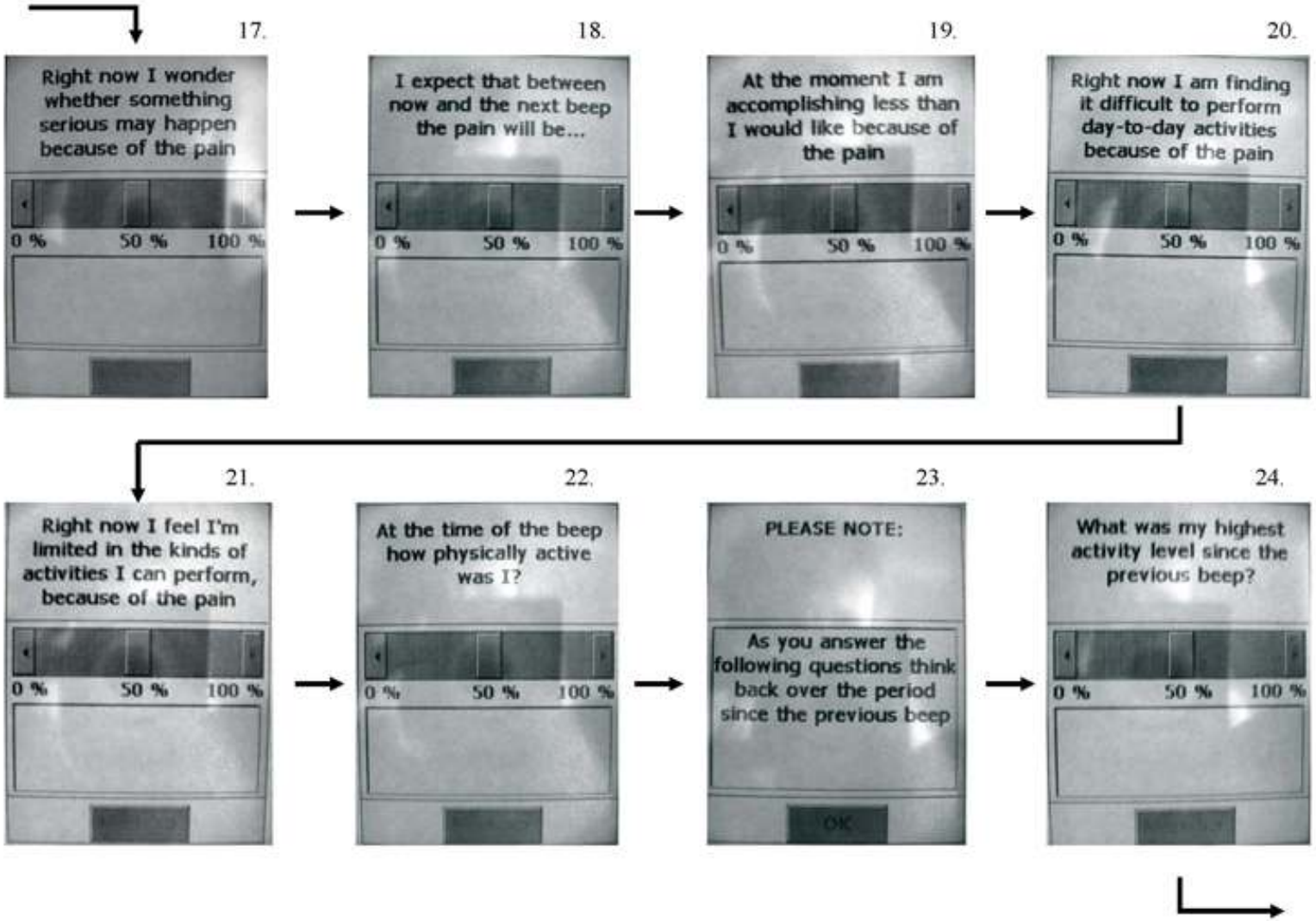
A list of the verbal descriptors used can be found in Table K.1. Items one and 17 on the following pages employed the descriptors in list A. Items 21 and 23 employed those in list E. Items three, five and seven used descriptors in list C. Only item 14 used list D. The remaining GRS scales employed list B.

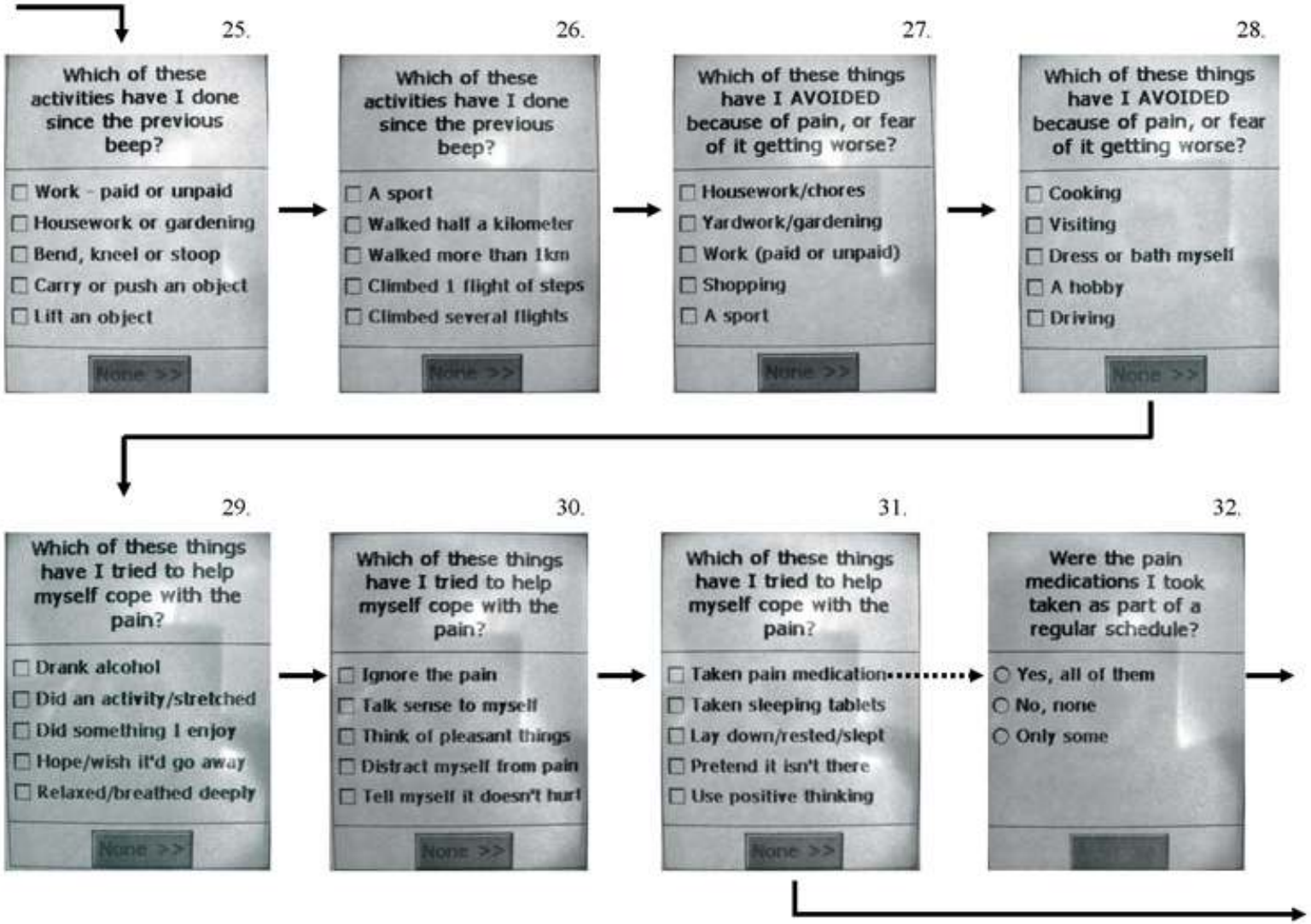
Table K.1 Descriptive anchors used in GRS sliding-scale items

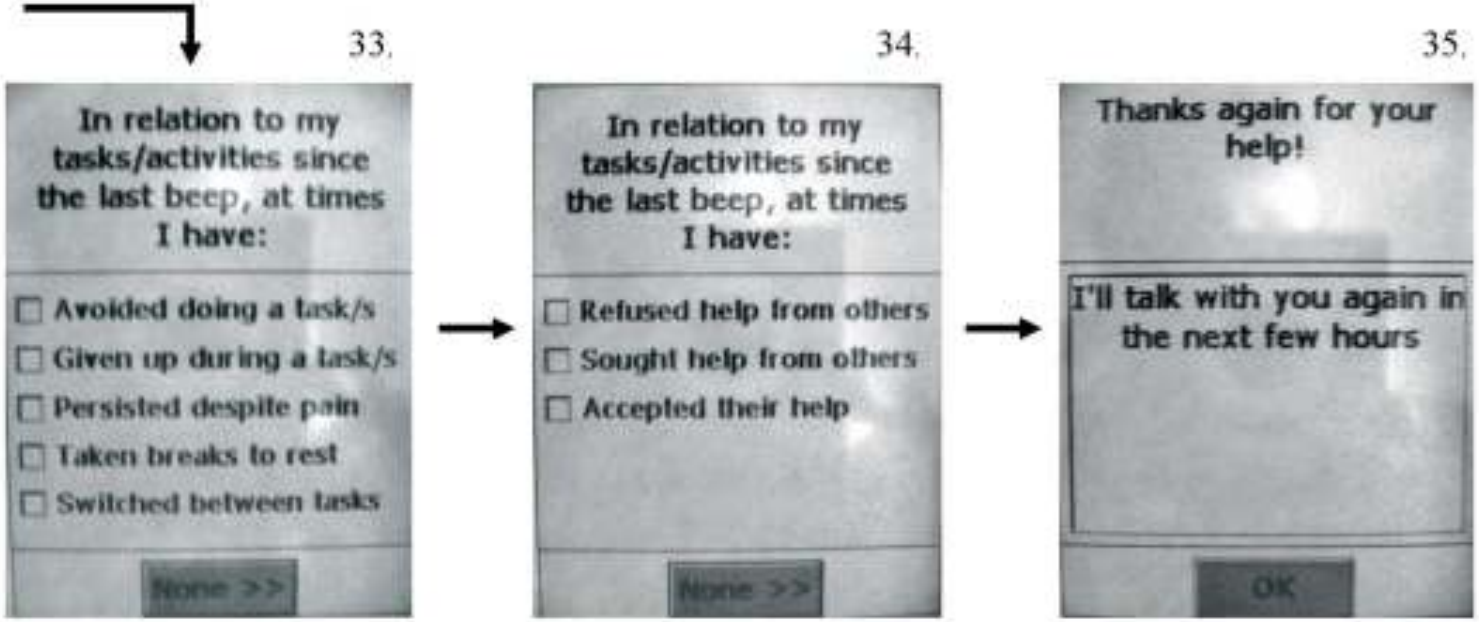
A	B	C	D	E
NOT NOTICABLE	TOTALLY	NOT AT ALL	FINE	NOT AT ALL
JUST NOTICABLE	DISAGREE	SOMEWHAT	NOT THAT BAD	ACTIVE
VERY WEAK	STRONGLY	MODERATELY	BEARABLE	SOMEWHAT
WEAK	DISAGREE	HIGHLY	UNPLEASANT	ACTIVE
MILD	SLIGHTLY	EXTREMELY	UNCOMFORTABLE	MODERATELY
MILD/MODERATE	DISAGREE		DISTRESSING	ACTIVE
MODERATE	SLIGHTLY		MISERABLE	HIGHLY
CONSIDERABLE	AGREE		AWFUL	ACTIVE
STRONG	STRONGLY		AGONISING	EXTREMELY
VERY STRONG	AGREE		INTOLERABLE	ACTIVE
INTENSE	TOTALLY		UNBEARABLE	
EXCRUCIATING	AGREE			
AS BAD AS COULD BE IMAGINED				


1.
Right now the bodily pain I am experiencing is...
0 %
50 %
100 %
2.
Right now I feel calm and peaceful
0 %
50 %
100 %
3.
How down do I feel right now?
0 %
50 %
100 %
4.
I am depressed at this moment
0 %
50 %
100 %
5.
How anxious do I feel right now?
0 %
50 %
100 %
6.
I am feeling frustrated at this moment
0 %
50 %
100 %
7.
How irritable do I feel right now?
0 %
50 %
100 %
8.
I feel tense or 'wound up' right now
0 %
50 %
100 %


9.
I feel tense or 'wound up' right now
0 %
50 %
100 %
10.
I feel cheerful right now
0 %
50 %
100 %
11.
We'd like to get your thoughts about the pain
REMEMBER: Answer these questions based on how you feel RIGHT now
OK
12.
At the moment I can tolerate pain without medication
0 %
51 %
100 %
SLIGHTLY AGREE
Next >>
13.
At the moment I am able to cope with the pain without medication
0 %
50 %
100 %
14.
I'm capable of controlling the amount of pain I experience (without medication)
0 %
50 %
100 %
15.
Right now the suffering I experience because of the pain is...
0 %
50 %
100 %
16.
Right now I think that having the pain is terrible and I can't stand it anymore
0 %
50 %
100 %


17.
Right now I wonder whether something serious may happen because of the pain
0 %
50 %
100 %
18.
I expect that between now and the next beep the pain will be...
0 %
50 %
100 %
19.
At the moment I am accomplishing less than I would like because of the pain
0 %
50 %
100 %
20.
Right now I am finding it difficult to perform day-to-day activities because of the pain
0 %
50 %
100 %
21.
Right now I feel I'm limited in the kinds of activities I can perform, because of the pain
0 %
50 %
100 %
22.
At the time of the beep how physically active was I?
0 %
50 %
100 %
23.
PLEASE NOTE:
As you answer the following questions think back over the period since the previous beep
OK
24.
What was my highest activity level since the previous beep?
0 %
50 %
100 %


25.
Which of these activities have I done since the previous beep?
Work - paid or unpaid
Housework or gardening
Bend, kneel or stoop
Carry or push an object
Lift an object
None >>
26.
Which of these activities have I done since the previous beep?
A sport
Walked half a kilometer
Walked more than 1km
Climbed 1 flight of steps
Climbed several flights
None >>
27.
Which of these things have I AVOIDED because of pain, or fear of it getting worse?
Housework/chores
Yardwork/gardening
Work (paid or unpaid)
Shopping
A sport
None >>
28.
Which of these things have I AVOIDED because of pain, or fear of it getting worse?
Cooking
Visiting
Dress or bath myself
A hobby
Driving
None >>
29.
Which of these things have I tried to help myself cope with the pain?
Drank alcohol
Did an activity/stretched
Did something I enjoy
Hope/wish it'd go away
Relaxed/breathed deeply
None >>
30.
Which of these things have I tried to help myself cope with the pain?
Ignore the pain
Talk sense to myself
Think of pleasant things
Distract myself from pain
Tell myself it doesn't hurt
None >>
31.
Which of these things have I tried to help myself cope with the pain?
Taken pain medication
Taken sleeping tablets
Lay down/rested/slept
Pretend it isn't there
Use positive thinking
None >>
32.
Were the pain medications I took taken as part of a regular schedule?
Yes, all of them
No, none
Only some


33.
In relation to my tasks/activities since the last beep, at times I have:
Avoided doing a task/s
Given up during a task/s
Persisted despite pain
Taken breaks to rest
Switched between tasks
None >>
34.
In relation to my tasks/activities since the last beep, at times I have:
Refused help from others
Sought help from others
Accepted their help
None >>
35.
Thanks again for your help!
I'll talk with you again in the next few hours
OK

APPENDIX L

PAMS-R and Feedback Form

The Pain Monitoring Project

Research Officer
Ben Chadwick
The School of Psychology, University of Queensland, St Lucia

Project Supervisor
Dr Justin Kenardy
The School of Psychology, University of Queensland, St Lucia

Hospital Staff
Professor Tess Cramond
Dr Bronwyn Williams
The Royal Brisbane Hospital, Herston

PROJECT SURVEY

This booklet must be fully completed by the end of the first day after monitoring is completed, thankyou.

Today's Date: _____	OFFICE USE ONLY Confidential ID:

Thankyou for your participation in this project. We are interested in your opinions about the palm-top-computer (PTC) and the project itself. Please circle a number on the 0 to 10 scales below to rate the following items:

1. Would you complete another week of monitoring?

0	1	2	3	4	5	6	7	8	9	10
Definitely No			Probably Not		Maybe		Yes, Probably			Definitely Yes

2. If a friend with ongoing pain was asked to participate in the project, would you recommend it to them?

0	1	2	3	4	5	6	7	8	9	10
Definitely No			Probably Not		Maybe		Yes, Probably			Definitely Yes

Please rate your agreement with the following statements:

3. I found this project to be a waste of my time.

0	1	2	3	4	5	6	7	8	9	10
Definitely Disagree			Probably Disagree		Maybe		Probably Agree			Definitely Agree

4. I found this project to be useful for me.

0	1	2	3	4	5	6	7	8	9	10
Definitely Disagree			Probably Disagree		Maybe		Probably Agree			Definitely Agree

5. I found this project interesting.

0	1	2	3	4	5	6	7	8	9	10
Definitely Disagree			Probably Disagree		Maybe		Probably Agree			Definitely Agree

6. I found the questions confusing.

0	1	2	3	4	5	6	7	8	9	10
Definitely Disagree			Probably Disagree		Maybe		Probably Agree			Definitely Agree

7. I found the palm-top computer annoying.

0	1	2	3	4	5	6	7	8	9	10
Definitely Disagree			Probably Disagree		Maybe		Probably Agree			Definitely Agree

8. I found the palm-top computer disruptive.

0	1	2	3	4	5	6	7	8	9	10
Definitely Disagree			Probably Disagree		Maybe		Probably Agree			Definitely Agree

9. I found the palm-top computer embarrassing under certain circumstances.

0	1	2	3	4	5	6	7	8	9	10
Definitely Disagree			Probably Disagree		Maybe		Probably Agree			Definitely Agree

10. I found the palm-top computer convenient to carry with me.

0	1	2	3	4	5	6	7	8	9	10
Definitely Disagree			Probably Disagree		Maybe		Probably Agree			Definitely Agree

11. I found the palm-top computer difficult to use.

0	1	2	3	4	5	6	7	8	9	10
Definitely Disagree			Probably Disagree		Maybe		Probably Agree			Definitely Agree

12. I think that other people with chronic pain would use the PTC for one week.

0	1	2	3	4	5	6	7	8	9	10
Definitely Disagree			Probably Disagree		Maybe		Probably Agree			Definitely Agree

13. I feel that the information I gave was representative of my week.

0	1	2	3	4	5	6	7	8	9	10
Definitely Disagree			Probably Disagree		Maybe		Probably Agree			Definitely Agree

14. I feel that the information I gave was representative of my life at the moment, with regards the questions that were being asked.

0	1	2	3	4	5	6	7	8	9	10
Definitely Disagree			Probably Disagree		Maybe		Probably Agree			Definitely Agree

15. In terms of the pain, this has been a typical week.

0	1	2	3	4	5	6	7	8	9	10
Definitely Disagree			Probably Disagree		Maybe		Probably Agree			Definitely Agree

16. In terms of my daily activities, this has been a typical week.

0	1	2	3	4	5	6	7	8	9	10
Definitely Disagree			Probably Disagree		Maybe		Probably Agree			Definitely Agree

17. In terms of my mood, stress, anxiety and psychological well being, this has been a typical week.

0	1	2	3	4	5	6	7	8	9	10
Definitely Disagree			Probably Disagree		Maybe		Probably Agree			Definitely Agree

18. Entries that I made were false (for example, completed by another person or made up)

0	1	2	3	4	5	6	7	8	9	10
Never		On rare occasions			Some of the time			Often		Always

19. I made entries without really giving my answers any consideration

0	1	2	3	4	5	6	7	8	9	10
Never		On rare occasions			Some of the time			Often		Always

20. When I dismissed entries, it was because (select all applicable, leave blank if not-applicable):

- ☐ My location was not safe for the PTC
- ☐ It would have been physically impossible for me to make an entry for at-least 30mins
- ☐ It would have been physically impossible for me to make an entry at that time
- ☐ It would have been inconvenient for me to make an entry for at-least 30 mins
- ☐ It would have been inconvenient for me to make an entry at that time
- ☐ I was physically exhausted
- ☐ I was psychologically distressed eg. tense, stressed, down
- ☐ I just couldn't be bothered
- ☐ My pain was too bad
- ☐ Other – please specify: _____

21. When I postponed entries, it was because (select all applicable, leave blank if not-applicable):

- ☐ My location was not safe for the PTC
- ☐ It would have been physically impossible for me to make an entry at that time
- ☐ It would have been inconvenient for me to make an entry at that time
- ☐ I was physically exhausted
- ☐ I was psychologically distressed eg. tense, stressed, down
- ☐ I just couldn't be bothered
- ☐ My pain was too bad
- ☐ Other – please specify: _____

22. When I missed entries altogether, it was because (select all applicable, leave blank if not-applicable):

- ☐ My location was not safe for the PTC
- ☐ It would have been physically impossible for me to make an entry at that time
- ☐ It would have been inconvenient for me to make an entry at that time
- ☐ I was physically exhausted
- ☐ I was psychologically distressed eg. tense, stressed, down
- ☐ I just couldn't be bothered
- ☐ My pain was too bad
- ☐ The PTC was in the room, but it was not loud enough
- ☐ The PTC was not in the room and I didn't hear it
- ☐ I was out and was not carrying the PTC with me
- ☐ It did not ring for long enough, and I missed it
- ☐ It was too embarrassing to answer it, so I ignored it
- ☐ Other – please specify: _____

23. Do you have any comments regarding aspects of the project that were annoying, difficult or in other ways negative? If so, do you have any suggestions for improvement?

24. Do you have any comments regarding aspects of the project that were useful, interesting or in other ways positive?

25. Do you have any other comments?

Research Officer: 3346 9297 (office hours), 0409 628 311 (after hours)

PAIN ASSESSMENT & MONITORING SURVEY

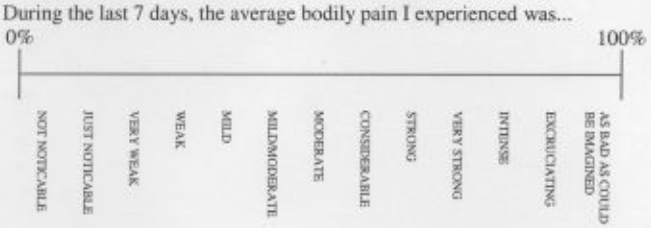
Today's Date: _____

We would like to ask you some questions about the pain. In some questions you will be asked to make ratings by placing a single vertical mark anywhere along a 10cm line. Please place only a single mark. In these questions your response can be guided by labels found underneath the line. Remember, you can place a mark anywhere along the line.

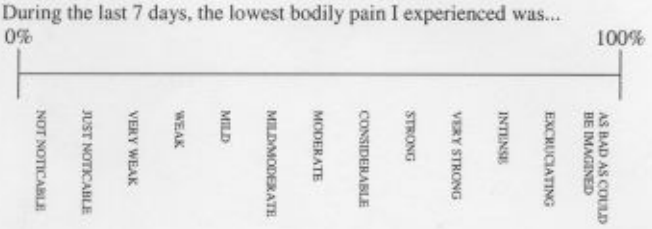
In other questions you will be asked to rate a range of responses by placing a number next to a series of questions. These questions ask you about how often you have done certain activities over the past 7 days. **Please complete all questions**.

IMPORTANT: *Please answer these questions from memory. Do not use memory aids such as a calendar or diary*

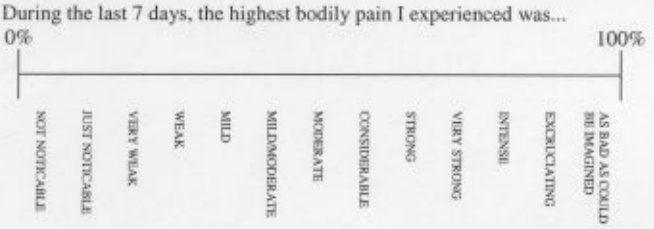
1. During the last 7 days, the average bodily pain I experienced was...



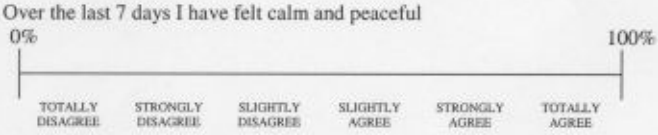
2. During the last 7 days, the lowest bodily pain I experienced was...



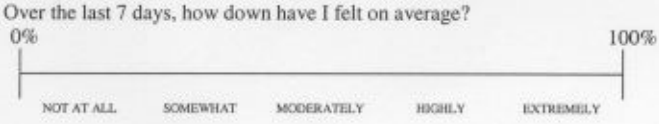
3. During the last 7 days, the highest bodily pain I experienced was...



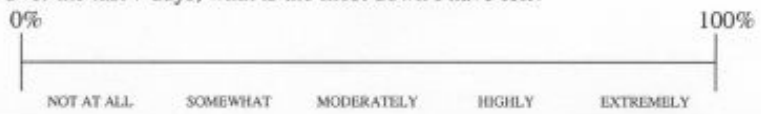
4. Over the last 7 days I have felt calm and peaceful



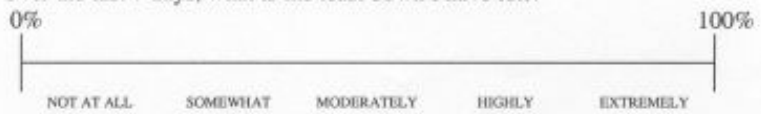
5. Over the last 7 days, how down have I felt on average?



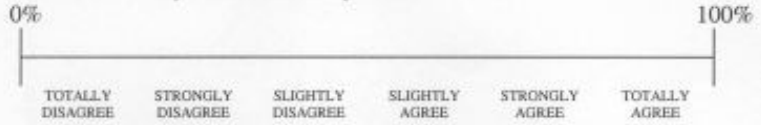
6. Over the last 7 days, what is the most down I have felt?



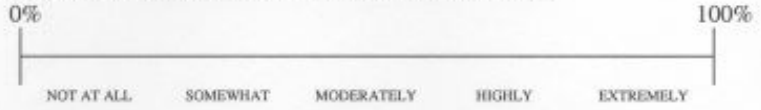
7. Over the last 7 days, what is the least down I have felt?



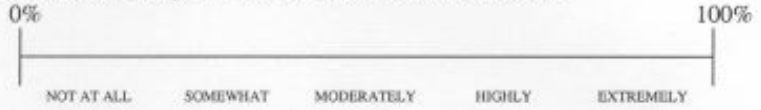
8. Over the last 7 days I have been depressed



9. Over the last 7 days, how anxious have I felt on average?



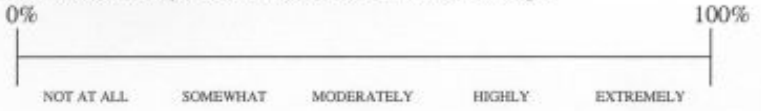
10. Over the last 7 days, what is the most anxious I have felt?



11. Over the last 7 days, what is the least anxious I have felt?

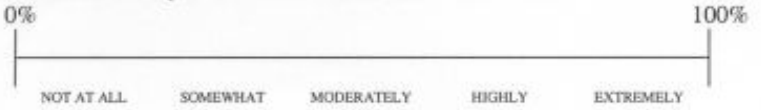
12. Over the last 7 days I have felt frustrated

13. Over the last 7 days, how irritable have I felt on average?

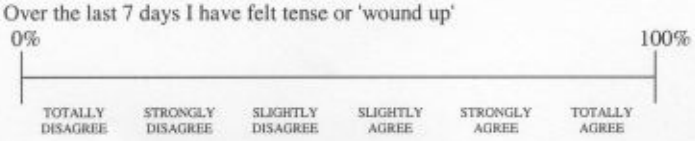


14. Over the last 7 days, what is the most irritable I have felt?

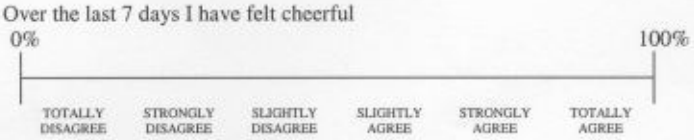
15. Over the last 7 days, what is the least irritable I have felt?



16. Over the last 7 days I have felt tense or 'wound up'

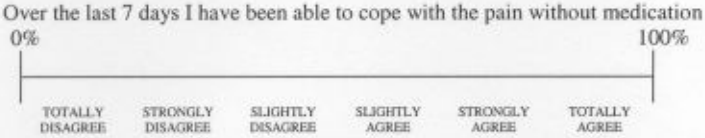


17. Over the last 7 days I have felt cheerful

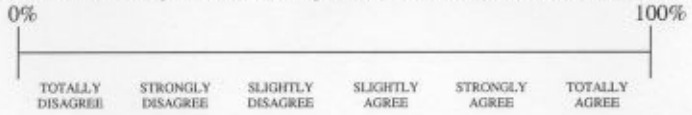


18. Over the last 7 days I have been able to tolerate pain without medication

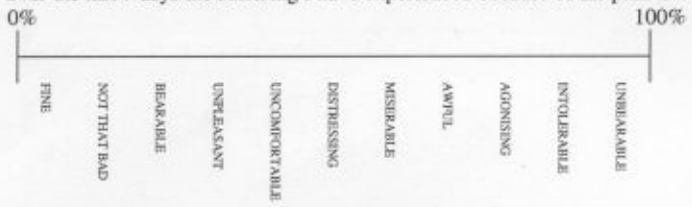
19. Over the last 7 days I have been able to cope with the pain without medication



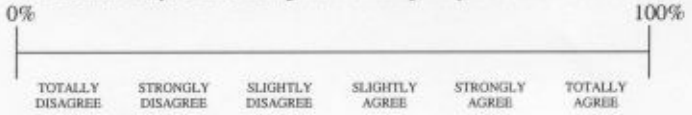
20. Over the last 7 days I have been capable of controlling the amount of pain I experience (without medication)



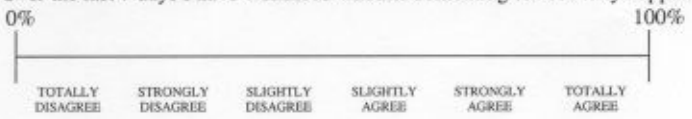
21. Over the last 7 days the suffering I have experienced because of the pain is...



22. Over the last 7 days I have thought that having the pain is terrible and I can't stand it anymore



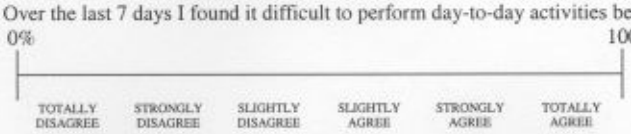
23. Over the last 7 days I have wondered whether something serious may happen because of the pain



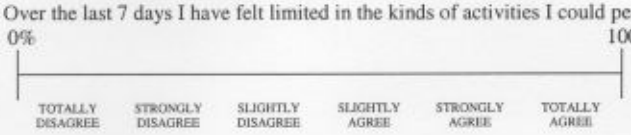
24. Over the last 7 days I believed I was capable of engaging in physical activity (eg, work, chores, shopping)

25. Over the last 7 days I believed I accomplished less than I would have liked because of the pain

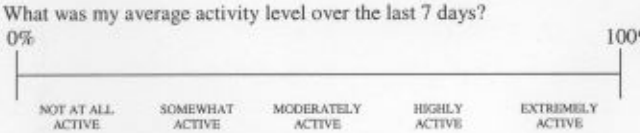
26. Over the last 7 days I found it difficult to perform day-to-day activities because of the pain



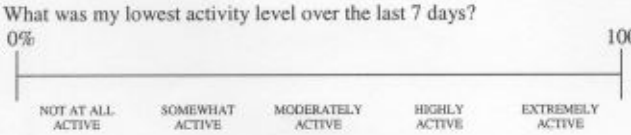
27. Over the last 7 days I have felt limited in the kinds of activities I could perform, because of the pain



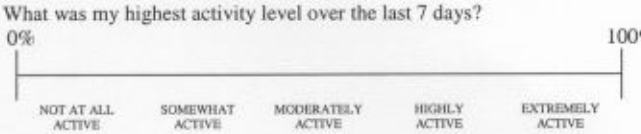
28. What was my average activity level over the last 7 days?



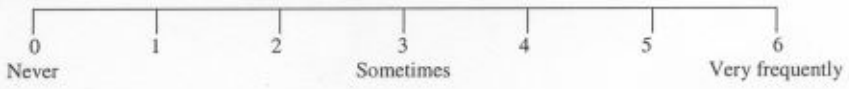
29. What was my lowest activity level over the last 7 days?



30. What was my highest activity level over the last 7 days?



For the remaining questions, please indicate, using the scale below, how much you engaged in each activity over the past 7 days. Remember, you can use any point along the scale.



Which of these activities have I done during the last 7 days?

31. ____Work - paid or unpaid
32. ____Housework or gardening
33. ____Bend, kneel or stoop

34. ____Carry or push an object
35. ____Lift an object
36. ____A sport
37. ____Walked half a kilometer
38. ____Walked more than 1km
39. ____Climbed 1 flight of steps
40. ____Climbed several flights

Which of these things have I AVOIDED because of pain, or fear of it getting worse, during the last 7 days?

41. ____Housework/chores
42. ____Yardwork/gardening
43. ____Work (paid or unpaid)
44. ____Shopping
45. ____A sport
46. ____Cooking
47. ____Visiting
48. ____Dress or bath myself
49. ____A hobby
50. ____Driving

Which of these things have I tried to help myself cope with the pain during the last 7 days?

51. ____Drank alcohol
52. ____Did an activity/stretched
53. ____Did something I enjoy
54. ____Hope/wish it'd go away
55. ____Relaxed/breathed deeply
56. ____Ignore the pain
57. ____Talk sense to myself
58. ____Think of pleasant things
59. ____Distract myself from pain
60. ____Tell myself it doesn't hurt
61. ____Taken pain medication as part of a regular schedule
62. ____Taken pain medications that were not part of a regular schedule
63. ____Taken sleeping tablets
64. ____Lay down/rested/slept
65. ____Pretend it isn't there
66. ____Use positive thinking

In relation to my tasks/activities during the last 7 days, at times I have:

67. ____ Avoided doing a task/s

68. ____ Given up during a task/s
69. ____ Persisted despite pain
70. ____ Taken breaks to rest
71. ____ Switched between tasks
72. ____ Refused help from others
73. ____ Sought help from others
74. ____ Accepted their help

For the following questions, remember to please answer from memory. Do not use memory aids such as a calendar or diary.

75. From memory, on which day did your MAXIMUM level of pain occur? _____

76. From memory, during which time of the day did this level of pain occur? (select one option below)
☐ 8:00 to 9:45am ☐ 9:45 to 11:30am ☐ 11:30am to 1:15pm ☐ 1:15 to 3:00pm
☐ 3:00 to 4:45pm ☐ 4:45 to 6:30pm ☐ 6:30 to 8:15pm ☐ 8:15 to 10:00pm

77. From memory, on which day did your MINIMUM level of pain occur? _____

78. From memory, during which time of the day did this level of pain occur? (select one option below)
☐ 8:00 to 9:45am ☐ 9:45 to 11:30am ☐ 11:30am to 1:15pm ☐ 1:15 to 3:00pm
☐ 3:00 to 4:45pm ☐ 4:45 to 6:30pm ☐ 6:30 to 8:15pm ☐ 8:15 to 10:00pm

79. From memory, on which day was your mood MOST down? _____

80. From memory, during which time of the day was your mood like this? (select one option below)
☐ 8:00 to 9:45am ☐ 9:45 to 11:30am ☐ 11:30am to 1:15pm ☐ 1:15 to 3:00pm
☐ 3:00 to 4:45pm ☐ 4:45 to 6:30pm ☐ 6:30 to 8:15pm ☐ 8:15 to 10:00pm

81. From memory, on which day was your mood LEAST down? _____

82. From memory, during which time of the day was your mood like this? (select one option below)
☐ 8:00 to 9:45am ☐ 9:45 to 11:30am ☐ 11:30am to 1:15pm ☐ 1:15 to 3:00pm
☐ 3:00 to 4:45pm ☐ 4:45 to 6:30pm ☐ 6:30 to 8:15pm ☐ 8:15 to 10:00pm

83. From memory, on which day were you MOST active? _____

84. From memory, during which time of the day was your activity-level like this? (select one option below)
☐ 8:00 to 9:45am ☐ 9:45 to 11:30am ☐ 11:30am to 1:15pm ☐ 1:15 to 3:00pm
☐ 3:00 to 4:45pm ☐ 4:45 to 6:30pm ☐ 6:30 to 8:15pm ☐ 8:15 to 10:00pm

85. From memory, on which day were you LEAST active? _____

86. From memory, during which time of the day was your activity-level like this? (select one option below)
☐ 8:00 to 9:45am ☐ 9:45 to 11:30am ☐ 11:30am to 1:15pm ☐ 1:15 to 3:00pm
☐ 3:00 to 4:45pm ☐ 4:45 to 6:30pm ☐ 6:30 to 8:15pm ☐ 8:15 to 10:00pm

Thank you for completing this booklet!