

Do coping strategies for pain mediate between psychosocial factors and physical activity for  
people with chronic pain?

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for the Degree of Doctor of Philosophy  
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By

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## Abstract

**Background.** Canadian public health guidelines recommend at least 150 minutes per week of moderate to vigorous physical activity (MVPA) for all adults including people with chronic diseases such as arthritis. Unfortunately, many of these individuals do not meet these guidelines and thus are less likely to accrue the many health benefits of being active.

At the core of successful self-management of health behaviours (e.g., MVPA) are the skills of self-regulation. Self-regulation is the ability to adapt and strategise in order to persist in the pursuit of a goal such as weekly MVPA. In order to understand self-regulation in the context of dealing with chronic disease symptoms and pursuing MVPA goals, gaining insight into the causal influences that motivate self-regulatory action is necessary. One approach to examining whether correlates are implicated in causal influence is to identify whether some correlates mediate the relationship between a variable thought to determine behaviour and actual behaviour. Social psychological theories about human behaviour specify such mediators.

Correlational research indicates a positive relationship between self-regulatory efficacy (SRE) and exercise as well as pain acceptance and exercise for people coping with chronic pain from arthritis. Process variables such as self-regulatory actions to cope with pain and exercise are examples of potential mediators of the relationships between SRE, pain acceptance, and MVPA. Theoretically, the nature of the proposed mediation relationships is that SRE and pain acceptance should be related to coping strategy use, which should influence exercise behaviour. Three such types of coping strategies (maintenance, adaptive, and maladaptive) have been identified in previous research.

Experts note many published studies of mediation effects do not satisfy criteria to properly test the mediation. Recommended criteria include but are not limited to large samples, minimising measurement error, and longitudinal research designs of at least three time points.

**Purposes.** Therefore, the purposes of each study in this dissertation program of research were as follows: Study 1 was an exploratory secondary analysis of a larger arthritis study data set to identify (a) proposed mediation relationships utilising regression analyses, and (b) determine whether SRE for scheduling/planning exercise (SRE-SP) met recommendations in the literature for the construction of SRE scales. The purpose of Study 2 was to refine measures. Specifically, examination of measures included (a) a modified, exercise-specific chronic pain acceptance questionnaire (CPAQ-E) and (b) a comparison of the utility of various exercise-specific and disease-specific SRE measures as predictors of future exercise. In Study 3, the purpose was to employ a three time point longitudinal design to test the proposed mediation relationships using coping strategies as mediators.

**Results.** Study 1 found some support for the proposed mediation relationships in that SRE and pain acceptance were significant predictors in the expected direction ( $ps < .001$ ) of each of the types of coping strategy use, with the exception of adaptive strategy use. A multiple regression found that only maintenance strategy use predicted exercise volume ( $p < .001$ ). The SRE-SP measure was found to meet most recommendations of SRE measure development.

Study 2 examined the factorial validity of the CPAQ-E, a modified pain acceptance measure. A 14-item, two-factor model was retained in the final factor structure ( $\chi^2=85.695$ ,  $df=64$ ,  $p<.037$ ;  $RMSEA=.055$ ;  $CFI=.967$ ;  $TLI=.954$ ) and had good psychometric properties among exercising adults with arthritis ( $N = 98$ ). The questionnaire also demonstrated some predictive utility in that both subscales and the total score positively predicted future weekly

exercise bouts ( $p$ s range from  $<.001$  to  $<.05$ ) and the activities engagement subscale predicted future weekly exercise volume ( $p < .05$ ). Among numerous SRE measures, only the SRE-SP and self-efficacy for exercise (SEE) measures significantly predicted future exercise volume ( $p=.002$  and  $p=.001$  respectively).

Study 3 utilised a three time point design to examine proposed mediation relationships between psychological measures (CPAQ-E, SRE-SP, SEE), coping strategy use, and exercise behaviour. Product of coefficients testing was the procedure used to test for mediation whereby  $z$  scores greater than 1.96 indicate statistical significance. Maintenance strategy use was found to partially mediate exercise behaviour in the expected direction regardless of which psychological variable was entered as the independent variable. Maladaptive strategy use did not significantly mediate CPAQ-E and exercise but had mixed support for partial mediation of SRE measures and exercise.

**Conclusions.** This research program expands upon existing correlational studies of social-cognitions related to exercise behaviour by examining mediation relationships for those with chronic pain. Maintenance strategy use was supported as a mediator between cognitions (SRE and pain acceptance) and exercise whereas maladaptive strategy use was only partly supported as a mediator of those relationships. Coping with extreme pain (e.g., arthritis flares) would be an additional context in which to study individuals' coping strategy use and similar mediation relationships. The CPAQ-E demonstrated initial utility as a measure of pain acceptance in pursuing exercise behaviour but should be compared directly with the original CPAQ to determine if either is superior to the other in exercise studies. Future studies should employ a large enough sample to explore possible differences in mediation relationships among inactive individuals, exercise initiates, and maintainers.

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## **Dedication**

*For my mum and dad*

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## **Glossary of Terms**

Physical activity – Physical activity is defined by the World Health Organization as any bodily movement produced by skeletal muscles that requires energy expenditure (World Health Organization, 2016).

Moderate to vigorous physical activity – This refers to the intensity of physical activity. This intensity is what is recommended by public health guidelines to accrue health benefits (Centers for Disease Control and Prevention, 2015b). This dissertation examines PLANNED moderate to vigorous physical activity.

Exercise – Exercise is an example of physical activity. Exercise is a planned form of physical activity that is purposeful in the pursuit of sustaining or improving physical fitness and function (Merriam-Webster, 2016a).

Coping – Coping is a means of contending with stress and conflict. For the purposes of this dissertation, coping refers to contending with pain in the pursuit of regular exercise (Weiten & Lloyd, 2008).

Pain – Perception of noxious stimuli by nociceptors experienced as physical discomfort (Merriam-Webster, 2016b).

Mediation – A phenomenon whereby an intermediary variable (mediator) identifies a mechanism for a predictive relationship between two variables (Baron & Kenny, 1986).

## **List of Abbreviations**

- ASES – Arthritis self-efficacy scale
- CDC – Center for disease control
- CFI – Comparative fit index
- C.I. – Confidence interval
- CPAQ - Chronic pain acceptance questionnaire
- CPAQ-E – Chronic pain acceptance questionnaire for exercise
- CSEP – Canadian Society for Exercise Physiology
- df – degrees of freedom
- DV – Dependent variable
- HMR – Hierarchical multiple regression
- IV – Independent variable
- KMO - Kaiser-Meyer-Olkin
- MV – Mediator variable
- MVPA – Moderate to vigorous physical activity
- PA – Physical Activity
- PCA – Principal components analysis
- PHAC – Public Health Agency of Canada
- RMSEA – Root mean square error of approximation
- SCT – Social Cognitive Theory
- SE – Self-efficacy
- SEE – Self-efficacy for exercise scale

SRE – Self-regulatory efficacy

SRE-SP - Self-regulatory efficacy to schedule/plan exercise

TLI – Tucker-Lewis index



## **Dissertation Format**

This dissertation is presented in manuscript style. It describes a program of research consisting of three related studies presented in American Psychological Association manuscript format with minor exceptions appropriate to guidelines suggested by the University of Saskatchewan. Accordingly, the studies appear as somewhat independent manuscripts bridged by segues that link the studies to the overall program of research for the dissertation. These studies are preceded and followed by a general introduction and general discussion, respectively, that are relevant to the overall research program. Given the partial independence of the manuscripts, there is some redundancy that may appear in the introductions of each.

## **1. General Introduction**

### **1.1 Arthritis and Exercise Self-management**

The health benefits of regular physical activity (PA) are numerous and well documented (Public Health Agency of Canada [PHAC], 2011). Canadian public health guidelines for PA were advanced by the Canadian Society for Exercise Physiology (CSEP) in 2011 and these guidelines recommend at least 150 minutes per week of moderate to vigorous physical activity (MVPA) for adults, including those with arthritis (PHAC, 2010). Unfortunately, like those among the general population, many people with arthritis do not meet these guidelines and therefore are not receiving the potential benefits of doing so (PHAC, 2010).

Arthritis can manifest its symptomatology in a variety of ways (e.g., pain, stiffness, swelling, fatigue) which can affect mobility and quality of life. Thus, management of these symptoms can be of great benefit to people with arthritis and regular MVPA is one avenue available by which to help to manage arthritis symptoms (PHAC, 2010). The use of MVPA for managing arthritis symptoms is an example of self-management (Gierc, Brawley, & Rejeski, 2016). According to Clark (2003), self-management is an aspect of disease management whereby individuals may collaborate with health care providers or family in adhering to a treatment plan (e.g., MVPA prescription) intended to manage their disease symptoms.

### **1.2 Social Cognitive Theory**

At the core of successful self-management of health behaviours (e.g., MVPA) are the skills of self-regulation. Self-regulation is the ability to adapt and strategise in order to persist in the pursuit of a goal such as a weekly MVPA goal (Gierc et al., 2016). A useful theory that can be applied to psychological understanding of the self-regulation of MVPA is social cognitive

theory (SCT: Bandura, 1986; 1997). Specifically, the agency aspect of SCT applies directly to the pursuit of goal-oriented behaviours. Bandura (1997) suggests that a variable that is central to an individual's ability to pursue these goals in the face of challenges or barriers is that of self-regulatory efficacy (SRE). SRE reflects the strength of individuals' confidence in their self-regulatory skills. The primary contributor towards SRE beliefs is prior experience with the behaviour in question (e.g., self-regulation strategies), although SRE beliefs can be informed by other means such as vicarious experience through similar others and social persuasion. In SCT, Bandura (1997) would suggest that the higher a person's SRE beliefs for a behaviour, the more they will persist with that behaviour despite challenges, and the better their adherence to that behaviour will be. Thus, the agency aspect of SCT is an appropriate theory with which to approach the study of self-management of MVPA for arthritis, and is the focus of this dissertation. The importance of SRE relative to the self-management of arthritis is further emphasised in recent reviews by Marks (2012; 2014).

Application of behavioural theories such as SCT is valuable for a number of reasons. Theories are empirically validated frameworks of behaviour and identify processes/variables that are most susceptible to change and therefore ideal targets for intervention. The blueprint for behaviour provided by theory can also assist in identifying why a behaviour change intervention may have failed. Theories also boast validity when successful interventions have been executed based upon these theories (Brawley, 1993). Despite these advantages to utilising theory in studies of health behaviour change, one review identified a paucity of theory-based studies in this area (Painter, Borba, Hynes, Mays, & Glanz, 2008). As well, Painter and colleagues' review (2008) noted that, of the small number of theory-based studies that were conducted, many were simply informed by theory rather than actually testing theory. To address this identified gap in

the literature, an example of a potential test of theory-based hypotheses concerning MVPA as the health behaviour of interest would be to perform a mediation analysis. This analysis would examine the relationship between theory-based variables such as SRE, intermediary (mediator) variables such as self-regulation strategy use, and MVPA behaviour.

### **1.3 Pain Acceptance**

In addition to SRE, a psychological variable of central importance to managing MVPA for people with arthritis may be that of pain acceptance (McCracken & Vowles, 2006). Pain acceptance may actually be interpreted as one of the intrapersonal factors identified in SCT, highlighting the possible complementary nature of SCT and pain acceptance. Pain acceptance is characterised by two constructs which are each represented as subscales in the chronic pain acceptance questionnaire (CPAQ: McCracken, Vowles, & Eccleston, 2004). These are: pain willingness, a willingness to experience pain in pursuit of valued activities; and activities engagement, to engage in those activities despite the expectation of inducing pain. Provided that MVPA is considered by an individual to be a valued activity, higher scores of pain acceptance should correspond with greater adherence to MVPA while lower pain acceptance may lead to avoidance of MVPA. Indeed, the connection between higher pain acceptance and MVPA has been supported by Gyurcsik, Brawley, Spink, Glazebrook, and Anderson (2011).

Examining intermediate process variables such as self-regulatory actions to cope with pain and exercise that mediate such observed relationships is a focus of the present research program. The same self-regulatory coping strategies that may mediate SRE and MVPA could be considered as mediators between pain acceptance and MVPA. As stated, the theoretical foundation that frames this dissertation is the agency aspect of SCT and, as an intrapersonal SCT factor, the complementary concept of pain acceptance in order to examine coping from a self-

regulatory perspective. It bears noting that coping is a concept that has been included in separate theories about stress and coping. The reader is referred to works by Selye (1976) and Lazarus (Lazarus, 1966; Lazarus & Folkman, 1984; Lazarus, 1993) for further elaboration about each of these theories.

#### **1.4 Mediation**

For a thorough description of the concept of mediation, Frazier, Tix, and Barron (2004) is an excellent resource. Frazier and colleagues (2004) contend that while it is useful to identify predictive relationships between psychological variables and outcome variables, it is important to move beyond these questions. A mediator is an intermediary variable that identifies a mechanism for a predictive relationship between two variables (Baron & Kenny, 1986). Therefore, if the research question is ultimately to discover answers of a causal nature, the study of mediation is a step beyond simpler prediction models. As described above, the potential mediation relationships of interest in this dissertation are between SRE (and pain acceptance), self-regulation strategy use (proposed mediator), and MVPA behaviour. If these relationships are supported by the present series of studies, there are implications for interventions directed at increasing MVPA. Findings may point to increasing SRE and/or pain acceptance as targets of intervention. Additionally, self-regulatory strategies may be a target of intervention. Promoting those strategies that foster activity and discouraging those that hinder activity may be added-value approaches to interventions targeting SRE and pain acceptance with the goal of increasing MVPA. Though these potential mediators are hypothesised to be significant, they are not intended to represent either a comprehensive identification of all factors that might contribute to mediation or all factors and mediators that may inform clinical practice.

There are disadvantages to mediation analyses which may in part contribute to Painter and colleagues' (2008) findings that tests of theory are infrequent. A high level of methodological rigour is required for mediation analyses. Statistically, the Baron and Kenny causal steps approach (1986) is a commonly accepted method of testing mediation using hierarchical multiple regression (HMR). This approach requires that for full mediation to be taking place 1) the independent variable (IV) must predict the dependent variable (DV) as represented by a significant  $c$  path, 2) the IV must predict the mediator variable (MV) as represented by a significant  $a$  path, 3) the MV must predict the DV as represented by a significant  $b$  path, and 4) the relationship between the IV and DV ( $c'$  path) should become zero upon the introduction of the MV (see Figure 1 for a visual representation).

This analysis often requires a large sample size and variables are required to be highly reliable for adequate power (Frazier et al., 2004). Also, as mediation is conceptualized as a causal chain of phenomena, longitudinal design is required whereby at least three time points are utilized (Frazier et al., 2004). Finally, the fourth step is designed to confirm full mediation, a result less probable in psychological research.

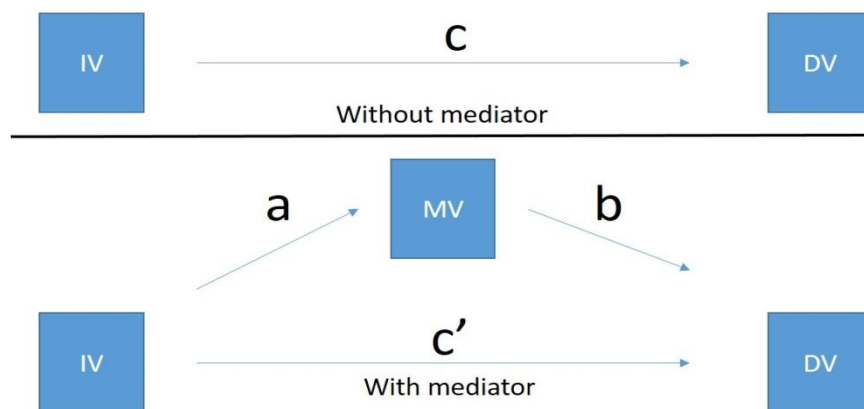


Figure 1. Mediation diagram. IV = independent variable, MV = mediator variable, DV = dependent variable.

For the reasons noted above, an alternate approach known as product of coefficients testing (Kenny, Kashy, & Bolger, 1998) is more appropriate for studies in behavioural science (i.e., the present research) in which partial mediation is more likely and because many unmeasured factors could contribute to full mediation. A product of coefficients procedure tests the indirect effect (paths *a* and *b*) and determines whether the amount of mediation is significant (i.e., versus only testing full mediation). In other words, if the *c* path is significantly reduced upon introducing the mediator, then mediation is taking place, frequently partial mediation. Product of coefficients testing can be used in concert with Baron and Kenny's (1986) approach, in place of the 4<sup>th</sup> step. The product of coefficients test divides the product of paths *a* and *b* by a standard error term. Although the error term as utilised in a Sobel's test is used most commonly, the Aroian formula includes one additional term that provides added precision and performed similarly to a Sobel test in a simulation (MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002). For an illustration of the differences in these formulae, refer to Figure 2.

$$\begin{aligned} \text{Sobel test equation: } z \text{ value} &= \frac{a*b}{\sqrt{(b^2*s_a^2 + a^2*s_b^2)}} \\ \text{Aroian test equation: } z \text{ value} &= \frac{a*b}{\sqrt{(b^2*s_a^2 + a^2*s_b^2 + s_a^2*s_b^2)}} \end{aligned}$$

Figure 2. Standard error terms for product of coefficients testing. *a* = coefficient for *a* path, *b* = coefficient for *b* path, *s* = standard error.

### 1.5 Purpose

The present dissertation was intended ultimately, in its third study, to test the potential mediation relationships between SRE and pain acceptance (IVs), self-regulation strategies (MV), and MVPA (DV). However, preliminary studies informing such a test of mediation are required. Briefly, the first study of this dissertation explored the relationships between the variables in the proposed mediation relationships utilizing data from a larger arthritis study. This study was a secondary analysis of data included in order to explore whether some indicators of potential relationships may exist and thus suggest whether conducting a more rigorous study is worthwhile. Study 2 focused on a measurement theme which served to address the rigorous requirements of mediation. The reliability and validity of variables to be used in the proposed tests of mediation were assessed. Additionally, there are multiple measures of SRE available and Study 2 was focused upon the identification of those most correspondent and psychometrically sound for use in a test of mediation. The final purpose of Study 2, in the interest of selecting the most appropriate measures, was to validate a novel, exercise-specific modification to the standard measure of pain acceptance. Findings from Studies 1 and 2 informed the design and choice of measures utilized in the test of mediation in Study 3.

## **2. Study 1**

### **2.1 Introduction**

Adherence to PA is problematic for people with arthritis despite the potential benefits for managing disease symptoms (PHAC, 2010). Regardless of arthritis type, health promotion and disease management advocates recommend regular weekly participation in 150 minutes of MVPA (Centers for Disease Control [CDC], 2011; PHAC, 2010). However, in addition to the general types of adherence barriers to PA faced by the general population, individuals with arthritis face symptom-related barriers to PA (Gyurcsik et al., 2009; Wilcox et al., 2006).



Efforts to understand the unique arthritis-related barriers to PA have been helpful in identifying psychological variables associated with better adherence (Der Ananian, Wilcox, Watkins, Saunders, & Evans, 2008; Gyurcsik, Brawley, Spink, & Sessford, 2013; Gyurcsik et al., 2011; Marks, Allegrante, & Lorig, 2005). Chief among these variables are self-efficacy (SE) and pain acceptance. SE is one construct of the agency aspect of Bandura's SCT (1986; 1997) and reflects one's confidence in being able to carry out actions in pursuit of motivated goals. SE can be applied to carrying out discrete tasks such as walking certain distances (task SE) or to ongoing self-regulation skills such as scheduling/planning PA (i.e., SRE). The second construct, pain acceptance, represents a person's capacity to pursue valued activities despite chronic pain and without fixating on a need to control pain (McCracken & Vowles, 2006).

In the arthritis and PA literature, Gyurcsik and colleagues (2011) found that people higher in pain acceptance engaged in a higher volume of PA. More recently, in their study of the symptom spikes that characterize arthritis flares, Gyurcsik and colleagues (2013) found that those who met PA guidelines of at least 150 minutes of weekly MVPA (PHAC, 2010) possessed stronger SRE beliefs regarding overcoming arthritis barriers and scheduling/planning PA. Stemming from these primarily correlational findings are two important directions for future research. One concerns the validity of measurement instruments used to assess SE and pain acceptance in people with arthritis. The other is to move beyond primarily correlational data to examine theoretically-suggested mechanism variables related to motivation and adherence by using mediation models.

### **2.1.1 Linking Measurement and Mediation**

Speaking to the issue of measurement, selective review and recommendation publications have been critical of commonly-used SE measures in arthritis (Frei, Svarin, Steurer-Stey, &

Puhan, 2009; Marks, 2012). A primary criticism concerns the use of general arthritis SE measures to predict many disparate behaviours (e.g., self-management; symptom management; mobility). Consequent suggestions of these publications have been to use more tailored and focused SE measures for a variety of reasons. Firstly, this is consistent with Bandura's suggestions (1997). Additionally, patients may have weaker SE beliefs for some self-management behaviours than others (Marks, 2012). To this end, further validation of the SE measures focused on PA behaviour and used in arthritis research may be useful. Factor analysis and evaluation of these SE measures in terms of methodological criteria set forth by Frei and colleagues (2009) are a means of validation. Briefly, these criteria include (a) defining and describing the aim of the instrument (e.g., predictive, discriminative, etc.), (b) practical and methodological considerations should be made a priori, (c) item identification should begin with a systematic literature search, (d) item selection should include the patient perspective, and (e) validation including test-retest reliability. This kind of rigorous assessment may strengthen the existing findings either by further validating measures used or by leading to refinements to the future use of such measures.

Further validation of the CPAQ would also be of value (Geiser, 1992; McCracken et al., 2004). Although it has been validated in chronic pain generally (McCracken et al., 2004) it has not been validated in arthritis specifically, in relation to individuals focussing upon PA.

A strong set of validated measures provides a more reliable foundation from which to pursue tests of mediation that would advance the largely correlational arthritis and PA adherence literature. Theory-based research tends to be in the minority relative to published health behaviour research, especially in terms of tests of theory (Painter et al., 2008). Tests of theory-based process variables linking behavioural beliefs to PA adherence may offer explanation about

the relationships between SRE, pain acceptance, and PA. Such explanations remain largely unexplored. Specific process variables have been identified and suggested but not tested. One such recent example in the PA and arthritis literature is the thesis by Cary (2014) and a subsequent publication (Cary, Gyurcsik, & Brawley, 2015a). Investigators measured the use of 3 coping strategies – adaptive, maladaptive, and maintenance. Specifically, adaptive strategy examples include alteration of the mode or intensity of exercise when pain is intense. A maintenance strategy would be continuing with the usual approach to adherence behaviour as planned, without alteration, in order to be active. Finally, maladaptive strategy examples primarily concern avoidance of PA behaviours. These strategies may be intermediate actions linking relations between identified psychological variables and PA behaviour. Findings by Cary and colleagues supported a positive relationship between pain acceptance and maintenance strategy use (Cary, Gyurcsik, & Brawley, 2015b).

### **2.1.2 Objectives and Hypotheses**

It was the objective of the present study to use data from a larger arthritis study to examine both measurement and mediation concerns mentioned earlier. Regarding measurement, one purpose was to assess the factorial and psychometric validity of SRE to schedule/plan PA (SRE-SP) and the CPAQ measures used in the larger study. Additionally, the SRE-SP measure was assessed in terms of criteria put forth by Frei and colleagues (2009) for the measurement of SE.

A second purpose was to explore process variables that may be potential mediators of PA behaviour. Specifically, SRE-SP and the CPAQ were used to predict the use of three types of behavioural coping strategies for pain anxiety and engaging in PA (adaptive, maintenance and maladaptive). These strategies were then used to prospectively predict future PA behaviour.

Additionally, the product of coefficients test of mediation (Kenny et al., 1998) was conducted on the *proposed* mediation relationships in this cross-sectional sample in order to examine their potential for test in a future prospective study. If the relationships hypothesized below were not in evidence, then pursuit of a future prospective study would be questionable.

Based on the background information above, hypotheses regarding predictive analyses were as follows: (a) SRE-SP and pain acceptance will be positively related to adaptive and maintenance strategies and negatively related to maladaptive strategies, (b) adaptive and maintenance strategies will be positively related to future PA and maladaptive strategies will be negatively related to future PA. It was hypothesised that mediation relationships would be significant.

## **2.2 Methods**

### **2.2.1 Participants and Design**

Secondary analysis of a larger data set was utilised for the pursuit of previously unexplored research questions related to mediation. An observational, prospective design was employed in the present study. Participants ( $N = 136$ ) were predominantly female (87%) adults with self-reported, medically-diagnosed arthritis ( $M_{age} = 49.75 \pm 13.89$  years). To be eligible, participants were required to (a) be adults, 18 years of age or older, (b) be residents of Canada or the United States, (c) report doing at least one bout of planned physical activity in the past 2 weeks lasting 20 minutes or more, (d) report having medically-diagnosed arthritis. Arthritis type was not assessed because self-reporting of this information is not reliable (CDC, 2015a). Participation in exercise is recommended for all types of arthritis (CDC, 2011).

### **2.2.2 Measures**

**Self-regulatory efficacy to schedule/plan physical activity.** This 9-item measure assessed participants' confidence in their abilities to schedule and plan MVPA over the coming two weeks. Example items were "Stick with the times you have planned to be active each week" and "Take time for yourself and be physically active as planned regardless of your other commitments." SRE-SP was assessed using a 0 (*not at all confident*) to 10 (*completely confident*) response scale as per the recommendations of Bandura (1997). The items on this scale have been used in prior research to examine both asymptomatic and symptomatic adults (e.g., DuCharme & Brawley, 1995; Gyurcsik, Spink, Priebe, Anderson, & Brawley, 2010; Woodgate, Brawley, & Weston, 2005). A mean score of the items was used to represent SRE and was reliable (Cronbach's  $\alpha = .94$ ).

**Pain acceptance.** Pain acceptance was assessed using the CPAQ (McCracken et al., 2004). This measure is comprised of 2 subscales (pain willingness and activities engagement) and can also be interpreted as a total score. Pain willingness can be described as being willing to experience pain in the pursuit of valued activities without feeling it is necessary to control pain. Activities engagement is representative of the extent to which individuals actually engage in activities that are important to them despite the possibility of these activities inducing pain. A sample item from the 9-item pain willingness subscale is "I need to concentrate on getting rid of my arthritis pain". A sample from the activities engagement subscale is "I am getting on with the business of living no matter what my level of arthritis pain is". Participants rated each item in terms of how true it was for themselves on a 0 (*never true*) to 6 (*always true*) response scale. Items in the pain willingness scale were reverse scored and summed while the activities engagement items were simply summed. The total CPAQ score was calculated by summing the 2 subscales. Higher scores on both subscales and the total score represent higher pain acceptance,

up to a maximum score of 120. The CPAQ has been validated in chronic pain populations (McCracken et al., 2004) and was reliable in the present study of individuals with arthritis (Cronbach's  $\alpha = .90$ ).

**Coping strategy use.** A measure of participants' use of adaptive, maladaptive, and maintenance strategies for coping with pain anxiety while attempting to be physically active was constructed by Cary (2014). The measure consists of 5 items representing adaptive strategies (e.g. "Alternate the type of exercise that you plan on doing"), 5 items representing maladaptive strategies (e.g. "You are overwhelmed and you stop doing your planned exercise"), and a single item representing a maintenance strategy ("Do all of your scheduled/planned exercise, regardless of your pain anxiety"). Responses to each item were scaled in terms of the degree to which participants would employ each strategy in the following 2 weeks (0 – *never do this*, to 8 – *always do this*). Scores for each scale were expressed as a sum. Reliabilities for adaptive and maladaptive scales were Cronbach's  $\alpha = .65$  and  $\alpha = .80$  respectively, which is the same as for Cary (2014).

**Physical activity.** Participants reported the average weekly frequency and duration of planned bouts of 20 minutes or more of moderate and vigorous activity during the previous two weeks. Total weekly volume of planned PA was calculated in a manner consistent with public health recommendations and previous work on PA and arthritis (CDC, 2011; Gyurcsik et al., 2013; PHAC, 2010). Participants were provided definitions of moderate and vigorous activity (CDC, 2010). Moderate activity was defined as "*...makes your heart beat faster and makes you breathe a little harder. You can talk easily while doing moderate activity, but you may not be able to sing comfortably. On a scale from 0 to 10, where sitting is 0 and the highest level of effort possible is 10, moderate exercise is a 5 or 6.* Vigorous activity was defined as "*... makes your*

*heart beat much faster. You may not be able to talk comfortably without stopping to catch your breath. On a scale of 0 to 10, where sitting is 0 and the highest level of effort possible is 10, vigorous activity is a 7 or 8."*

Activity bouts of less than 20 minutes were not used because the focus of the SRE measure in the present study is on *planned activity that requires self-regulation* rather than unplanned, shorter incidental bouts. Additionally, planned bouts of longer duration have demonstrated better recall and are self-reported with higher accuracy than unplanned, incidental short duration bouts of activity (Cust et al., 2008). Guidelines for the conversion of vigorous activity minutes into moderate-equivalent minutes dictate that vigorous minutes be doubled (Nelson et al., 2007). Therefore, the total volume of planned PA per week was calculated by summing weekly moderate activity (frequency x duration) with weekly vigorous activity (frequency x duration x 2).

The foregoing measures can be found in Appendix A.

### **2.2.3 Procedures**

Following receipt of approval from the University Behavioural Research Ethics Board, web-based study announcements were used to recruit the study sample. These announcements included a link to the online survey and were posted to arthritis-related message boards, arthritis organisations' official websites (e.g. the Arthritis Society, local chronic disease program, etc.), and social media pages of these organisations (e.g. Facebook, Twitter).

Data were collected via a baseline online survey and a follow-up online survey two weeks later. Before beginning the online survey, participants were required to complete the electronic consent form and then answer questions to establish eligibility. After satisfying the

eligibility criteria, participants completed the 20-30 minute survey. Those participants who provided permission to be contacted by email to complete a follow-up survey two weeks later were sent the link to the second survey.

#### **2.2.4 Data Management and Analysis**

Analyses were performed using SPSS version 20. Data were screened for outliers and for missing data. No participants were missing entire scales but for any scales missing a single item, mean replacement was used (Tabachnick & Fidell, 2012). A small number of participants ( $n = 8$ ) reported either the days or minutes of exercise but not both. A conservative strategy for replacing the missing data was employed whereby the lowest possible answer was inserted (i.e. 1 day, or 20 minutes – if minutes were reported, they must have been performed on at least 1 day and recall that activity bouts needed to be at least 20 minutes long). Outliers were identified as z-scores greater than 3.29 and were handled according to recommendations by Tabachnik and Fidell (2012). These outliers were in the exercise measure and the lowest of the outliers was reduced to one score greater than the next largest exercise score. The subsequent two outliers were each reduced to one value higher in order to preserve their rank order at the highest end of the exercise distribution.

To examine objectives regarding measurement, a factor analysis was conducted on both the CPAQ and SRE-SP measures. The CPAQ consists of 2 subscales, thus, a principal components analysis (PCA) was performed forcing a 2-factor solution. The PCA approach was used as opposed to a confirmatory factor analysis because the instrument was being tested in a unique population. More specifically, it was anticipated that participants could respond differently than the population in which the CPAQ was originally validated. A confirmatory method might be appropriate when a research hypothesis is that the population in the present



study should respond similarly to the population examined in the original CPAQ study. Given that subscales were correlated, an oblique rotation was used.

The SRE-SP scale was constructed as a single factor. Thus, an orthogonal rotation was used. Assumptions of factor analysis were tested and met such as sampling adequacy and controlling outliers.

The objectives related to mediation were analysed using HMRs. Assumptions of HMR were tested and met including multicollinearity and homoscedasticity. First, three separate HMRs were performed using each of the three coping strategy scores as the DV. In all three HMRs, SRE-SP was entered into the first step and the CPAQ total score was entered into the second step. The reason for entering SRE-SP first is that it is a construct based in SCT (Bandura, 1986) which is theorised to be related to self-regulation of health behaviour (e.g., coping strategies for managing exercise behaviour). Cohen, Cohen, West, and Aiken (2003) suggest that in HMR analyses theory-based variables are entered first.

To assess whether coping strategy use predicted PA volume, a regression model was tested where all 3 coping strategy scores were entered in a single step predicting the DV of planned PA volume. To further assess viability of future more rigorous tests of mediation, product of coefficients testing was conducted as described by Kenny and colleagues (1998). Specifically, this means that for each potential mediation relationship, the product of paths  $a$  (independent variable to mediator) and  $b$  (mediator to DV) was divided by a standard error term. The result is a  $z$ -score, which can be compared against the critical value 1.96 to identify significance at  $p < .05$ . In the event, this  $z$ -score was significant, this would be reason to conclude a possibility or potential for future tests of mediation and a reason to pursue this goal in

subsequent studies that would satisfy more rigorous measurement and design criteria. In other words, a reason to pursue Studies 2 and 3 of the dissertation.

## **2.3 Results**

### **2.3.1 Measurement Objective**

**Factor analyses.** A PCA with oblique rotation was conducted on the CPAQ. This was done to examine its factorial validity in a sample of people with arthritis and compare this to the CPAQ factors reported by McCracken and colleagues (2004) in samples with chronic pain. Three factors yielded eigenvalues greater than one but based on McCracken and colleagues' (2004) reporting of a two-factor solution, and after examination of the scree plot supported a two-factor solution, a two-factor solution was forced. These two factors accounted for 50.7% of the variance. Sampling adequacy was acceptable as indicated by a Kaiser-Meyer-Olkin (KMO) indicant of .9. Upon examination of the pattern matrix, the majority of the 20 CPAQ items loaded on the expected subscale and none had major cross-loadings (factor loadings greater than .45; Field, 2005).

A PCA with intended oblique rotation was conducted on the SRE-SP scale. This was done to examine whether any more than the one expected factor emerged. A single factor yielded an eigenvalue greater than one and examination of the scree plot supported the notion that SRE-SP represents a single factor. No rotation was possible given this solution. This factor accounted for 68.3% of the variance. Sampling adequacy was acceptable as indicated by a KMO indicant of .9.

**Self-efficacy measure evaluation.** Frei and colleagues (2009) performed an evaluation of SE measures used in chronic disease, including arthritis. The basis for this evaluation focused

on both development and validity of the instrument and the authors offered 5 recommendations for SE scale development. SRE-SP adheres to the first 2 recommendations for development criteria set by Frei and colleagues (2009). These are that it possesses (a) a defined aim of the instrument and (b) defined a priori considerations. To elaborate upon criteria (a), SRE-SP is intended to serve evaluative, discriminative, predictive, and planning functions. With regard to (b), a priori considerations included development of a brief (under 10 minutes), self-administered, single-scale instrument yielding continuous data amenable to statistical analysis. The importance of theoretical considerations of item wording are acknowledged by Frei and colleagues (2009) but are said to be outside of the scope of their publication, referring the reader to Bandura's work (2006; 1997). SRE-SP was based upon Bandura's conceptual description of SRE.

Criteria (c) suggests that potential item identification be accomplished through a systematic literature search of similar instruments followed by focus groups comprised of patients. Following this, criteria (d) refers to the method of selecting items for inclusion. Speaking to these two points, the SRE-SP items were identified and selected based on the self-regulatory actions required to plan and schedule PA observed in various studies in the extant literature. Identification was theory-, and expert-driven.

Criteria (e) encompasses tests of validity of the instrument. The SRE-SP measure has not undergone test-retest reliability or responsiveness testing at this time. It has demonstrated internal consistency (Cronbach's  $\alpha = .94$ ) and predictive validity in the present study. SRE-SP was used to predict planned weekly MVPA volume 2 weeks after baseline measures. The model was significant ( $R^2$  adjusted = .22;  $p$ 's < .001).

### **2.3.2 Potential Mediation Objective**

To assess whether SRE-SP and the CPAQ predicted the frequency of use of three separate types of coping strategy, three separate HMRs were conducted. In step one, SRE-SP was the independent variable, and the CPAQ was added in step two. Both predictors contributed in all three HMRs (see Table 1). However, SRE-SP became non-significant after adding the CPAQ when predicting adaptive strategies. It is also surprising that the direction of the relationship between adaptive strategy use and the predictor variables was negative. The direction of relationships between predictor variables and the other two types of strategies were in the expected direction. To assess the relationship between coping strategy use and weekly planned MVPA volume two weeks later, a multiple regression was performed using all three coping strategy types as predictors in a single model. The model was significant ( $R^2$  adjusted = .20,  $p < .001$ ) but only maintenance strategy use contributed significantly ( $\beta = .35$ ,  $p < 0.001$ ).

Next, steps were taken to test potential mediation relationships using Kenny and colleagues' (1998) described method. This procedure excluded models containing adaptive strategies because the measure itself was not highly reliable ( $\alpha = .65$ ), did not contribute significant variance to the prediction of MVPA, and evidenced minimal relationships with psychological variables not in the expected direction.

Separate models were tested in which either maladaptive or maintenance strategies were mediators and either CPAQ or SRE-SP were the independent variable. In all cases, MVPA was the dependent variable. For each relationship, the critical value of  $z = 1.96$  indicated significance at  $p < .05$ . When examining maintenance as the mediator, both SRE-SP ( $z = 3.02$ ) and CPAQ ( $z = 3.48$ ) achieved this critical value supporting a significant potential mediation effect. Likewise, when examining maladaptive strategies as the mediator, both CPAQ ( $z = 2.36$ ) and SRE-SP ( $z = 2.21$ ) achieved this critical value supporting the possibility of potential mediation effects.

Table 1. Hierarchical multiple regressions predicting coping strategy use

Independent Variable	Adjusted $R^2$	$\beta$	$R^2$ Change
<b>Predicting Maladaptive Strategies</b>			
Step 1	.176***		
SRE-SP		-.427**	
Step 2	.423***		.249***
SRE-SP		-.269***	
CPAQ		-.524***	
<b>Predicting Maintenance Strategies</b>			
Step 1	.220***		
SRE-SP		.476***	
Step 2	.359***		.142***
SRE-SP		.356***	
CPAQ		.395***	
<b>Predicting Adaptive Strategies</b>			
Step 1	.061**		
SRE-SP		-.261**	
Step 2	.160***		.105***
SRE-SP		-.159	
CPAQ		-.339***	

Note: SRE-SP = Self-regulatory efficacy to schedule and plan exercise, CPAQ = Chronic pain acceptance questionnaire. \*\*=  $p < .01$ , \*\*\*=  $p < .001$

## 2.4 Discussion

The present study sought to improve specific aspects of the arthritis and exercise literature. Both measurement and identification of potential mediators of the psychological correlates of exercise behaviour were the objectives pursued. These objectives concern two psychological variables that have demonstrated reliable association to exercise among individuals with arthritis – pain acceptance and SRE-SP. In several studies, higher levels of each psychological variable have been associated with higher levels of PA. One suggestion offered in these studies has been to identify possible mediators of the relationships observed (Gyurcsik et al., 2013; 2011). Thus, in the present study, the possibility of whether coping strategies for

dealing with pain anxiety would act as mediators was examined. Inasmuch as an important criterion for testing mediation is to minimize measurement error, the two objectives of the present study were logically intertwined.

In regard to measurement of the predictor variables (SRE and CPAQ) that have been associated with PA in previous investigations among individuals with arthritis, several considerations were the focus of examination. For instance, a systematic review by Frei and colleagues (2009) was critical of the development of SE measures for chronic diseases such as arthritis. They offered a set of criteria suggested to improve SE measures in chronic disease and these were considered in the evaluation of the SRE-SP measure used in the present study. As well, the importance of specificity of SE measures has been identified by Marks (2012) as being important for prediction between SE measures and the corresponding criterion behaviour.

With respect to the pain acceptance measure, the CPAQ has been validated in regard to chronic pain generally, but not to arthritis pain specifically. Specificity of the CPAQ relative to arthritis pain and PA may also be important. Thus, based on specificity and content recommendations in the literature (Frei et al., 2009; Marks, 2012), and based on requirements of minimizing measurement error; both important for mediation analyses, evaluation of the SRE-SP and CPAQ measures and their factorial validity was undertaken among exercising individuals with arthritis.

Consistent with its division into two subscales, factor analysis supported a two-factor solution for the CPAQ. The original factor structure was observed in people with chronic pain and the current factor structure among individuals with arthritis supports its factorial validity. Also consistent with its use to date, the factor analysis of the SRE-SP measure resulted in a single overall scale and a single-factor best fit solution.

Examining the recommendations of Frei and colleagues (2009) for improving SE measures, it can be concluded that the SRE-SP measure possesses (a) a defined aim of the instrument (evaluative, descriptive, predictive, and planning) and (b) defined a priori considerations (i.e., brief [under 10 minutes], self-administered, single-scale instrument yielding continuous data amenable to statistical analysis). The SRE-SP measure possesses some, but not all, of the recommended validation criteria outlined by Frei and colleagues (2009). While it has demonstrated predictive validity and high internal consistency in the present study, demonstrating test-retest reliability should be the goal of future research.

With respect to the approach to item selection and generation, Frei and colleagues (2009) recommend initially generating items via systematic literature searches of similar instruments and by conducting focus groups. The items on the SRE-SP measure were generated by experts utilising theoretical considerations of actions required for self-regulation of planning and scheduling. Frei and colleagues (2009) do acknowledge the importance of theoretical recommendations but state that this was beyond the scope of their review. They subsequently refer the reader to Bandura's work (2006; 1997) who provides the theoretical background for SRE.

An additional theoretical consideration that strengthens the SRE-SP measure and is not considered in Frei and colleagues' review is that of temporal context of instructions. Inasmuch as SE beliefs concern differential confidence about the actions individuals will perform in future, it is important to include a specific time period to which participants respond (e.g. "confidence to schedule and plan activity in the *next two weeks*" as opposed to a general statement "confidence to schedule and plan activity"). This provides a common time frame for all participants rather than a nonspecific frame to which participants may vary greatly in their response. As well, a

time frame also ensures some correspondence between the belief items and the prediction of future behaviour (e.g., average weekly moderate to vigorous physical activity over the *next two weeks*).

While the SRE-SP measure may benefit from undergoing test-retest reliability evaluation, it mostly satisfies the recommendations of Frei and colleagues' review. The method of theory- and expert-driven item generation/selection does not correspond exactly to Frei and colleagues' recommendations following their systematic literature search and focus groups (2009) but it does adhere to theoretical recommendations identified as important by those authors. Further, if deficiencies are identified with existing SE measures (Frei et al., 2009) then basing the development of future scales on flawed existing scales may logically perpetuate these deficiencies. Coupled with the evidence of factorial validity for the SRE-SP and the CPAQ, initial support for continued use of these measures in arthritis and exercise literature is suggested.

Following suggestions by Frazier and colleagues (2004), the magnitude of the relationships necessary to examine potential mediation were initially explored by conducting HMRs to assess how well psychological variables (SRE followed by CPAQ) predicted the proposed mediator variables of coping strategies. Subsequently, a multiple regression was conducted to assess how well these proposed mediator variables predicted MVPA volume, the criterion variable. HMRs were significant and consistent with hypotheses regarding maladaptive or maintenance coping strategies as mediators. When considering all three coping strategies predicting MVPA, maintenance was the only significant predictor of MVPA.

In HMR analyses exploring adaptive strategies, results were inconsistent with hypotheses. One possible reason is that the adaptive coping measure was not highly reliable suggesting possible measurement error ( $\alpha = .65$ ). Scores on this measure were positively



correlated (.38,  $p < .001$ ) with maladaptive strategy use which may imply that the sample contained people who either used maintenance strategies, or a combination of maladaptive and adaptive strategies.

The more robust relationships observed (maladaptive and maintenance strategies) were tested for indicants of potential mediation using the product of coefficients method described by Kenny and colleagues (1998) to examine potential mediation. This method involves dividing the product of the  $a$  and  $b$  paths by an error term. The error term used in this case is one suggested by Kenny and colleagues (Baron & Kenny, 1986; Kenny et al., 1998) known as the Aroian formula. The Aroian formula performs similarly to Sobel's (MacKinnon et al., 2002) but contains one additional term in the formula. This provides a  $z$  score which indicates whether the addition of the mediator in the model significantly diminishes the relationship between the independent and dependent variables. Results of these analyses further supported the potential mediation relationships. These findings are an indication that it may be worthwhile conducting a future study using a temporal design suited to more inferential tests of mediation.

#### **2.4.1 Strengths and Limitations**

Certain limitations to this study must be identified. This was a secondary analysis of data from a larger study and measurement was limited to two time points. A true test of mediation would require a third time point, that the independent variable and mediator would be measured at separate times to support their hypothesised temporal relationship. It should also be clear that only the potential for mediation was considered using suggested criteria for examining mediation if a temporal relationship did exist. Thus, strength and direction of the relationships for the test of mediation were identified. If they were of sufficient strength and comparability to be examined in the case of a mediation test (cf., Frazier et al., 2004) then one of the basic criteria

for testing future mediation would be satisfied. Significant relationships were confirmed for two of the mediators.

Strengths of the study include utilising theoretically-based prediction which are notably scant in health behaviour research (Painter et al., 2008). Also reportedly rare are studies which attempt to meet criteria necessary for tests of a mediation relationship such as minimizing measurement error and considering the relative strength of different relationships before considering a test (Frazier et al., 2004). As Study objectives, two of the criteria for achieving the exploration of potential mediation were achieved.

#### **2.4.2 Future Directions**

Per Marks' (2012) recommendation of specificity, the CPAQ should be modified to refer to PA explicitly in the measure when the behaviour of interest is PA. This notion is indirectly supported by the findings of Moore, Stewart, Barnes-Holmes, Barnes-Holmes, and McGuire (2015). Their findings indicated that pain tolerance is higher when pain is a barrier to the pursuit of more highly valued activities than less valued activities. This is relevant because the CPAQ currently assesses pain acceptance in pursuit of valued activities but the measure does not offer insight as to whether PA is actually considered a valued activity by the respondent. Given evidence from Moore and colleagues (2015) study, the CPAQ's utility in predicting MVPA may well be confounded by whether or not the respondent values PA. As for the SRE-SP measure, it is recommended that its test-retest reliability also be evaluated to contribute to a more comprehensive view of the overall validity of the measure.

In future, a modified CPAQ, as described above, should be subject to factorial and predictive validation. SRE-SP may also be further evaluated in terms of its predictive validity

when compared against other frequently used SE measures such the Arthritis Self-Efficacy Scale (ASES: Lorig, Chastain, Ung, Shoor, & Holman, 1989) and the Self-Efficacy for Exercise scale (SEE: Resnick & Jenkins, 2000). Such future research should serve to clarify whether the importance of specificity of measures as highlighted by Marks (2012) is necessary.

### **2.4.3 Conclusions**

The present study offers continued support for (a) the CPAQ and SRE-SP measures use in arthritis and exercise investigations, (b) future examination of mediation relationships utilising a more rigorous study design, and (c) a test of a modified CPAQ focused specifically on exercise to enhance its predictive utility with regard to exercise and arthritis research.

### **2.4.4 Segue Between Studies 1 and 2**

A carefully designed test of mediation requires reducing measurement error as much as possible. Opportunities to minimise measurement error identified by Study 1 offer a logical next step towards conducting a test of the proposed mediation relationships.

To this end, there were two purposes of Study 2. The first was to modify the CPAQ so that it is specific to the context of exercise. This is commensurate with recommendations by Marks (2012) indicating that measures should be specific to the behaviour they are intended to predict. Tests of factorial and predictive validity and reliability will be a part of this purpose.

The second purpose was to separately examine various SE measures in terms of their ability to predict future MVPA and determine a best predictor. Tests of reliability will also be undertaken to serve this purpose. The continuing goal and thus reason for Study 2 is to improve measurement for future studies (Study 3) examining mediation.

## 3. Study 2

### 3.1 Introduction

#### 3.1.1 Introduction and Association Between Dissertation Studies

People with arthritis stand to obtain health benefits from the same levels of MVPA ( $\geq$  150 minutes) as the general population (PHAC, 2010). However, few people with arthritis meet this guideline (PHAC, 2010). While studies have identified some psychological variables, such as SRE and pain acceptance, as being potentially helpful in understanding adherence to MVPA (Flora, Brawley, Sessford, Cary, & Gyurcsik, 2015; Gyurcsik et al., 2013; Gyurcsik et al., 2011), these theory-based studies have been largely correlational. This is reflective of findings of a review of health behaviour research indicating that theory-based behavioural studies rarely go beyond correlational designs (Painter et al., 2008).

To answer the need for theoretical research that moves beyond correlational methodology, examination of mediation relationships may be appropriate. Based upon both the agency aspect of SCT and prior research, SRE and pain acceptance have been related to future MVPA (Flora et al., 2015). Relative to identifying a mediation relationship, criteria (cf., Frazier et al., 2004) that might indicate whether a test of mediation was worthwhile was examined in the first study of this dissertation. In this work, individuals' coping strategies for dealing with pain anxiety was considered as a potential mediator. This study was a secondary analysis of data from a larger study that did not have the temporal design necessary to test mediation. Relationships between the predictor and potential mediator as well as between the potential mediator and dependent variable suggested that a more rigorous test of mediation might be worthwhile to pursue as a future investigation. However, another criteria Frazier and colleagues (2004) suggest

as important for tests of mediation requires minimizing measurement error. In the interest of serving the future purpose of conducting a mediation study, Study 2 addresses the measurement criteria important for such tests. This entails evaluation of the SRE and pain acceptance measures in a new sample of individuals with arthritis who are engaged in a least some self-regulated exercise. Findings will inform the selection of measures with which to conduct the test of mediation planned for the final dissertation study. Background on the key variables proposed for the future test of mediation is instructive when considered relative to exercising individuals with arthritis.

### **3.1.2 Measurement Considerations Among the Key Variables**

**Self-efficacy for exercise and arthritis symptom management.** There are multiple SRE measures available, some of which are exercise-specific (e.g., SRE-SP, SEE), some arthritis-specific (ASES), or both exercise- and arthritis-specific (SRE for overcoming arthritis barriers). Depending upon the research question posed, making the correct decision about which measure to include in the proposed mediation study is important. Reviews have been critical of the methods of construction of numerous SRE measures for chronic diseases, including arthritis (Frei et al., 2009), and have highlighted the importance of correspondence with criterion measures (Marks, 2012). The first study of this dissertation evaluated the construction of the SRE-SP, while the present study will assess a number of SE measures in predicting MVPA, including SRE-SP, in an effort to evaluate their measurement properties and their correspondence with the criterion measure of MVPA.

**Chronic pain acceptance.** The CPAQ is a validated measure of pain acceptance (McCracken et al., 2004). Pain acceptance, as measured by the CPAQ, is comprised of two important concepts and corresponding subscales – pain willingness and activities engagement.

*Pain willingness* is willingness to experience pain in the pursuit of valued activities, as opposed to ruminating over controlling pain. *Activities engagement* is participating in those valued activities despite the pain rather than abstaining from them. However, the CPAQ is phrased generally and does not specify which valued activities respondents should attend to in answering the CPAQ items. Respondents may be answering with a variety of activities in mind which may or may not include exercise.

To offer a clue that may answer this question in part, unpublished data from an arthritis exercise barriers experiment (see Appendix B) was examined to explore which activities people had in mind when answering the CPAQ. Respondents were offered examples of activities (e.g., employment, social, exercise, open-ended “other”, etc.) and indicated whether each was considered when answering the CPAQ. Those activities considered were also scaled in terms of their value from 0 (*Do not value at all*) to 10 (*Value very highly*). The mean value score for exercise was 8.89 and 98% reported considering exercise while answering the CPAQ. However, most activities were endorsed highly by respondents (employment was the lowest at 60%) indicating that people consider many activities concurrently when answering the existing CPAQ and are not thinking exclusively about exercise.

For the purposes of using the CPAQ to study exercise behaviour, a modification to the measure’s instructions focusing on exercise was made. The CPAQ-E was assessed in the present study. The author of the original CPAQ (L. McCracken, personal communication, November 13, 2014) offered support for such a modification and did not foresee any reduction in validity as a result of the modifications made. There is a precedent for modification of the CPAQ as the measure has been modified as a short form known as the CPAQ-8 (Rovner, Arestedt, Gerdle,

Borsbo, & McCracken, 2014) as well as the CPAQ-A for adolescents (Wallace, Harbeck-Weber, Whiteside, & Harrison, 2011).

### **3.1.3 Objectives and Hypotheses**

The present study had two related objectives regarding measurement. The first concerned evaluating the construct validity of the CPAQ-E. To examine this objective, a factor analysis was conducted on the CPAQ-E measure to assess whether the modifications made resulted in alteration of the factor structure demonstrated by the original CPAQ (McCracken et al., 2004).

The second objective consisted of two parts. The first part examined predictive utility and was to assess (a) whether the modified CPAQ-E or its subscales predict future MVPA and (b) which SRE measures predict future MVPA. The second part was related to the first in that only the significant SRE measures from Part 1 were used to determine if any were superior to one another as predictors of MVPA. It was hypothesized that the CPAQ-E would be a useful predictor of MVPA. Regarding SRE measures, it was hypothesized that exercise-specific measures would be superior to those disease-specific measures that do not reference exercise, in their prediction of MVPA because they are more correspondent with the behaviour in question (Bandura, 1997).

## **3.2 Methods**

### **3.2.1 Participants and Design**

The study design was prospective, observational in which data were collected via a baseline online survey and a follow-up online survey two weeks later. Ninety-eight predominantly female (86%) adults with self-reported, medically-diagnosed arthritis ( $M_{age} = 49.66 \pm 14.23$  years) completed surveys at both time points. One-hundred ninety began the Time 1 survey. Participant attrition can be described as follows: 29 participants were excluded for

eligibility reasons, 25 participants failed to complete the second survey, and 38 participants began survey 1 but did not complete it. To participate, the following eligibility criteria were met: (a) 18 years of age or older, (b) residents of Canada or the United States, (c) report doing at least one bout of planned physical activity in the past 4 weeks lasting 15 minutes or more, (d) report having medically-diagnosed arthritis.

### 3.2.2 Measures

**Self-regulatory efficacy - scheduling/planning.** This 9-item measure assessed participants' confidence in their abilities to schedule and plan activity over the coming two weeks. Example items were "Stick with the times you have planned to be active each week" and "Take time for yourself and be physically active as planned regardless of your other commitments." A 0 (*not at all confident*) to 10 (*completely confident*) response scale was used as per the recommendations of Bandura (1997), and the total score is a mean of the items. This measure has been used previously in published research examining both asymptomatic and symptomatic adults (e.g., DuCharme & Brawley, 1995; Gyurcsik et al., 2010; Woodgate et al., 2005). Internal consistency for the present sample was Cronbach's  $\alpha = .94$ .

**Self-regulatory efficacy to overcome arthritis barriers.** Five barriers identified as relevant to persons with arthritis engaging in PA were included on the SRE to overcome arthritis barriers scale (Brittain, Gyurcsik, McElroy, & Hillard, 2011; Gyurcsik et al., 2009; Gyurcsik et al., 2011). These were pain, stiffness, swelling, tiredness, and experiencing a flare. A binary response as to whether each symptom barrier would occur was collected after participants provided efficacy scores to the following question; "How confident are you in your abilities to cope with this barrier and do your moderate to vigorous physical activity as planned over the next 2 weeks (14 days):?" (scale of 0 – *not at all confident*, to 10 – *completely confident*). The



mean value included only those barriers that participants reported would occur, thus reflecting their confidence to overcome salient symptom barriers (Brawley, Martin, & Gyurcsik, 1998).

Internal consistency could not be calculated as the items included for each individual differed.

**Self-regulatory efficacy to overcome general barriers.** Twelve barriers were elicited from focus groups and an online survey (study under review) and included in the measure. For each barrier, participants were asked their confidence to overcome that barrier (“Please give us your best estimate of your confidence to overcome each barrier and exercise as planned over the next 2 weeks [14 days]”) as well as a binary response as to whether that barrier would occur. The efficacy response scale for each item was 0 (*not at all confident*) to 10 (*completely confident*). The mean score included only those barriers that participants reported would occur, thus reflecting their confidence to overcome salient barriers (Brawley et al., 1998). Internal consistency could not be calculated as the items included for each individual differed.

**Arthritis self-efficacy scale.** The ASES was developed for use in the Arthritis Self-Management Program (Lorig et al., 1989). Its 20 items are separated into three subscales: pain (5 items, e.g., “How certain are you that you can decrease your pain quite a bit?”), function (9 items, e.g., “How certain are you that you can walk 100 feet on flat ground in 20 seconds?”), and other symptoms (6 items, e.g., “How certain are you that you can control your fatigue?”). Each item is scored from 1 (*very uncertain*) to 10 (*very certain*) and each subscale is represented by its mean score. There is no total score. Cronbach’s alpha indicated that pain ( $\alpha = .80$ ), function ( $\alpha = .89$ ), and other symptoms ( $\alpha = .88$ ) subscales were all internally consistent.

**Self-efficacy for exercise.** The SEE is a modification by Resnick and Jenkins (2000) of an unpublished scale by McAuley (1990) that concerns exercise in the face of barriers. The scale consists of nine items scaled from 0 (*not confident*) to 10 (*very confident*) and the total score is a

mean of all items. The scale was originally designed for adults participating in an outpatient exercise program. The scale is prefaced with “How confident are you right now that you could exercise three times per week for 20 minutes if?”. Barriers to exercise are then listed (e.g. “...the weather was bothering you”, “...you did not enjoy it”, etc.). Support for the reliability and validity of the SEE can be found in Resnick and Jenkins (2000). Internal consistency was acceptable in the present study (Cronbach’s  $\alpha = .90$ ).

**Pain acceptance for exercise.** Pain acceptance was assessed using a modification of the CPAQ (McCracken et al., 2004). The original 20-item CPAQ is comprised of 2 subscales (pain willingness and activities engagement) and can also be interpreted as a total score. The developer of the CPAQ (L. McCracken, personal communication, November 13, 2014) advised that a modification to focus participants on exercise should not negatively impact the validity or reliability of the measure. The present modification of the measure specified the wording of each original item to focus respondents’ attention on exercise behaviour. A sample item from the 9-item pain willingness subscale is “I need to concentrate on getting rid of my pain before I can exercise” (originally “I need to concentrate on getting rid of my pain”). A sample from the activities engagement subscale is “I am getting on with my exercise plans no matter what my level of pain is” (originally “I am getting on with the business of living no matter what my level of pain is”). Participants rated each item in terms of how true it was for themselves on a 0 (*never true*) to 6 (*always true*) response scale. Items in the pain willingness scale were reverse scored and summed while the activities engagement items were simply summed. The total CPAQ-E score was calculated by summing the 2 subscales. Higher scores on both subscales and the total score represent higher pain acceptance, up to a maximum score of 114. The CPAQ has been

validated in chronic pain populations (McCracken et al., 2004) and the CPAQ-E was internally consistent in the present study (Cronbach's  $\alpha = .92$ ).

**Physical activity.** Participants reported the average weekly frequency and duration over the past two weeks of planned bouts of moderate and vigorous activity lasting at least 15 minutes. Total weekly planned PA volume was calculated in a manner consistent with public health recommendations and previous work on PA and arthritis (CDC, 2011; Gyurcsik et al., 2013; PHAC, 2010). Definitions of moderate and vigorous activity were provided to participants. Moderate activity was defined as "*...makes your heart beat faster and makes you breathe a little harder. You can talk easily while doing moderate activity, but you may not be able to sing comfortably. On a scale from 0 to 10, where sitting is 0 and the highest level of effort possible is 10, moderate exercise is a 5 or 6.*" Vigorous activity was defined as "*... makes your heart beat much faster. You may not be able to talk comfortably without stopping to catch your breath. On a scale of 0 to 10, where sitting is 0 and the highest level of effort possible is 10, vigorous activity is a 7 or 8.*"

Activity bouts of less than 15 minutes were not assessed because the SRE measure in the present study focuses on *planned activity* that required self-regulation. This is in contrast to unplanned, shorter incidental bouts. Planned bouts of longer duration have also demonstrated better recall and are self-reported with higher accuracy than unplanned, incidental short duration bouts of activity (Cust et al., 2008). When calculating MVPA for eventual conversion to caloric equivalents or some other metric, guidelines for the conversion of vigorous activity minutes into moderate-equivalent minutes instruct that vigorous minutes be doubled (Nelson et al., 2007). However, this use of MVPA minutes would not be appropriate for the research question in the present investigation. In the present study, SRE beliefs about *planned MVPA* was used to predict

the correspondent MVPA bout frequency and minutes (i.e., volume) recalled for which people planned. What is being self-regulated is the time individuals take to complete a given bout of either moderate and/or vigorous activity in excess of 15 continuous minutes. Therefore, the total volume of planned PA per week was calculated with a focus on minutes of either kind of activity as defined in the measure's instructions. Accordingly, weekly moderate activity (frequency x duration) and weekly vigorous activity (frequency x duration) were summed for total volume. Frequency represented the number of planned weekly bouts of MVPA and this was used as an additional measure of exercise.

The foregoing measures can be found in Appendix C

### **3.2.3 Procedures**

Upon obtaining approval from the University Behavioural Research Ethics Board, web-based study announcements were used to recruit the study sample. These announcements included a link to the online survey and were posted to arthritis newsletters and to national arthritis organisations' official websites (e.g. the Arthritis Society, local chronic disease program, etc.). Announcements were also posted to social media pages of these organisations (e.g. Facebook, Twitter).

At the onset of the online survey, participants were required to complete the electronic consent form. After answering questions pertaining to eligibility criteria, participants completed the 20-30 minute survey, which included the psychological predictor variables (CPAQ-E and all SRE measures). A link to the brief follow-up survey (approximately 5 minutes) was sent by email two weeks later to those participants who provided their permission and consisted of a repeated measure of SRE-SP required for assessing test-retest reliability as well as the exercise measure.

### 3.2.4 Data Management and Analytical Plan

Analyses were performed using SPSS version 23 and Mplus. Data were screened for outliers and for missing data. Mean item score replacement for a given individual was used for an individual's scales that were missing a single item (Tabachnick & Fidell, 2012). A small number of participants reported either the days or minutes of exercise ( $n = 2$ ) and one was missing both. A conservative strategy was utilised for replacing the missing MVPA data whereby the lowest possible answer was inserted (i.e. 1 day, or 15 minutes – if minutes were reported, they must have been performed on at least 1 day). For inclusion, activity bouts needed to be 15 minutes or more.

Z-scores greater than 3.29 indicated outliers and were handled according to recommendations by Tabachnik and Fidell (2012). Outliers were only observed in the exercise measure. The lowest of the outliers was reduced to 1 score (1 minute) greater than the next largest MVPA score in order to address the problem while maintaining rank order of individual values.

To examine the objective regarding measurement, a factor analysis was conducted on the CPAQ-E measure using Mplus. Assumptions of the analysis were tested and met including sampling adequacy and controlling outliers. The original CPAQ consists of 2 correlated subscales. Thus an oblique rotation was used. Mplus factor analysis was performed using an iterative procedure. Advantages of using Mplus rather than SPSS for factor analysis include use of a gold standard method (maximum likelihood) for estimating missing data and provision of significance tests for factor loadings (Muthen & Muthen, 1998-2012). The SRE-SP measure was examined for test-retest reliability.

One study objective concerned validity of measures. MVPA predictors were analysed using simple linear regressions as well as HMRs. Assumptions of regression were tested and met including multicollinearity and homoscedasticity. First, separate regressions were conducted using each of the potential predictors as the independent variable and MVPA as the dependent variable (both MVPA volume and MVPA bouts were analysed as the dependent variable in separate analyses). Recall that it was hypothesized that exercise-specific measures will be superior to disease-specific measures in their prediction of MVPA. Measures of SRE which significantly predicted MVPA were then included together in an HMR to explore which, if any, are superior predictors.

### **3.3 Results**

#### **3.3.1 Pain Acceptance Factor Structure**

When analyzed using Mplus, the initial 19-item CPAQ- E model had poor fit when the expected 2-factor solution that constitutes the original CPAQ was examined (e.g. significant  $\chi^2$ , RMSEA > 0.10). An iterative procedure was then undertaken whereby items were omitted one at a time to assess the effect of their removal on the model. This approach resulted in the removal of items 2, 4, 5, 10, and 16. The reasons for item removal were as follows. Item 2 was multicollinear with item 6 as indicated by modification indices ( $\theta = 36.88$ ) and a correlation of .72. Items 4, 5, 10, and 16 did not load significantly on either factor.

The reduced 14 item scale resulted in a 2-factor model with good fit indices as can be seen in Table 2 (RMSEA = .055, CFI = .97). All CPAQ-E items in the reduced model loaded on the expected subscale consistent with the original CPAQ as illustrated by Table 3, and both subscales were internally consistent ( $\alpha = .88$ ).

Table 2. CPAQ-E factor models

# of items	# of factors	Fit Indices						
		Chi-square analyses			RMSEA analysis		CFI	TLI
		$\chi^2$	<i>df</i>	<i>p</i>	RMSEA	90% C.I.		
19	1	400.648	152	<.001	.121	.107-.136	.733	.700
	2	296.886	134	<.001	.105	.089-.121	.825	.777
	3	199.505	117	<.001	.80	.060-.098	.911	.871
	4	214.274	101	<.001	.101	.082-.119	.878	.794
	5	485.598	86	<.001	.205	.187-.223	.571	.148
14	1	182.474	77	<.001	.111	.090-.132	.841	.812
	<b>2</b>	<b>85.695</b>	<b>64</b>	<b>.037</b>	<b>.055</b>	<b>.015-.084</b>	<b>.967</b>	<b>.954</b>

Note: RMSEA: root mean square error of approximation; CFI: comparative fit index; TLI: Tucker-Lewis index. Models examined reflect the 19- and 14-item versions of the CPAQ-E. Boldface coefficients display the fit indices of the 14-item, two-factor retained model.

### 3.3.2 Test-retest Reliability

Test-retest reliability of the SRE-SP measure was assessed by correlating baseline and follow-up values for the measure. The correlation was significant ( $.77 p < .001$ ).

### 3.3.3 Predicting Physical Activity Volume

**Weekly volume.** Using the various independent variables as single predictors, the results were as follows. The CPAQ-E activities engagement subscale significantly predicted weekly minutes of MVPA ( $R^2Adj. = .05, p = .014$ ) but in separate analyses, each of the total score and the pain willingness subscale did not. Both the SRE-SP ( $R^2Adj. = .086, p = .002$ ) and SEE ( $R^2Adj. = .103, p = .001$ ) measures significantly predicted weekly MVPA minutes but the SRE barriers measures and ASES subscales did not.

Table 3. *Factor loadings for the final 14-item model of CPAQ-E*

Item description	Factor one	Factor two
1. I am getting on with my exercise plans no matter what my level of pain is. <sup>a</sup>	<b>.90</b>	-.06
3. It's OK to experience pain during exercise. <sup>a</sup>	<b>.34</b>	.17
6. Although things have changed, I am able to exercise despite my chronic pain. <sup>a</sup>	<b>.43</b>	.26
7. I need to concentrate on getting rid of my pain before I can exercise. <sup>b</sup>	.08	<b>.67</b>
8. There are many activities I do when I feel pain, such as exercise. <sup>a</sup>	<b>.76</b>	-.01
11. My thoughts and feelings about pain must change before I can exercise. <sup>b</sup>	-.02	<b>.72</b>
12. Despite the pain, I am now sticking to my exercise plans. <sup>a</sup>	<b>.84</b>	.04
13. Keeping my pain level under control takes first priority, above exercising. <sup>b</sup>	.21	<b>.69</b>
14. Before I can make any serious exercise plans, I have to get some control over my pain. <sup>b</sup>	.19	<b>.72</b>
15. When my pain increases, I can still exercise. <sup>a</sup>	<b>.68</b>	.19
17. I avoid putting myself in exercise situations where my pain might increase. <sup>b</sup>	-.23	<b>.87</b>
18. My worries and fears about what exercise-related pain will do to me are true. <sup>b</sup>	.03	<b>.78</b>
19. It's a relief to realize that I don't have to change my pain to get on with my exercise plans. <sup>a</sup>	<b>.55</b>	.14
20. I have to struggle to do exercise when I have pain. <sup>b</sup>	-.04	<b>.55</b>

Note: Boldfaced coefficients represent loadings retained for each factor.

<sup>a</sup>Activities engagement subscale

<sup>b</sup>Pain willingness subscale



**Weekly bouts.** Each of the independent variables was used to predict bouts of planned activity. The CPAQ-E activities engagement subscale significantly predicted weekly bouts of MVPA ( $R^2Adj. = .126, p < .001$ ) as did the total score ( $R^2Adj. = .084, p = .002$ ) and the pain willingness subscale ( $R^2Adj. = .033$  to  $.13, p < .05$ ). Both the SRE-SP ( $R^2Adj. = .145, p < .001$ ) and SEE ( $R^2Adj. = .281, p < .001$ ) measures significantly predicted weekly MVPA bouts. SRE for overcoming general barriers also significantly predicted weekly MVPA bouts ( $R^2Adj. = .063, p = .018$ ) while SRE for arthritis barriers and the ASES subscales did not.

**Utility of multiple self-efficacy predictors.** As both the SRE-SP and SEE measures were predictive of MVPA bouts and minutes, both measures were entered into HMR analyses to examine their predictive utility.

**Weekly minutes.** Both predictors independently predicted weekly MVPA minutes. Therefore, block 1 in an HMR model would be significant regardless of which variable is entered first. However, the second block containing both SRE-SP and SEE was non-significant. Beta values for each predictor in block 2 were also non-significant (please see Table 4).

Table 4. Hierarchical multiple regression results for exercise minutes and efficacy measures

Independent Variable	Adjusted $R^2$	B	$R^2$ Change
Step 1	.086**		
SRE-SP		.309**	
Step 2	.110		.033
SRE-SP		.163	
SEE		.233	

Note: SRE-SP = Self-regulatory efficacy to schedule and plan exercise. SEE = Self-efficacy for exercise. \*\* =  $p < .01$

**Weekly bouts.** When SRE-SP was entered in the first block to predict weekly MVPA bouts, it was a significant independent predictor. However, upon introducing SEE in the second block, SRE-SP was rendered non-significant while SEE was the sole significant predictor ( $\beta = .478, p < .001$ ). Please see Table 5 for beta values.

Table 5. *Hierarchical multiple regression results for exercise bouts and efficacy measures*

Independent Variable	<i>Adjusted R<sup>2</sup></i>	B	<i>R<sup>2</sup> Change</i>
Step 1	.145***		
SRE-SP		.392**	
Step 2	.279***		.140***
SRE-SP		.094	
SEE		.478***	

Note: SRE-SP = Self-regulatory efficacy to schedule and plan exercise. SEE = Self-efficacy for exercise. \*\* =  $p < .01$ , \*\*\* =  $p < .001$

### 3.4 Discussion

#### 3.4.1 Chronic Pain Acceptance Measure

The CPAQ represents people’s willingness to pursue valued daily activities despite pain. The CPAQ has demonstrated utility in exercise studies such that higher scores correspond with higher levels of PA volume (Flora et al., 2015; Gyurcsik et al., 2011). However, people may be thinking of a variety of “valued activities” when answering the CPAQ (e.g., employment, family care, etc.). An exercise-specific modification to the CPAQ may be appropriate for use in exercise studies (L.M. McCracken, personal communication, November 13, 2014). The present study sought to assess the exercise-specific CPAQ-E in terms of factor structure, reliability, and predictive validity. It was hypothesized that these tests would support the use of the CPAQ-E.

Findings regarding the 14 item CPAQ-E support the original measure's (CPAQ) conceptualization as a two-factor construct. CPAQ-E factor loadings correspond with the subscales of the original CPAQ (activities engagement and pain willingness) and have acceptable reliability scores. The activities engagement subscale is the only score on the CPAQ-E that predicted weekly minutes of activity. The total score and both subscales significantly predict weekly bouts of activity. One possible explanation for these results is that recall for number of bouts is better than for total weekly minutes meaning that the measurement error associated with recall is partly the reason for weaker prediction of minutes. Depending on the research question of interest in future studies, it is important to be aware of the correspondence between measures and outcomes of interest to aid in selecting the most appropriate set of predictors and outcomes.

### **3.4.2 Self-efficacy Measures**

A variety of disease-specific and activity-specific SE measures are available. The best choice of measure should be the one that addresses and is correspondent with the specific behaviour being predicted and follows theoretical recommendations for such measures. Less effective may be one-size-fits-all for particular diseases but not specific to behaviours (e.g., ASES). Testing various SE measures' predictive validity for exercise behaviour, and directly comparing these SE measures against one another in this respect may be helpful in guiding future measurement selection for specific research questions. Choice of measures is of particular importance in mediation studies and this information shall inform the final study in this dissertation. It was hypothesized that measures focused on self-managing exercise (e.g., SRE-SP, SRE for general and arthritis barriers, and SEE) would have more predictive utility than disease measures such as the ASES that do not focus on exercise behaviours.

The ASES is disease-specific but intended to predict a variety of outcomes such as pain, disability, and depression (Brady, 2011). It is not exercise-specific. This may be the reason that none of its subscales were predictive of PA behaviour. Most exercise-specific measures were predictive of PA, including SRE-SP, SRE for general barriers, and McAuley's SEE scale (1990; modification by Resnick & Jenkins, 2000). One exception was that SRE for arthritis barriers, also an exercise-specific measure, did not predict PA.

The SRE-SP measure refers to actual self-regulatory skills required to maintain PA behaviours. This may be why it is a better predictor than SRE for arthritis barriers which assesses confidence in overcoming those barriers and remaining active, but not the self-regulatory skills to do so. Higher levels of SRE for overcoming arthritis barriers to exercise during arthritis flares have been found in people whose symptoms are severe but still meet PA guidelines versus those who do not (Gyurcsik et al., 2013). Therefore this type of SRE measure may be more salient to respondents when their symptoms are severe (e.g., flares). The severity of symptoms in arthritis flares poses a unique and greater challenge to exercise adherence than usual symptoms. This was demonstrated in a study by Sessford, Brawley, and Gyurcsik (2015) in which participants' reported lower SRE scores (both SRE-SP and SRE for overcoming arthritis barriers) for flare circumstances than for usual symptoms.

The SEE measure was slightly, though not significantly, a better predictor of MVPA minutes than the SRE-SP measure (10.3% versus 8.6% variance accounted for). A possible reason for this result may be that the SEE asks respondents to consider their confidence to maintain an absolute volume of weekly PA (3 x 20 minutes) while the SRE-SP measure asks respondents about the context of maintaining a subjective amount of activity ("your planned weekly activity").

Contextualising SRE exercise measures with a standardised volume of PA may be more appropriate for studies aimed at predicting volume of activity. In this case, the dependent and predictor variables should be correspondent with one another. The SRE measures referring to subjective PA volume (e.g., “your planned weekly activity”) may be better suited to predicting whether people meet their weekly goals or not, as weekly goals can vary widely between participants.

While this study has achieved its two aims: (1) assessing the CPAQ-E in terms of its utility in predicting PA and (2) comparing various types of SE measures in predicting PA, it has revealed another important measurement consideration. This concerns the correspondence between the PA being referred to in the instructions in the chosen SRE measure (e.g. subjective individual goals, arbitrary absolute volumes such as in the SEE, or volumes correspondent with public health guidelines) and the PA measure. The decision about how to ensure correspondence will likely be driven by the goals and research questions of a given study.

### **3.4.3 Strengths and Limitations**

This theory-driven study provides data that may improve decision-making regarding choice of measures in studies of exercise and arthritis. It is the first test of an exercise-specific modification of the CPAQ. A limitation is that the original CPAQ measure was not included in the study to reduce subject burden. The CPAQ-E is nearly identical to the original with the exception of the reference to exercise in each item. However, a future comparison of the utility of the CPAQ and the CPAQ-E in predicting PA would be of value. It may be prudent to compare each measure using separate randomly-selected sub-groups within the same large sample (i.e., exercisers with chronic pain) to determine if there are differences in CPAQ and CPAQ-E

responses between subgroups of the larger homogeneous sample. Differences might suggest the direction for future use of the CPAQ-E.

#### **3.4.4 Conclusions**

The present study offers support for the utility of an exercise-specific version of the CPAQ in studies of exercise and arthritis. Further, the selection of SE measures for prediction that are most specific to the behaviour in question (exercise specific measures such as SRE-SP and SEE) appears to be more useful than choosing broad SE measures that are intended for studying a variety of behaviours (e.g. the ASES) as per Bandura (1997). Careful consideration should be given to how the behaviour in question is to be conceptualised and measured (e.g. total weekly volume of activity, dichotomous outcomes of meeting/not meeting exercise goals or guideline levels) as well as how the behaviour is referred to as per instructions/items of chosen SE measures. Correspondence between the two may be important (Courneya & McAuley, 1995).

#### **3.4.5 Segue Between Studies 2 and 3**

Study 2 helped to answer questions aimed at refining choices of measures for a future test of mediation. Initial support for the validity of a modified CPAQ measure was demonstrated and the most appropriate SRE measures were empirically confirmed (SEE and SRE-SP). Additional questions were raised regarding the conceptualisation of MVPA to be used in future studies with respect to the correspondence between SRE and MVPA measures.

Based upon this knowledge, Study 3 can proceed with the goal of testing proposed mediation of relationships between psychological factors related to exercise and actual behaviour. As informed by Study 1, the potential mediators are coping strategies with pain. Strategies for coping with pain should be salient to individuals with chronic pain for whom

regular exercise is recommended. The sample in Study 3 was broadened to include individuals with all types of chronic pain, not only for conceptual but also, practical reasons. Tests of mediation require the researcher to maximise the sample size in accordance with power requirements of mediation analyses (for more on this, see section 4.1.3 “Choosing to examine chronic pain”). Study 3 therefore flows logically from the purposes of the first two dissertation studies.

## **4. Study 3**

### **4.1 Introduction**

#### **4.1.1 Rationale for the Study**

A paucity of theory-based research has been identified in the health behaviour literature (Painter et al., 2008). According to the review by Painter and colleagues (2008), there are relatively few studies that are theory-based. Those which report a theoretical foundation are frequently correlational in nature and examine theoretical variables as a secondary or post hoc purpose of behaviour change. The present study of exercise for people with chronic pain is a theory-based study that is designed to test whether a specific mechanism that is part of the agency aspect of SCT (Bandura, 1986; 1997) can be detected using a mediation model. Specifically, the proposed model identifies SRE beliefs as the independent variable, participants’ usage of strategies for coping with pain when attempting regular exercise as the mediator, and actual exercise behaviour as the dependent variable.

A model concerning another psychological factor related to exercise, pain acceptance, will also be tested. In this instance, an exercise-specific modification to the CPAQ (the CPAQ-

E) is the independent variable and the mediators and dependent variable are the same as those described above.

For the purposes of this dissertation, the phrase chronic pain refers to chronic non-cancer pain. The duration of chronic pain was defined in this study as pain lasting at least 3 months (Main & Spanswick, 2001). Given that there is support for exercise as treatment for various forms of chronic pain (Brosseau et al., 2008; Jansen, Viechtbauer, Lenssen, Hendriks, & de Bie, 2011; Mannerkorpi & Henriksson, 2007; Stewart et al., 2007; Teasell et al., 2010; van Middelkoop et al., 2010), a greater understanding of psychological factors that are related to exercise adherence for people with chronic pain is of value. Although there are no public health guidelines/recommendations for the chronic pain population for being active, there are recommendations for the chronic disease of arthritis. Such recommendations function as a potential exercise prescription for those individuals experiencing the pain from this chronic disease (PHAC, 2010). Despite having to manage chronic arthritis pain, the guidelines for arthritis are the same as for the general population ( $\geq 150$  weekly minutes of MVPA). Based on the evidence for exercise as an effective treatment for various types of pain, and the absence of specialised exercise guidelines for those with chronic pain, the study of exercise adherence for people with chronic pain may be as important as it is for arthritis.

#### **4.1.2 Theoretical Background and Research Improvements**

The rationale for the proposed mediation relationship is supported by SCT and by the findings of previous studies in this dissertation. The agency aspect of SCT indicates that people who are higher in SRE for self-managing behaviour (e.g., exercise) should cope with barriers (e.g., pain) to that behaviour with a more adaptive approach, enabling them to better adhere to the behaviour.



Similarly, in other predictive models, pain acceptance has been associated with higher levels of exercise and SRE (Gyurcsik et al., 2011). Intuitively, such findings may be expected as pain acceptance is conceptualised as the pursuit of valued daily activities despite pain (McCracken et al., 2004). Indeed, acceptance of pain has also been associated with adaptive responses to pain (McCracken, Spertus, Janeck, Sinclair, & Wetzel, 1999). Thus, individuals who are accepting of their pain would be expected to utilise adaptive strategies for coping with pain when exercising. These relationships were examined in Study 1 of this dissertation to determine if they exhibited associations sufficiently strong to recommend a future test of mediation using a temporal design (i.e., minimum three time points of assessment).

In Study 1, SRE-SP, pain acceptance, and coping strategy use were measured at time 1. Coping strategy use was conceptualised as adaptive (e.g., lowering intensity of exercise when in pain), maladaptive (e.g., choosing not to exercise due to pain), and maintenance (exercising as planned despite pain). At time 2, weekly minutes of MVPA were assessed. Separate potential mediation models were tested using a product of coefficients method (Kenny et al., 1998) whereby either pain acceptance or SRE-SP were utilised as the independent variable, each of the three coping strategy measures were entered as the mediator, and MVPA volume was the dependent variable. In most iterations of these analyses, the mediation relationships were significant and in the expected direction. The exception was that when adaptive strategy use was the mediator, the relationship was non-significant for both SRE and pain acceptance.

**Study design and measurement improvements.** The significant findings above supported further study of the proposed relationships using a more rigorous study design. This design should allow for identifying the temporal nature of the relationship. This Study 1 suggestion was addressed in the present study with a temporal design consisting of three time

points. The weakness of the Study 1 adaptive strategies measure suggested that an alternate conceptualisation might be necessary. This was a measurement goal in the present study (see “Coping strategy use” under “measures” in the methods section).

**Measurement considerations.** With the goal of undertaking a more rigorous study, better designed to detect and test for mediation, Study 2 addressed measurement considerations important for mediation analyses. Specifically, Frazier, Tix, and Barron (2004) recommended minimising measurement error. Study 2 of the dissertation was specifically conducted to assist in choosing the most appropriate measures for pain acceptance and SRE with a future test of mediation in mind.

Whereas the recognized measure of pain acceptance, the CPAQ, is a validated measure (McCracken et al., 2004) it assesses individuals’ pain acceptance in the pursuit of “valued activities” generally, without specific reference to exercise. Secondary analyses of a larger arthritis study (see Appendix B) indicated that active individuals with arthritis are indeed considering exercise when responding to the CPAQ, but they are considering it as only one of many valued activities (e.g., employment, social, etc.). In an attempt to reduce possible measurement error and make the CPAQ more correspondent with exercise outcomes, a modification to the CPAQ was made contextualising instructions, and each item, to exercise behaviour. Modifications to the measure were discussed with the creator of the CPAQ (L. McCracken, personal communication, November 13, 2014). He did not anticipate any reduction in validity and encouraged pursuit of testing the modified CPAQ. This exercise-specific modification of the CPAQ (CPAQ-E) was then evaluated in terms of factor structure and predictive validity. The CPAQ-E yielded the same two-factor structure as the original CPAQ which corresponds with its two subscales. The activities engagement subscale was predictive of

weekly MVPA minutes two weeks later and the total CPAQ score, as well as both subscales, were predictive of weekly bouts of MVPA.

Other measurement purposes of Study 2 were to examine a number of SE measures for their correspondence to the criterion variable of PA. They were assessed for predictive validity and a comparison with one another was conducted. Two SRE measures were identified as being the strongest predictors of future MVPA volume and these measures, SRE-SP and McAuley's SEE (1990), are the SRE measures of choice in the present study.

Additional insight from Study 2 came in the form of the importance of correspondence between SRE measures and the MVPA measure. The exercise referred to by SRE measures differed. The SRE-SP (DuCharme & Brawley, 1995; Gyurcsik et al., 2010; Woodgate et al., 2005) measure refers to "your planned weekly activity" which may vary in absolute volume between participants. The SEE (McAuley, 1990; Resnick & Jenkins, 2000) refers to 3 x 20 minutes per week and therefore all participants answer with the same volume of exercise in mind. Given these insights, steps were taken to make SRE and MVPA measures more correspondent in the present study. For example, the SRE-SP measure was completed using the usual subjective context of "your planned weekly activity" but participants were also asked afterward to scale their confidence for the same set of items if they had instead considered guideline levels (PHAC, 2010) of MVPA ( $\geq 150$  weekly minutes). This alternate measure of SRE-SP would be expected to be more correspondent with MVPA when MVPA was measured as a dichotomous dependent variable representing those meeting or not meeting public health guidelines. Additionally, participants were asked what their weekly goal of MVPA was in minutes so that MVPA could also be conceptualised as a dichotomous variable (meeting

personal goals or not meeting goals). This conceptualisation of MVPA would be expected to be correspondent with the usual SRE-SP context of “your planned weekly activity”.

#### **4.1.3 Choosing to Examine Chronic Pain**

The primary reason for shifting the focus of Study 3 from arthritis (Studies 1 and 2) to the chronic pain population for this final dissertation study was to increase the recruitment of participants potentially available. A greater number of participants would increase the statistical power desirable for a temporal examination of the mediation hypothesis. Specifically, the key variables of interest in the present Study (SRE for self-managing exercise and chronic pain acceptance) represent concepts that should be equally relevant to arthritis pain and chronic pain populations when examining exercise adherence. Additionally, there are no separate public health guidelines for exercise for chronic pain. Finally, both conceptually and empirically, the rationale for the proposed mediation relationships for both arthritis and chronic pain does not differ.

#### **4.1.4 Objectives and Hypotheses**

**Primary objective.** The primary objective of this study was to test the proposed mediation relationships previously outlined. In the present study, the product of coefficients method (Kenny et al., 1998; also see Frazier et al., 2004) suggests that if the coefficients for the *a* and *b* paths are significant, and the product of these coefficients divided by a standard error term yields a significant result, then the mediation relationship is significant. The product of coefficients test is a statistical test of significance similar to step 4 in Baron and Kenny’s (1986) causal steps for mediation but is able to detect partial mediation, not just full mediation (i.e., tests the significance of the decrease in the relationship between the independent and dependent

variables upon inclusion of the mediator). Further details on this test and the Baron and Kenny (1986) method can be found in the analytical plan section of the methods.

Using Kenny and colleagues' (1998) product of coefficients method, it was hypothesised that mediation relationships would be detected such that:

(a) higher levels of SRE and pain acceptance will be related to higher levels of adaptive and maintenance strategy use but lower levels of maladaptive strategy use,

(b) higher levels of adaptive and maintenance strategy use will be associated with higher levels of MVPA, and

(c) that higher levels of maladaptive strategy use will be associated with lower levels of MVPA.

**Secondary objective.** A secondary objective of the study was to assess similar mediation relationships using SRE-SP as the predictor and the same coping strategies as mediators but using different goals as dependent variables. The first goal examined was using the dichotomous dependent variable conceptualised as *meeting or not meeting MVPA guidelines* (i.e., a public health goal). To examine the second goal, the dependent variable was conceptualised as meeting or not meeting *individual self-reported weekly MVPA goals* (i.e., a personal goal). Participants provided SRE-SP responses for the specific context of meeting MVPA guidelines and this measure was used for the MVPA guidelines goal. For the personal goal, the SRE-SP measure was used without modification as the measure is already worded in reference to an individual's planned activity (i.e., personal goal).

It was hypothesized that these tests of mediation would be significant, supporting mediation such that SRE variables positively relate to adaptive and maintenance strategies and negatively relate to maladaptive strategies. Maintenance and adaptive strategies were expected to

positively predict meeting MVPA goals while maladaptive strategies should negatively predict meeting MVPA goals.

## **4.2 Methods**

### **4.2.1 Participants and Design**

One hundred and thirty predominantly female (84%) adults with self-reported chronic pain ( $M_{age} = 34.4 \pm 14.8$  years) completed surveys at all 3 time points out of 243 who began the Time 1 survey. Attrition was the result of 49 individuals who began Time 1 but did not complete it, 28 participants who were screened out of Time 1 for not meeting inclusion criteria, and 36 participants who were lost to dropout after completing Time 1. Some differences in psychological variables and activity level were observed between those who completed all time points and those who dropped out, however there was no difference in pain intensity between the groups (see Appendix D). Chronic pain was defined as pain lasting 3 months or longer (Main & Spanswick, 2001). The study was conducted via online surveys spanning three time points, at 2-week intervals, to facilitate the temporal examination of potential mediation relationships. The design was prospective and observational.

### **4.2.2 Measures**

Note that because eligibility did not require individuals to be active, all psychological measures contained added instructions to assist the inactive in answering questions regarding exercise. These instructions read as follows: “If you do not currently exercise, please try to answer these questions as if you were exercising. It will help us understand how you might react to being in pain and trying to exercise.” Of the entire sample ( $N = 130$ ), only 20 individuals were completely inactive and the remainder were regularly active at some level.

**Self-regulatory efficacy to schedule/plan exercise.** This measure contains nine items assessing participants' confidence in their abilities to schedule and plan activity over the coming four weeks. Example items include "Stick with the times you have planned to be active each week" and "Take time for yourself and be physically active as planned regardless of your other commitments." Each item was scaled on an 11-point response scale (0 - *not at all confident* to 10 - *completely confident*) in line with SCT recommendations (Bandura, 1997). Published research examining both asymptomatic and symptomatic adults has utilised this measure previously (e.g., DuCharme & Brawley, 1995; Gyurcsik et al., 2010; Woodgate et al., 2005). Internal consistency for the present sample was Cronbach's  $\alpha = .96$ . Participants were also asked to rate as a single item, how they would score their overall SRE-SP if the measure had referred to 150 minutes per week (i.e., guideline levels) instead of "their planned activity" level.

**Self-efficacy for exercise.** The SEE (McAuley, 1990) was modified by Resnick and Jenkins (2000) and their modification is employed in the present study. It is a 9-item measure scaled from 0 (*not confident*) to 10 (*very confident*). Adults participating in an outpatient exercise program were the population for which the scale was originally designed. The instructions read; "How confident are you right now that you could exercise three times per week for 20 minutes if:". Participants then respond to various individual barriers to exercise (e.g. "...the weather was bothering you", "...you did not enjoy it", etc.). Resnick and Jenkins (2000) report that the scale is reliable and valid. Internal consistency was acceptable in the present study (Cronbach's  $\alpha = .92$ ).

**Pain acceptance for exercise.** A modification of the CPAQ (McCracken et al., 2004) was utilised in the present study. This exercise-specific modification (CPAQ-E) was tested in Study 2 of this dissertation and demonstrated initial acceptable factor structure, validity, and

reliability (see Study 2). Factor structure was also assessed in the present study and supported use of the full scale with no major cross-loadings (factor loadings greater than .45; Field, 2005; see Appendix E). The CPAQ-E, similar to the original 20-item CPAQ, is comprised of 2 subscales (pain willingness and activities engagement) and can also be interpreted as a total score. The CPAQ-E specified the wording of each item to focus respondents' attention on exercise behaviour. An example of a modified item from the pain willingness subscale is "I need to concentrate on getting rid of my pain before I can exercise" (originally "I need to concentrate on getting rid of my pain"). An example of a modified item from the activities engagement subscale is "I am getting on with my exercise plans no matter what my level of pain is" (originally "I am getting on with the business of living no matter what my level of pain is"). The response scale (0 - *never true* to 6 - *always true*) reflects participants' belief in each statement. The pain willingness scale (Cronbach's  $\alpha = .86$ ) is reverse scored and summed while the activities engagement scale (Cronbach's  $\alpha = .92$ ) is simply summed. The total CPAQ-E score is the sum of the 2 subscales. Higher subscale scores, and total scores, represent higher pain acceptance. The total score ranges from 0 up to a maximum score of 120. The internal consistency of the CPAQ-E in the present study was Cronbach's  $\alpha = .61$  which is below acceptable (Field, 2005). Because the activities engagement subscale demonstrated the highest reliability and greatest correlation with other variables in the potential mediation relationships, it was used in mediation testing.

**Coping strategy use.** This study used a slight modification of Cary and colleagues' (2015b) measure of participants' use of adaptive, maladaptive, and maintenance strategies for coping with pain anxiety while attempting to be physically active. The nature of the modification was to refer to pain instead of pain anxiety. The measure consists of 5 items representing



adaptive strategies (e.g. “Alternate the type of exercise that you plan on doing”), 5 items representing maladaptive strategies (e.g. “You are overwhelmed and you stop doing your planned exercise”), and a single item representing a maintenance strategy (“Do all of your scheduled/planned exercise, regardless of your pain”). Responses to each item were scaled in terms of frequency of use of each strategy in the past 2 weeks (0 – *never do this*, to 8 – *always do this*). The sum of each scale represented the scale score. In an effort to improve poor initial reliability of the adaptive scale ( $\alpha = .57$ ), two items were removed (“You make efforts to relax to reduce tension, so that you can exercise” and “USE HEAT OR ICE before/after your planned exercise”). Following this, reliabilities for adaptive and maladaptive scales were Cronbach’s  $\alpha = .66$  and  $\alpha = .82$  respectively.

**Physical activity.** Average weekly frequency and duration over the past two weeks of planned bouts of moderate and vigorous activity lasting at least 30 minutes were reported. Total weekly planned PA volume was calculated in a manner consistent with public health recommendations (CDC, 2011; PHAC, 2010). Participants were provided with definitions of moderate and vigorous activity. Moderate activity was defined as “...*makes your heart beat faster and makes you breathe a little harder. You can talk easily while doing moderate activity, but you may not be able to sing comfortably. On a scale from 0 to 10, where sitting is 0 and the highest level of effort possible is 10, moderate exercise is a 5 or 6.* Vigorous activity was defined as “... *makes your heart beat much faster. You may not be able to talk comfortably without stopping to catch your breath. On a scale of 0 to 10, where sitting is 0 and the highest level of effort possible is 10, vigorous activity is a 7 or 8.*”

Activity bouts of less than 30 minutes were not assessed because the SRE measure in the present study focuses on *planned activity* that requires self-regulation. Unplanned, shorter

incidental bouts would not be correspondent with this measure. Better recall and higher accuracy are advantages of assessing planned bouts of longer duration as opposed to unplanned, incidental short duration bouts of activity (Cust et al., 2008). Participants were also asked to report their weekly PA goals (volume measured in minutes) in order to assess whether these goals were met. A dichotomous variable of “met goals” or “did not meet goals” was utilised in analyses predicted by measures that are rooted in the context of individuals’ planned activity levels rather than absolute volumes.

The foregoing measures can be found in Appendix F.

#### **4.2.3 Procedures**

Approval from the University Behavioural Research Ethics Board was obtained. Web-based study announcements, as well as paper posters in pain clinics and explanatory flyers provided at municipal pain workshops, were used to recruit the study sample. Web-based announcements were disseminated through the University’s online bulletin board and Social Sciences Research Laboratories’ participant pool. Announcements were also shared via arthritis newsletters, and to national arthritis organisations’ official websites (e.g. the Arthritis Society, local chronic disease program, etc.). Organisations also posted the announcement to their social media accounts (e.g. Facebook, Twitter).

Participants were required to complete the electronic consent form prior to beginning the online survey. After answering questions pertaining to eligibility criteria, participants completed the 20-30 minute survey. A link to the first follow-up survey (approximately 5 minutes) was sent by email 2 weeks later, and a link to the final survey was sent 4 weeks after baseline. Emails regarding follow-up surveys were only sent to those participants who provided their permission at baseline.

#### 4.2.4 Data analysis/handling

Analyses were performed using SPSS version 23. Data were screened for outliers and for missing data. One participant was missing a response to the maintenance strategy item and this was replaced with the sample mean. Entire scales were not missing for any participant. For any scales missing a single item, mean replacement of the average of other items on the specific scale was used (Tabachnick & Fidell, 2012). Two participants reported the days but omitted minutes of exercise. To replace missing data, a conservative strategy was employed whereby the lowest possible answer was inserted (i.e., 30 minutes – recall that activity bouts needed to be at least 30 minutes long). Criteria for outliers was a z-score greater than 3.29. Recommendations by Tabachnik and Fidell (2012) were utilised to manage these outliers while preserving their rank order in the distribution.

Skewness and kurtosis were beyond conventional values for the following variables: weekly MVPA minutes, SRE-SP, adaptive strategies, and the CPAQ-E activities engagement subscale. Transformations were performed as recommended by Tabachnik and Fidell (2012) and improved the distribution of these variables. Analyses were performed using both the raw and transformed data. Findings were similar, thus the decision was to present raw data results for ease of interpretation (Tabachnick & Fidell, 2012).

Primary objective mediation tests were analysed using HMRs. Assumptions of HMR were tested and met including multicollinearity and homoscedasticity. Multiple models were conducted. The coefficient for the *a* paths was obtained by regressing either SRE-SP, SEE, or the activities engagement subscale of the CPAQ-E on each of the 3 coping strategy variables (adaptive, maladaptive, and maintenance). The coefficient for the *b* paths was obtained by regressing each of the 3 coping strategy variables on MVPA (conceptualised as weekly minutes

or weekly bouts). Tests of the significance of potential mediation relationships followed the product of coefficients approach by Kenny and colleagues (1998). Specifically, this means that for each potential mediation relationship, the product of paths *a* and *b* was divided by a standard error term. The result is a *z*-score which can be compared against the critical value 1.96 to identify significance at  $p < .05$ .

Reasons for using this test as an alternative to the popular Baron and Kenny (1986) approach include those of power, sampling, and concept. The first reason for departing from the original Baron and Kenny approach is the very large sample size requirement. For example, detection of full mediation with medium sized *a* and *b* paths requires almost 400 participants (Fritz & Mackinnon, 2007). Secondly, mediation relationships may exist without a significant *c* path, (MacKinnon, 2008). Finally, Baron and Kenny's fourth step (path *c* becomes zero upon introducing the mediator) is designed to confirm a complete mediation relationship, which is rare in behavioural psychology. Thus, interesting partial mediation relationships could be overlooked if this complete mediation criterion was followed. Additional support for the product of coefficients method is that it performs similarly to a Sobel test according to a simulation conducted by MacKinnon and colleagues (2002). To test mediation using output from logistic regressions, an approach by MacKinnon and Dwyer (1993) was utilised in an online calculator (Herr, n.d.) offering the more common Sobel test statistic.

## **4.3 Results**

### **4.3.1 Demographics**

Most participants were physically active to some degree during the month prior to the study period with 86% reporting at least 1 bout of planned MVPA lasting at least 30 minutes.

The nature of chronic pain experienced by the sample was self-reported as follows: arthritis (40.8%), fibromyalgia (11.5%), chronic low back pain (37.7%), nerve damage (11.5%), and headache, (21.5%). An open-ended “other” response was offered to which 67 participants responded. Of these, over 50% could be classified as musculoskeletal pain (e.g., bursitis, tendinitis, patellofemoral syndrome, tarsalgia, etc.), while smaller numbers reported such conditions as Crohn’s (n = 3), Parkinson’s (n = 1) and various nerve pathologies (n = 5).

#### **4.3.2 Tests of Primary Mediation Hypotheses**

Steps were taken to test potential mediation relationships using the product of coefficients method described by Kenny and colleagues (1998). A summary of these tests can be found in Table 6. As in Study 2, examination of adaptive strategies was excluded because the measure was not highly reliable ( $\alpha = .66$ ), did not significantly predict MVPA, and relationships with psychological variables were small. This was also true of the single item measure introduced in this study intending to offer an alternate measure of adaptive strategies use.

Separate mediation models were tested in which either maintenance or maladaptive strategies were mediators and either CPAQ-E activities engagement scale, SEE, or SRE-SP were independent variables. MVPA was the dependent variable, conceptualised both as total weekly minutes and total weekly bouts. For each relationship, the critical value of  $z = 1.96$  indicated significance at  $p < .05$ . Recall that the critical value referred to in all primary mediation tests is derived from an Aroian equation, which performed similarly to the Sobel test (MacKinnon et al., 2002). See Figure 3 for the subtle difference (one additional term in calculating the standard error) between the two equations. Hereafter, any reference to critical values refers to this method.

$$\text{Sobel test equation: } z \text{ value} = \frac{a*b}{\sqrt{(b^2*s_a^2 + a^2*s_b^2)}}$$

$$\text{Aroian test equation: } z \text{ value} = \frac{a*b}{\sqrt{(b^2*s_a^2 + a^2*s_b^2 + s_a^2*s_b^2)}}$$

Figure 3. Differences between Aroian and Sobel test equations.  $a$  = coefficient for path  $a$ ,  $b$  = coefficient for path  $b$ ,  $s$  = standard error

**SRE-SP-MVPA relationships.** When examining the maintenance strategy as the mediator, the hypothesized mediation relationships predicting both weekly MVPA minutes ( $z = 2.98$ ) and bouts ( $z = 2.65$ ) achieved the critical value supporting a significant partial mediation effect. When examining maladaptive strategies as the mediator, the mediation relationship predicting weekly MVPA bouts ( $z = 2.38$ ) achieved the critical value but the relationship predicting minutes did not ( $z = 1.80$ ).

**SEE-MVPA relationships.** When examining maintenance as the mediator, the mediation relationships predicting both weekly MVPA minutes ( $z = 3.24$ ) and bouts ( $z = 2.98$ ) achieved the requisite critical value supporting a significant partial mediation effect. When examining maladaptive strategies as the mediator, the mediation relationship predicting weekly MVPA minutes ( $z = 2.58$ ) achieved the critical value but the relationship predicting bouts did not ( $z = .84$ ).

Table 6. *Summary of significant mediation relationships predicting exercise volume*

<b>Relationship</b>	<b>Mediator</b>	<b>Significant?</b>
SRE-SP and MVPA minutes	Maintenance	Yes
	Maladaptive	No
SRE-SP and MVPA bouts	Maintenance	Yes
	Maladaptive	Yes
CPAQ-E and MVPA minutes	Maintenance	Yes
	Maladaptive	No
CPAQ-E and MVPA bouts	Maintenance	Yes
	Maladaptive	No
SEE and MVPA minutes	Maintenance	Yes
	Maladaptive	Yes
SEE and MVPA bouts	Maintenance	Yes
	Maladaptive	No

Note: SRE-SP = self-regulatory efficacy to schedule/plan, CPAQ-E = chronic pain acceptance questionnaire for exercise, SEE = self-efficacy for exercise.

**Activities engagement - MVPA relationships.** When examining maintenance as the mediator, the mediation relationships predicting both weekly MVPA minutes ( $z = 2.68$ ) and bouts ( $z = 2.22$ ) achieved the requisite critical value supporting a significant partial mediation effect. However, when examining maladaptive strategies as the mediator, the relationships did not achieve the critical value when predicting weekly MVPA minutes ( $z = 1.12$ ) or bouts ( $z = 1.61$ ).

Mediation tests that failed to achieve the critical value for significance all exhibited non-significant relationships between the mediator and the dependent variable (the  $b$  path) with one exception. The model using SEE to predict MVPA bouts mediated by maladaptive strategies exhibited a significant  $b$  path ( $p = .002$ ), in the expected direction, yet still failed to achieve the critical value for significance (see Table 7 for beta values).

#### **4.3.3 Tests of Secondary Mediation Hypotheses**

Recall that the Sobel's test was used to calculate secondary mediation tests because that is the critical value used by the online calculator (Herr, n.d.) for mediation tests including logistic regressions.

**Relationship between SRE-SP to MVPA guidelines goal.** When examining maintenance as the mediator, the proposed mediation relationship did not achieve the requisite critical Sobel's test value when predicting the meeting of MVPA guidelines ( $z = 1.42$ ,  $p = .15$ ). However, when examining maladaptive strategies as the mediator, the relationship predicting the meeting of MVPA guidelines achieved a significant Sobel's test value ( $z = 2.24$ ,  $p = .03$ ).



Table 7. Beta weights for a and b paths of proposed mediation relationships

<b>Independent Variable</b>	<b>Unstandardised beta – a path</b>	<b>Mediator</b>	<b>Unstandardised beta – b path</b>	<b>Dependent Variable</b>
<b>SRE-SP</b>	<b>.507*</b>	<b>Maintenance</b>	<b>27.352*</b>	<b>MVPA volume</b>
<b>CPAQ-E</b>	<b>.111*</b>	<b>Maintenance</b>	<b>24.770*</b>	<b>MVPA volume</b>
<b>SEE</b>	<b>.396*</b>	<b>Maintenance</b>	<b>34.111*</b>	<b>MVPA volume</b>
<b>SRE-SP</b>	<b>-1.927*</b>	<b>Maladaptive</b>	<b>-4.266</b>	<b>MVPA volume</b>
<b>CPAQ-E</b>	<b>-.449*</b>	<b>Maladaptive</b>	<b>-2.793</b>	<b>MVPA volume</b>
<b>SEE</b>	<b>-1.643*</b>	<b>Maladaptive</b>	<b>-6.475*</b>	<b>MVPA volume</b>
<b>SRE-SP</b>	<b>.507*</b>	<b>Maintenance</b>	<b>.304*</b>	<b>MVPA bouts</b>
<b>CPAQ-E</b>	<b>.111*</b>	<b>Maintenance</b>	<b>.255*</b>	<b>MVPA bouts</b>
<b>SEE</b>	<b>.396*</b>	<b>Maintenance</b>	<b>.364*</b>	<b>MVPA bouts</b>
<b>SRE-SP</b>	<b>-1.927*</b>	<b>Maladaptive</b>	<b>-.071*</b>	<b>MVPA bouts</b>
<b>CPAQ-E</b>	<b>-.449*</b>	<b>Maladaptive</b>	<b>-.051</b>	<b>MVPA bouts</b>
<b>SEE</b>	<b>-1.643*</b>	<b>Maladaptive</b>	<b>-.085*</b>	<b>MVPA bouts</b>

Note: SRE-SP = self-regulatory efficacy to schedule/plan, CPAQ-E = chronic pain acceptance questionnaire for exercise, SEE = self-efficacy for exercise. \* $p < .05$

**Relationships concerning personal weekly MVPA goals.** Tests of mediation utilising the dichotomous variable representing meeting, or not meeting, personal weekly MVPA goals were not conducted because there were no significant correlations between any of the 3 coping strategy styles and the dichotomous weekly goals variable. Thus, mediation could not be examined.

#### 4.4 Discussion

The present study sought to examine and test potential mediation relationships between psychological variables (independent variables: SE and pain acceptance) and MVPA volume (dependent variable) for people with chronic pain. Mediator variables utilised in both of these examinations were measures of coping strategy use for exercising despite pain (either maintenance, maladaptive, or adaptive strategies). The research question was informed by theory and existing research. Frazier and colleagues (2004) suggest that many tests of mediation reported in the literature do not take sufficient care in conducting these tests with respect to reducing measurement error in all variables and in utilizing a study design that is consistent with identifying the temporal nature of proposed mediation relationships. Indeed, Frazier and colleagues (2004) argue that the literature would be improved if at least some of the criteria suggested would be achieved. Therefore, this study was conducted across three time points and measurement refinement/testing from Study 2 informed choice of measures that had minimal measurement error.

#### **4.4.1 Primary Objective: Mediation of Weekly MVPA**

Tests of mediation were performed using the product of coefficients test described by Kenny and colleagues (1998). The present study found partial support for both maintenance and maladaptive strategy use as mediators of the relationships between psychological predictors and MVPA volume. More specifically, relationships utilising maintenance strategy as the mediator were consistently significant. This was true regardless of whether MVPA was conceptualised as total weekly bouts or total weekly minutes. These relationships were significant for all predictors: SRE-SP (Gyurcsik et al., 2010), SEE (Resnick & Jenkins, 2000), and CPAQ-E (modified CPAQ: McCracken et al., 2004). The nature of the relationships was as hypothesised,

whereby higher scores on the independent variable predicted greater maintenance strategy use, which, in turn, predicted higher levels of MVPA.

Less consistent were findings where maladaptive strategies were used as the mediator. These relationships did not reach significance when CPAQ-E was the independent variable, regardless of whether MVPA minutes or bouts was entered as the dependent variable. In the cases of SRE-SP and SEE, relationships were only significant when the dependent variable was either MVPA bouts (SRE-SP) or MVPA minutes (SEE) but not both. Despite these mixed findings, the direction of the relationships was as hypothesised in all cases such that higher scores on the independent variable predicted lower maladaptive strategy use and the relationship between maladaptive strategy use and MVPA was negative.

#### **4.4.2 Adaptive Strategy Measurement Issues**

As was the case in Study 1, the measure of adaptive strategy use demonstrated poor reliability and poor predictive utility in the present study. One possible reason, particularly for a poor correlation with MVPA volume, is that one item represents the frequency with which a person reduces the length of exercise bouts to cope with pain. This item would intuitively correlate negatively with weekly MVPA volume.

Another possible reason for the measure's poor performance is that it is a measure of frequency of use with each item scaled from 0 ("never") to 8 ("always") and a sum of item scores representing the total score. An example of how this measure may be conceptually problematic is as follows: an individual always uses one particular strategy successfully (e.g., change mode of exercise from running to swimming) and no other strategies so they would score an 8 (always) for that item and 0 (never) for all remaining items. Despite that person reporting

that they do utilise an adaptive coping strategy to successfully adhere to exercise despite pain, they would score relatively low on the total adaptive score.

An alternate single-item adaptive strategy measure was employed in an effort to overcome this measurement problem. The single-item measure did not measure frequency of use. Instead, participants rated how well a broad description of adaptive coping strategy use (“To alter your exercise plans in some way that allows you to still exercise but just not as you originally planned [e.g., for less time, less intense, different type of exercise, etc.]”) described their use. Despite this effort to improve the measurement of adaptive strategies, this single item measure exhibited similar liabilities in terms of poor predictive utility and poor correlation with other psychological and MVPA variables. Therefore, tests of mediation relationships were only conducted using maintenance and maladaptive strategies as mediators. Further refinement of adaptive strategy measurement is recommended.

#### **4.4.3 Secondary Objective: Predicting Levels of MVPA**

Exploratory mediation testing was conducted utilising SRE-SP as the independent variable, coping strategy use as the mediator, and one of two dichotomous measures of MVPA. These measures were whether individuals meet/do not meet *MVPA guidelines* and whether they meet/do not meet self-reported personal *weekly MVPA goals*. These alternate measures were examined in the interest of correspondence between SRE measures and MVPA measures. For example, the standard wording of the SRE-SP measure refers to the participant’s “planned physical activity”, the duration and frequency of which will vary between individuals, and thus may correspond with a measure of meeting/not meeting their *self-reported* MVPA goals. Because meeting MVPA guidelines is of public health interest as an outcome, the reference to an absolute, guideline volume of weekly MVPA ( $\geq 150$  minutes) was a modification to the SRE-SP

measure which should make SRE-SP more correspondent with the categorical dependent variable of whether participants meet/do not meet MVPA guidelines.

Findings indicated that maintenance strategies do not significantly mediate SRE-SP and meeting/not meeting MVPA guidelines. However, maladaptive strategy use does significantly mediate the relationship. The relationship was in the expected direction such that higher SRE-SP predicts lower maladaptive strategy use, while higher maladaptive strategy use predicts not meeting the guidelines. The variability captured by maintenance strategy use (single-item measure) is less than for maladaptive strategy use (5-item scale) which may explain in part why maladaptive strategy use performed better as a mediator. Variability in the dependent variable was also limited, partly due to the nature of a dichotomous variable, and partly due to a majority of the sample meeting MVPA guidelines (67% at Time 1, 62% at Time 3).

When examining MVPA as meeting/not meeting *personal MVPA goals*, the proposed mediators did not significantly correlate with the dependent variable and therefore mediation testing did not proceed. Overall, these findings were weaker than for relationships examining MVPA as volume. It may be that conceptualising *personal MVPA goals* as a dichotomous variable reduced variability resulting in reducing the likelihood of detecting relationships. Variability was particularly limited in this case because 75% of the sample met their personal weekly MVPA goals.

#### **4.4.4 Strengths and Limitations**

A strength of the present study is that it is framed in theory and tests a specific type of theoretical hypothesis (Painter et al., 2008). Additionally, the present study tests mediation relationships utilising a test of significance of the change in c paths (the reduction in prediction

of the dependent variable by the independent variable upon inclusion of the mediator) which is rarely conducted in mediation studies (MacKinnon et al., 2002). Assessing the significance of the change in *c* paths is akin to testing significance of the overall mediation model in addition to simply testing individual paths.

Also bearing in mind the importance of reducing measurement error in tests of mediation, the reduction of measurement error in the present study was informed by Study 2. The present study was aimed at measurement refinement and included multiple measures of SE and coping strategy use (e.g., single item as well as scale measures). This allowed the opportunity to select the most reliable among these measures in further efforts to reduce measurement error.

The present study also offers the first support for the use of the CPAQ-E (i.e., following its pilot use in Study 2), in a model of mediation. The CPAQ-E is a modification of the CPAQ intended to increase specificity of pain acceptance relative to exercise.

Potential limitations of this study include the lingering issues with measurement of adaptive strategies. The lack of a valid and reliable measure of adaptive strategy use precluded conducting tests of mediation. This leaves the possible role of adaptive strategies as mediators unexamined. In terms of the ability to detect mediation effects, the relatively small sample size ( $N = 130$ ) may have limited statistical power. Future investigations might consider recruitment of more participants to gain power and the possibility of a more sensitive test of partial mediation.

#### **4.4.5 Conclusions**

Maintenance strategy use appears to mediate relationships between psychological variables and weekly MVPA volume. Maladaptive strategy use was identified less consistently

as a mediator but did offer some utility relative to the relation between SE variables and weekly MVPA volume. Relationships were in the expected direction but not significant. It is speculated that at least part of the problem with detecting mediation may be related to measurement of the mediator (e.g., poor reliability of adaptive strategies) and MVPA volume (e.g., large standard deviation). Further research is necessary to establish a valid measure of adaptive strategy use with limited measurement error. When examining these mediation relationships utilising dichotomous MVPA variables, the relationships are weaker. This may be in part due to the decreased variability inherent to dichotomising a continuous variable.

The CPAQ-E also demonstrated utility in predicting MVPA. However, future research should directly compare the validity of the CPAQ-E against the original CPAQ to determine whether the increased specificity of context in the CPAQ-E results in greater predictive utility for exercise studies in chronic pain.

## **5. General Discussion**

Many people with arthritis, do not meet MVPA guidelines despite potential health benefits (PHAC, 2010). Past arthritis and exercise research has identified positive relationships between SE and MVPA (Gyurcsik et al., 2013) as well as pain acceptance and MVPA (Gyurcsik et al., 2011). In the interest of building on these findings, the present dissertation aimed to test theoretical predictions in order to examine possible mediators of these relationships. The theoretical foundation and empirical research guiding this examination was SCT as well as the research concerning attitudes regarding chronic pain acceptance. The proposed mediators were self-regulatory coping strategies for managing exercise despite pain, including maladaptive, adaptive, and maintenance strategies.

The three studies in this program of research represent a progression from 1) an exploratory cross-sectional assessment of the proposed mediation relationships to determine the possibility that they meet a basic criterion for testing (i.e., relationships do exist), to 2) a related study focused on reducing measurement error among the variables being examined and increasing the specificity of the independent variables that are part of the potential mediation relationships, to 3) utilising an improved study design to test for mediation as well as measurement refinements informed from Study 2.

## **5.1 Study 1**

Study 1 of this dissertation sought to examine self-regulatory strategies for coping with pain anxiety (maintenance, adaptive, and maladaptive strategies) as possible mediators of the relationships between (a) SE and MVPA, and (b) pain acceptance and MVPA. A further objective was to assess validity of the independent variables given the importance of reducing measurement error in tests of mediation (Frazier et al., 2004). Study 1 utilised data from a larger arthritis study. This secondary use of the data allowed for exploratory prediction analyses which provided justification for further research of the proposed mediation relationships.

The independent variables of interest in Study 1 were SRE-SP and the CPAQ (McCracken et al., 2004). The CPAQ has been validated in the chronic pain literature and factor analysis in Study 1 offered support for its validation among the arthritis population specifically. The validity of the SRE-SP measure was also supported relative to the arthritis population in terms of its factor structure, as well as its predictive validity (predicting MVPA). This evidence agreed with recommendations for better quality in chronic disease SE measures set forth by Frei and colleagues (2009).



The purpose of Study 1 was to explore the possibility of mediation relationships by examining psychological correlates of MVPA (SE and pain acceptance). These variables were used in separate models as the independent variable to predict MVPA volume (the dependent variable). The mediator variables tested were measures of maintenance and maladaptive coping strategy use. The adaptive strategy use measure was excluded as it demonstrated measurement and conceptual problems. Mediation models were examined using the product of coefficients procedure. This procedure tests whether the relationship between the independent and dependent variables is significantly reduced following the addition of the mediator to the model. In one model, the relationship between the CPAQ and MVPA was reduced to non-significance (i.e., the criteria for full mediation) with the inclusion of maintenance strategies as a mediator. The remaining models tested were all significant, indicating partial mediation. Thus, these cross-sectional results suggest future examinations of mediation might be worth pursuing by using a longitudinal study design and more rigorous criteria as suggested by Frazier and colleagues (2004).

The nature of the relationships was as hypothesised, such that in their separate analyses higher SRE-SP and CPAQ scores were positively related to maintenance scores and inversely related to maladaptive scores. In turn, maladaptive scores were inversely related to MVPA and maintenance scores were positively related to MVPA.

## **5.2 Study 2: Measurement**

Prior to proceeding with a prospective study (Study 3) designed to test mediation, Study 2 was conducted in an effort to refine the measure of pain acceptance. Additional objectives included comparison of various SE measures in predicting MVPA and assessment of test-retest reliability of the SRE-SP measure as recommended in Study 1. Recall that the overall goal of

Study 2 was the reduction of measurement error with the future goal of conducting the test of mediation (cf., Frazier et al., 2004).

The CPAQ measures pain acceptance as related to “valued activities” which may or may not include MVPA, or may also include other activities such as employment, housework, etc. In an effort to improve correspondence between the CPAQ and exercise behaviour, a purpose was to modify the CPAQ (CPAQ-E) where each item was contextualised to refer to exercise. This modification, and the purpose of the modification, were supported by McCracken, the originator of the CPAQ (L. McCracken, personal communication, November 13, 2014). The CPAQ-E was tested in terms of factor structure, reliability, and predictive validity (predicting exercise). It demonstrated initial factorial validity with a two-factor structure consistent with the two subscales of the original CPAQ and acceptable internal consistency.

When predicting the number of *weekly bouts* of exercise, the total score and both subscales demonstrated predictive validity. When predicting total *weekly MVPA in minutes*, only the activities engagement subscale significantly predicted. Taken together, these findings supported the use of the CPAQ-E in subsequent exercise studies. The psychometric properties and initial validation of the measure were sufficient to pursue the next dissertation study concerning exercise and pain. Thus, as part of the purpose of Study 3, the CPAQ-E was used in a test of mediation.

In the literature on chronic disease and in particular arthritis, numerous SE measures abound. This can also be said of the exercise literature. In order to pursue the goal of limiting measurement error, a number of measures were examined with this characteristic in mind. These measures included disease-specific measures that relate broadly to managing arthritis and are not exercise-specific (e.g., the ASES) as well as exercise-specific measures that are not arthritis-

specific (e.g., SRE-SP and SEE). Only the exercise-specific measures predicted MVPA volume. When predicting weekly volume of MVPA, SRE-SP and SEE performed comparably and therefore, both were selected for future use in Study 3.

### **5.3 Study 3: Testing Mediation**

The culminating study of the dissertation was designed following criteria that provided a more rigorous test of mediation relationships than explored in Study 1. Greater rigour was made possible by improving study design and measurement. These improvements can be summarized as follows. The study design included three time points for measurement in order to assess the temporal nature of the proposed mediation relationships (Frazier et al., 2004). The selection of measures utilised in Study 3 was informed by the findings of Study 2, including the use of the CPAQ-E. The larger sample size recommended for tests of mediation was made possible by including people with any type of chronic pain as well as those with arthritis. As well, coping strategies used as proposed mediators referenced coping with pain, something applicable and salient to people with chronic pain as well as those with arthritis. Recall that exercise is recommended for both populations and thus applicable to the context (exercising) and measures referring to both pain and exercise.

Proposed mediation relationships between the independent variable (SRE-SP, SEE, or CPAQ-E), the mediator (maladaptive or maintenance strategy use), and the dependent variable (weekly MVPA minutes or weekly MVPA bouts) were each tested using the product of coefficients method (Kenny et al., 1998). When maintenance strategy use was entered as the mediator, all mediation relationships achieved significance. This was true whether the independent variable was SRE-SP, SEE, or CPAQ-E and whether the dependent variable was MVPA bouts or minutes. These tests supported partial mediation, as the relationships between

the independent and dependent variables remained significant, but reduced, upon introducing the mediator to the respective models.

Findings related to maladaptive strategies were mixed. Relationships using CPAQ-E to predict both measures of MVPA (bouts and minutes) were non-significant when mediated by maladaptive strategies. Relationships using SRE-SP to predict MVPA were only significant for MVPA bouts when mediated by maladaptive strategies. Relationships using SEE to predict MVPA were only significant for MVPA minutes when mediated by maladaptive strategies. For those relationships that were significant, partial mediation was supported.

The present examination offered insight into possible mechanisms for previously observed relationships between pain acceptance and MVPA, as well as between SE and MVPA. Maintenance strategy use was well-supported as a partial mediator of these relationships. People higher in pain acceptance and SE appear to persist with their planned MVPA without adjustment for pain, which would lead to higher MVPA volume.

Findings regarding maladaptive strategy use were in the expected direction such that pain acceptance and SE were negatively related to maladaptive strategy use. In turn, it was negatively related to MVPA. On the other hand, relationships including pain acceptance and maladaptive strategies did not achieve significant product of coefficients tests that would support mediation.

#### **5.4 Strengths and Limitations**

Strengths of this dissertation include its grounding in SCT and addressing multiple calls for various improvements in research. For example, Frei and colleagues (2009) have identified problems with SE measures and made recommendations for improvement, particularly with respect to their validation.

Study 3 represents a test of SCT hypotheses. Such tests are particularly scarce in health behaviour change research according to Painter and colleagues (2008). To provide more well designed tests of such hypotheses, Frazier and colleagues (2004) offer recommendations for conducting studies of mediation with a higher level of rigour and this dissertation was informed by these recommendations (e.g., longitudinal design, minimising measurement error, testing the significance of the reduction in the c path).

Possible limitations, despite recruitment efforts, include (a) a relatively small sample size for mediation studies which may increase the risk of a type II error, and (b) the sample including predominantly people who might be classified as regularly physically active (regardless of PA guidelines). Addressing (b) more specifically, despite recruitment efforts to include those who were totally inactive in Study 3, over half of the sample self-reported being active at guideline levels. The strength and nature of the relationships examined in this dissertation may not be the same if exercise initiates were the focus of the population studied. Finally, all study samples had a much larger proportion of female respondents than males raising the question of whether the relationships observed would be valid for both sexes. Non-representativeness of the samples relative to the population of individuals with arthritis who experience pain and who exercise limits conclusions. While there are known sex differences in the reporting of pain (Bartley & Fillingim, 2013), differences in the same studies relative to the other variables involved in the tests of mediation are not known. Further, there is no reason to believe that the proposed mediation relationships should differ between the sexes. Regardless, future studies might attempt to sample more males to determine if mediational relationships between the sexes are the same or different.

## **5.5 Contributions to Exercise Psychology**

The aforementioned strengths of the studies all reflect contributions to exercise psychology. To elaborate, these findings offer insight by identifying probable mechanisms through which previously observed relationships between psychological variables (SE and pain acceptance) and MVPA are thought to function. As well, support for the factorial validity of the CPAQ in the arthritis population as well as initial support for an exercise-specific modification to the CPAQ (CPAQ-E) was found. In contrast to previously published studies which utilise cross-sectional, correlational designs based upon structural equation modelling to examine mediation, the approach toward a test of mediation in the present dissertation was commensurate with recommendations by Frazier and colleagues (2004). Finally, a number of future directions which logically stem from the findings of the dissertation provide further opportunity for contribution if undertaken.

## **5.6 Future Directions**

Adaptive strategies are part of self-regulatory skills that have been demonstrated to be beneficial to MVPA adherence in a variety of populations (Brawley, Flora, Locke, & Gierc, 2014). Despite efforts in Study 3 to utilise an additional method of measurement to that which was used in Study 1, both methods failed to offer a valid measure. An important future direction would be the pursuit of a reliable and valid measure of adaptive strategy use for coping with pain. Potentially, the use of focus groups may offer insight into additional ways to approach adaptive strategy measurement. For example, focus groups may provide salient aspects of adaptation that may be common across participants and that could be used to inform the development of a future measure of adaptive strategy. Once such a measure has been established and validated, the examination of adaptive strategy use as a mediator of psychosocial variables and MVPA should be conducted.

An additional pursuit related to measurement may include seeking to reduce measurement error in the measurement of MVPA. The use of accelerometry could be considered for this purpose as it is an objective measure of activity. However, if accelerometry were to be used, careful attention should be paid to the unique effects on measurement error that may be introduced. For example, a review of accelerometry use in older adults (Schrack et al., 2016) identifies a number of challenges to their use. Among these, a lack of consensus regarding the placement of the device on the body, the determination of wear time, the activity threshold to be measured, the data algorithm, and resultant output of the device. Additional issues identified by the authors include a limited ability to capture non-impact activity (e.g., cycling, strength training, etc.) as well as compliance issues. All such issues may contribute to measurement error and indicate that though an objective measure via accelerometry is attractive to the researcher, it is not a clearly superior approach to self-report that would obviate the reduced measurement error criteria emphasized for tests of mediation.

Study 3 determined that individuals with chronic pain, many of whom met MVPA guidelines, used a maintenance strategy to pursue MVPA when experiencing pain (i.e., they do their planned MVPA without modification). Future research should explore possible differences in the proposed mediation relationships that may exist between those who are initiates of MVPA and those who are very experienced with MVPA. It may be that exercise initiates utilise more adaptive strategies for coping with pain as they experiment with self-regulating the novel behaviour of regular MVPA, while more experienced exercisers may simply continue their MVPA without modification.

Further study of these potential mediation relationships in the context of coping strategies used for instances of extreme pain (e.g., arthritis flares) should also be pursued. One testable

hypothesis would be that the ability of individuals to pursue their planned activity without modification may be lessened during a flare, making adaptive self-regulation strategies an important means of adhering to MVPA, even for those who are experienced exercisers.



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## **Appendix A – Study 1 measures**

**Time 1 measures:**

**Confidence to schedule and plan exercise**

These questions have to do with your confidence to schedule and plan your exercise. Please report your confidence in doing each of the following in the next 2 weeks (14 days):

Make your planned exercise a value/priority each week

0- Not at all confident	1	2	3	4	5- Moderately confident	6	7	8	9	10- Entirely confident
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Plan and prepare in advance so that nothing interferes with your planned exercise each week

0- Not at all confident	1	2	3	4	5- Moderately confident	6	7	8	9	10- Entirely confident
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Rearrange your schedule so that you can fit your planned exercise into your day

0- Not at all confident	1	2	3	4	5- Moderately confident	6	7	8	9	10- Entirely confident
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Make sure you do not miss a whole week of your planned exercise over the next 2 weeks (14 days)

0- Not at all confident	1	2	3	4	5- Moderately confident	6	7	8	9	10- Entirely confident
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Take time out for yourself and exercise as planned regardless of your other commitments

0- Not at all confident	1	2	3	4	5- Moderately confident	6	7	8	9	10- Entirely confident
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Find a time to do your planned exercise that most suitably fits your lifestyle

0- Not at all confident	1	2	3	4	5- Moderately confident	6	7	8	9	10- Entirely confident
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Put in 4 or more planned exercise sessions in a week

0- Not at all confident	1	2	3	4	5- Moderately confident	6	7	8	9	10- Entirely confident
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Exercise at the times you have planned

0- Not at all confident	1	2	3	4	5- Moderately confident	6	7	8	9	10- Entirely confident
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Change your planned exercise when needed, such as when you have plans to walk for 30 minutes but you can only fit in a walk for 20 minutes

0- Not at all confident	1	2	3	4	5- Moderately confident	6	7	8	9	10- Entirely confident
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

## **Pain Acceptance Questionnaire**

Below you will find a list of statements. Please rate the truth of each statement as it applies to you and your arthritis pain.

I am getting on with the business of living no matter what my level of arthritis pain is:

0- Never True	1- Very rarely true	2- Seldom true	3- Sometimes true	4- Often true	5- Almost always true	6- Always true
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

My life is going well, even though I have arthritis pain:

0- Never True	1- Very rarely true	2- Seldom true	3- Sometimes true	4- Often true	5- Almost always true	6- Always true
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

It's OK to experience arthritis pain:

0- Never True	1- Very rarely true	2- Seldom true	3- Sometimes true	4- Often true	5- Almost always true	6- Always true
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I would gladly sacrifice important things in my life to control this arthritis pain better:

0- Never True	1- Very rarely true	2- Seldom true	3- Sometimes true	4- Often true	5- Almost always true	6- Always true
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

It's not necessary for me to control my arthritis pain in order to handle my life well:

0- Never True	1- Very rarely true	2- Seldom true	3- Sometimes true	4- Often true	5- Almost always true	6- Always true
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Although things have changed, I am living a normal life despite my arthritis pain:

0- Never True	1- Very rarely true	2- Seldom true	3- Sometimes true	4- Often true	5- Almost always true	6- Always true
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I need to concentrate on getting rid of my arthritis pain:

0- Never True	1- Very rarely true	2- Seldom true	3- Sometimes true	4- Often true	5- Almost always true	6- Always true
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There are many activities I do when I feel arthritis pain:

0- Never True    1- Very rarely true    2- Seldom true    3- Sometimes true    4- Often true    5- Almost always true    6- Always true

I lead a full life even though I have arthritis pain:

0- Never True    1- Very rarely true    2- Seldom true    3- Sometimes true    4- Often true    5- Almost always true    6- Always true

Controlling arthritis pain is less important than any other goals in my life:

0- Never True    1- Very rarely true    2- Seldom true    3- Sometimes true    4- Often true    5- Almost always true    6- Always true

My thoughts and feelings about arthritis pain must change before I can take important steps in my life:

0- Never True    1- Very rarely true    2- Seldom true    3- Sometimes true    4- Often true    5- Almost always true    6- Always true

Despite the arthritis pain, I am now sticking to a certain course in my life:

0- Never True    1- Very rarely true    2- Seldom true    3- Sometimes true    4- Often true    5- Almost always true    6- Always true

Keeping my arthritis pain level under control takes first priority whenever I'm doing something:

0- Never True    1- Very rarely true    2- Seldom true    3- Sometimes true    4- Often true    5- Almost always true    6- Always true

Before I can make any serious plans, I have to get some control over my arthritis pain:

0- Never True    1- Very rarely true    2- Seldom true    3- Sometimes true    4- Often true    5- Almost always true    6- Always true

When my arthritis pain increases, I can still take care of my responsibilities:

0- Never True    1- Very rarely true    2- Seldom true    3- Sometimes true    4- Often true    5- Almost always true    6- Always true

I will have better control over my life if I can control my negative thoughts about arthritis pain:

0- Never True    1- Very rarely true    2- Seldom true    3- Sometimes true    4- Often true    5- Almost always true    6- Always true

I avoid putting myself in situations where my arthritis pain might increase:

0- Never True    1- Very rarely true    2- Seldom true    3- Sometimes true    4- Often true    5- Almost always true    6- Always true

My worries and fears about what arthritis pain will do to me are true:

0- Never True    1- Very rarely true    2- Seldom true    3- Sometimes true    4- Often true    5- Almost always true    6- Always true

It's a relief to realize that I don't have to change my arthritis pain to get on with my life:

0- Never True    1- Very rarely true    2- Seldom true    3- Sometimes true    4- Often true    5- Almost always true    6- Always true

I have to struggle to do things when I have arthritis pain:

0- Never True    1- Very rarely true    2- Seldom true    3- Sometimes true    4- Often true    5- Almost always true    6- Always true

### **Coping strategies**

We are now interested in what you do about your planned moderate to vigorous exercise when you have the experiences and thoughts about your arthritis pain listed above. Those thoughts and experiences are sometimes referred to as 'pain anxiety'. We would like you to rate the extent to which you do each of the following about your planned exercise when you have pain anxiety?

ALTERNATE the TYPE of EXERCISE that you planned on doing (for example, swim one day, walk another day; do different exercises on the same day).

- 0- Never do this
- 1
- 2
- 3
- 4- Do this about half the time
- 5
- 6
- 7
- 8- Always do this

You DO SOMETHING ELSE that you ENJOY (like watch tv, go to a movie, shop, listen to music, etc.).

- 0- Never do this
- 1
- 2
- 3
- 4- Do this about half the time
- 5
- 6
- 7
- 8- Always do this

Do ALL OF YOUR SCHEDULED/PLANNED exercise, regardless of your pain anxiety.

- 0- Never do this

- 1
- 2
- 3
- 4- Do this about half the time
- 5
- 6
- 7
- 8- Always do this

You FEEL LIKE YOU CAN'T GO ON so you STOP doing your planned exercise.

- 0- Never do this
- 1
- 2
- 3
- 4- Do this about half the time
- 5
- 6
- 7
- 8- Always do this

TAKE PAIN MEDICATION (e.g., ibuprofen, Tylenol, prescriptions, etc.) so that you do exercise as planned.

- 0- Never do this
- 1
- 2
- 3
- 4- Do this about half the time
- 5
- 6
- 7

- 8- Always do this

You STOP doing ALL of your planned exercise.

- 0- Never do this
- 1
- 2
- 3
- 4- Do this about half the time
- 5
- 6
- 7
- 8- Always do this

Do LESS EXERCISE than you planned (for example, you exercise for 25 minutes instead of the originally planned 45 minutes).

- 0- Never do this
- 1
- 2
- 3
- 4- Do this about half the time
- 5
- 6
- 7
- 8- Always do this

You ARE OVERWHELMED and you STOP doing your planned exercise.

- 0- Never do this
- 1
- 2
- 3
- 4- Do this about half the time

- 5
- 6
- 7
- 8- Always do this

You DO OTHER THINGS WITH YOUR FRIENDS/FAMILY instead of your planned exercise.

- 0- Never do this
- 1
- 2
- 3
- 4- Do this about half the time
- 5
- 6
- 7
- 8- Always do this

Change the TYPE of EXERCISE you planned (e.g., you choose exercises that are easier on your body, like walking instead of jogging; swimming instead of walking).

- 0- Never do this
- 1
- 2
- 3
- 4- Do this about half the time
- 5
- 6
- 7
- 8- Always do this

You make efforts to relax to reduce tension, so that you can exercise.

- 0- Never do this
- 1

- 2
- 3
- 4- Do this about half the time
- 5
- 6
- 7
- 8- Always do this

USE HEAT OR ICE before/after your planned exercise.

- 0- Never do this
- 1
- 2
- 3
- 4- Do this about half the time
- 5
- 6
- 7
- 8- Always do this

Did you remember to answer these questions in response to when you have pain anxiety (those thoughts and experiences about your pain that you responded to above)? If not, feel free to go back and change your answers.

**Time 2 measures:**

**Exercise**

We would like you to think about your exercise history. As an ACCURATE REPORTING of your exercise is one key to our research, please carefully read the following: ONLY think about EXERCISE THAT YOU PLANNED TO DO IN YOUR FREE TIME FOR 20 MINUTES OR MORE. This means that you scheduled/planned it and set time aside in your day to exercise. Some examples of exercise: You may be registered in a swim/aerobics class at a local gym – this means that you have plans to exercise on each day that your class takes place in a week. Exercise may also be planned when you get up in the morning – you notice it is nice outside and you plan to walk outside. The KEY is that you plan to exercise in advance and set time aside in your free time to exercise for 20 minutes or more. We understand that you may do other types of exercise, like walking while doing groceries, have a physically demanding job, or you may do planned exercise for less than 20 minutes at one time. These types exercise are not the focus of our research.

With this in mind, please think about 2 types of planned exercise: (1) Moderate and (2) Vigorous. Moderate Exercise makes your heart beat faster and makes you breathe a little harder. You can TALK EASILY while doing moderate exercise, but you may not be able to sing comfortably. Vigorous Exercise makes your heart beat much faster. You may NOT BE ABLE TO TALK COMFORTABLY without stopping to catch your breath. Intensity can be estimated using a scale of 0 to 10, where sitting is 0 and 10 is the highest level of effort possible. Moderate intensity exercise is a 5 or 6. Vigorous intensity exercise is a 7 or 8.

Think about the last 2 weeks (14 days). Did you do any planned moderate or vigorous exercise for at least 20 minutes at one time during your free time?

- Yes
- No

On average, how many days in each 7 day period (1 week) did you actually do MODERATE and/or VIGOROUS exercise for at least 20 continuous minutes during your free time?

	0 days in a week	1 day in a week	2 days in a week	3 days in a week	4 days in a week	5 days in a week	6 days in a week	7 days in a week
Moderate exercise	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Vigorous exercise	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

How many TOTAL MINUTES were you doing planned MODERATE and/or VIGOROUS exercise in a typical day?



For example, you may have done two walks of 20 minutes each time during a day– so you would put 40 minutes below. Or you may have walked or done another type of moderate exercise for 35 minutes at one time – so you would put 35 below. We understand that you may not do the same amount of exercise on each day. We would like you to give us your best estimate of the average amount of time you exercised. For example, if you did 40 minutes on one day and 30 minutes on another day, your average would be 35 minutes.

Total minutes of MODERATE exercise in a typical day (remember – only think about those times when you did 20 or more minutes)

Total minutes of VIGOROUS exercise in a typical day (remember – only think about those times when you did 20 or more minutes)

What kinds of exercise did you do (check all that apply):

	Walk	Swimming class	Swim laps	Land-based exercise	Bike	Other, please specify:
Moderate exercise	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Vigorous exercise	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Use this space to specify if you selected "other" in the previous question

Moderate exercise

Vigorous exercise

**Appendix B - Frequency and value ratings of valued activities considered when answering  
the CPAQ**

*Frequency and value ratings of valued activities considered when answering the CPAQ*

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Activity	Frequency ( <i>N</i> = 86) <i>n</i> (%)	Value (0 – 10) <i>M</i> ± <i>SD</i>
Employment	51 (60%)	7.90 ± 2.60
Social	72 (87%)	7.97 ± 2.30
Exercise	82 (98%)	8.89 ± 1.55
Hobbies	67 (80%)	8.37 ± 1.94
Household care	35 (79%)	7.34 ± 2.35
Other	33 (42%)	8.03 ± 2.65

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*Note.* CPAQ = Chronic Pain Acceptance

## **Appendix C – Study 2 measures**

**Time 1 measures:**

**Confidence to schedule and plan exercise**

These questions have to do with your confidence to schedule and plan your exercise. Please report your confidence in doing each of the following in the next 2 weeks (14 days):

	0 - Not at all confident	1	2	3	4	5 - Moderately confident	6	7	8	9	10 - Entirely confident
Make your planned exercise a value/priority each week	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Plan and prepare in advance so that nothing interferes with your planned exercise each week	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Rearrange your schedule so that you can fit your planned exercise into your day	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Make sure you do not miss a whole week of your planned exercise over the next 2 weeks (14 days)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	0 - Not at all confident	1	2	3	4	5 - Moderately confident	6	7	8	9	10 - Entirely confident
Take time out for yourself and exercise as planned regardless of your other commitments	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Find a time to do your planned exercise that most suitably fits your lifestyle	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Put in 4 or more planned exercise sessions in a week

Exercise at the times you have planned

Change your planned exercise when needed, such as when you have plans to walk for 30 minutes but you can only fit in a walk for 20 minutes

**Confidence to overcome arthritis barriers**

We are interested in any barriers that you may have when trying to carry out your plans to do moderate to vigorous exercise in the next 2 weeks (14 days). Barriers can make it difficult or completely stop you from doing your exercise. How confident are you in your abilities to cope with each barrier and do your moderate to vigorous physical activity as planned over the next 2 weeks (14 days):

	0 - Not at all confident	1	2	3	4	5 - Moderately confident	6	7	8	9	10 - Entirely confident
You are in pain due to your arthritis	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Your joints are stiff from your arthritis	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Your joints are swollen from your arthritis	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Your arthritis symptoms are increased beyond your usual experiences (meaning you are in an arthritis "flare")	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
You are tired from your arthritis	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please give us your best estimate of whether each of these barriers will occur over the next 2 weeks (14 days):

	Will occur	Will not occur
You are in pain due to your arthritis	<input type="radio"/>	<input type="radio"/>
Your joints are stiff from your arthritis	<input type="radio"/>	<input type="radio"/>
Your joints are swollen from your arthritis	<input type="radio"/>	<input type="radio"/>
Your arthritis symptoms are increased beyond your usual experiences (meaning you are in an arthritis "flare")	<input type="radio"/>	<input type="radio"/>
You are tired from your arthritis	<input type="radio"/>	<input type="radio"/>

**Confidence to overcome exercise barriers**

We are interested in any barriers that you may have when trying to carry out your plans to do moderate to vigorous exercise in the next 2 weeks (14 days). Barriers can make it difficult or completely stop you from doing your exercise. We know that you may have barriers from your arthritis. However, we would like you to focus only on the following non-arthritis barriers.

Please give us your best estimate of your confidence to overcome each barrier and exercise as planned over the next 2 weeks (14 days).

	0 - Not at all confident	1	2	3	4	5 - Moderately confident	6	7	8	9	10 - Entirely confident
You do not feel well (e.g., flu/cold)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
You have been physically active at work (e.g., you have a physically demanding job)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
There is extreme winter weather (e.g., too cold, icy, windy)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
There is extreme summer weather (e.g., too hot, rain storms)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	0 - Not at all confident	1	2	3	4	5 - Moderately confident	6	7	8	9	10 - Entirely confident
You have a busy schedule because of work reasons (e.g., meetings)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
You have a busy schedule because of family reasons (e.g.,	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



spending time with family)

You must deal with bad traffic

You must deal with poor road conditions

You have travel/vacation plans

0 - Not at all confident    1    2    3    4    5 - Moderately confident    6    7    8    9    10 - Entirely confident

The cost of a structured exercise program/membership is too high

The location of a structured exercise program/membership is not convenient

The hours/schedule of an exercise facility are not convenient

Please give us your best estimate of whether each of these barriers will occur over the next 2 weeks (14 days):

	Will occur	Will not occur
You do not feel well (e.g., flu/cold)	<input type="radio"/>	<input type="radio"/>
You have been physically active at work (e.g., you have a physically demanding job)	<input type="radio"/>	<input type="radio"/>
There is extreme winter weather (e.g., too cold, icy, windy)	<input type="radio"/>	<input type="radio"/>
There is extreme summer weather (e.g., too hot, rain storms)	<input type="radio"/>	<input type="radio"/>
You have a busy schedule because of work reasons (e.g., meetings)	<input type="radio"/>	<input type="radio"/>

- You have a busy schedule because of family reasons (e.g., spending time with family)
- You must deal with bad traffic
- You must deal with poor road conditions
- You have travel/vacation plans
- The cost of a structured exercise program/membership is too high
- The location of a structured exercise program/membership is not convenient
- The hours/schedule of an exercise facility are not convenient

**Chronic Pain Acceptance Questionnaire for Exercise\***

Below you will find a list of statements. Please rate the truth of each statement as it applies to you and your arthritis pain.

	Never true	Very rarely true	Seldom true	Sometimes true	Often true	Almost always true	Always true
I am getting on with my exercise plans no matter what my level of pain is.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My exercise is going well, even though I have chronic pain.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It's OK to experience pain during exercise.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would gladly sacrifice exercise to control this pain better.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	Never true	Very rarely true	Seldom true	Sometimes true	Often true	Almost always true	Always true
It's not necessary for me to control my pain in order to exercise.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Although things have changed, I am able to exercise despite my chronic pain.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I need to concentrate on getting rid of my	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

pain before I can exercise.

There are many activities I do when I feel pain, such as exercise.

Never true    Very rarely true    Seldom true    Sometimes true    Often true    Almost always true    Always true

Controlling pain is less important than exercise.

My thoughts and feelings about pain must change before I can exercise.

Despite the pain, I am now sticking to my exercise plans.

Keeping my pain level under control takes first priority, above exercising.

Before I can make any serious exercise plans, I have to get some control over my pain.

Never true    Very rarely true    Seldom true    Sometimes true    Often true    Almost always true    Always true

When my pain increases, I can still exercise.

I will have better control over my exercise plans if I can control my negative thoughts about pain.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I avoid putting myself in exercise situations where my pain might increase.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My worries and fears about what exercise-related pain will do to me are true.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It's a relief to realize that I don't have to change my pain to get on with my exercise plans.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have to struggle to do exercise when I have pain.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

\* Item 9 from the activities engagement subscale (“I exercise even though I have chronic pain”) was omitted from the survey as a result of an error in building the survey.

**Self-efficacy for Exercise**

How confident are you right now that you could exercise three times per week for 20 minutes if:

	0 - Not confident	1	2	3	4	5	6	7	8	9	10 - Very confident
the weather was bothering you	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
you were bored by the program or activity	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
you felt pain when exercising	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
you had to exercise alone	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
you did not enjoy it	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
you were too busy with other activities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
you felt tired	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
you felt stressed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
you felt depressed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Arthritis Self-efficacy Scale**

For each of the following questions, please select the number that corresponds to how certain you are that you can do the following tasks regularly at the present time.

0 - Very uncertain      1   2   3   4   5   6   7   8   9   10 - Very certain

How certain are you that you can decrease your pain quite a bit?           

How certain are you that you can continue most of your daily activities?           

How certain are you that you can keep arthritis pain from interfering with your sleep?           

How certain are you that you can make a small-to-moderate reduction in your arthritis pain by using methods other than taking extra medication?           

0 - Very uncertain      1      2   3   4   5   6   7   8   9   10 - Very certain

How certain are you that you can make a large reduction in your arthritis pain by using methods other than taking extra medication?                 

How certain are you that you can walk 100

feet on flat ground in 20 seconds?

How certain are you that you can walk 10 steps downstairs in 7 seconds?

How certain are you that you can get out of an armless chair quickly, without using your hands for support?

How certain are you that you can button and unbutton 3 medium-sized buttons in a row in 12 seconds?

0 - Very uncertain      1      2      3      4      5      6      7      8      9      10 - Very certain

How certain are you that you can cut 2 bite-size pieces of meat with a knife and fork in 8 seconds?

How certain are you that you can turn an outdoor faucet all the way on and all the way off?

How certain are you that you can scratch your upper back with both your right and left hands?

How certain are you that you can get in and out of the passenger side of a car without assistance from another person and without physical aids?

How certain are you that you can put on a long-



sleeve front-opening shirt or blouse (without buttoning) in 8 seconds?

	0 - Very uncertain	1	2	3	4	5	6	7	8	9	10 - Very certain
How certain are you that you can control your fatigue?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How certain are you that you can regulate your activity so as to be active without aggravating your arthritis?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How certain are you that you can do something to help yourself feel better if you are feeling blue?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
As compared with other people with arthritis like yours, how certain are you that you can manage arthritis pain during your daily activities?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How certain are you that you can manage your arthritis symptoms so that you can do the things you enjoy doing?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How certain are you that you can deal with the frustration of arthritis?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

## **Time 2 measures:**

### **Exercise**

We would like you to think about your exercise history. As an accurate reporting of your exercise is one key to our research, please carefully read the following: **ONLY** think about exercise that you planned to do in your free time during your day. This means that you scheduled/planned it and set time aside in your day to exercise. We also want you to think about your planned exercise that you did for **AT LEAST 15 minutes or more at ONE TIME**. Some examples of exercise: You may be registered in a swim/aerobics class at a local gym – this means that you have plans to exercise on each day that your class takes place in a week. Exercise may also be planned when you get up in the morning – you notice it is nice outside and you plan to walk outside. The **KEY** is that you **PLAN TO EXERCISE in ADVANCE and SET TIME ASIDE in your FREE TIME to EXERCISE FOR 15 minutes or more**. We understand that you may do other types of exercise, like walking while doing groceries, have a physically demanding job, or you may do planned exercise for less than 15 minutes at one time. These types exercise are not the focus of our research.

With this in mind, please think about 2 types of planned exercise: (1) Moderate and (2) Vigorous. Moderate Exercise makes your heart beat faster and makes you breathe a little harder. You can **TALK** easily while doing moderate exercise, but you may not be able to sing comfortably. Vigorous Exercise makes your heart beat much faster. You may not be able to talk comfortably without stopping to catch your breath. Intensity can be estimated using a scale of 0 to 10, where sitting is 0 and 10 is the highest level of effort possible. Moderate intensity exercise is a 5 or 6. Vigorous intensity exercise is a 7 or 8.

Please find definitions for moderate and vigorous physical activity at the bottom of this page if you wish to refer back to them

Think about the last 2 weeks (14 days). Did you do any planned moderate or vigorous exercise for at least 15 minutes at one time during your free time?

- Yes
- No

On average, how many days in each 7-day period (1 week) did you actually do **MODERATE** exercise for at least 15 minutes continuous minutes during your free time? Check **✓**one only:

- 0 days in a week
- 1 day in a week
- 2 days in a week
- 3 days in a week

- 4 days in a week
- 5 days in a week
- 6 days in a week
- 7 days in a week

How many TOTAL MINUTES were you doing planned moderate exercise in a typical day? For example, you may have done two walks of 20 minutes each – so you would put 40 minutes below. Or you may have walked or done another type of moderate exercise for 35 minutes at one time – so you would put 35 below.

Total minutes in a typical day (remember – only think about those times when you did 15 or more minutes)

What kinds of moderate exercise did you do? Check  all that apply:

- Walk
- Swimming class
- Swim laps
- Bike
- Land-based exercise class
- Other (what was it?) \_\_\_\_\_

Think about the last 2 weeks (14 days). Did you do any planned vigorous exercise for at least 15 minutes at one time during your free time?

- Yes
- No

Please think about the last 2 weeks (14 days). On average, how many days in each 7-day period (1 week) did you actually do VIGOROUS exercise for at least 15 continuous minutes during your free time? Check  one only:

- 0 days in a week
- 1 day in a week
- 2 days in a week
- 3 days in a week
- 4 days in a week

- 5 days in a week
- 6 days in a week
- 7 days in a week

How many TOTAL MINUTES were you doing your planned vigorous exercise in a typical day?

Total minutes in a typical day (remember – only think about those times when you did 15 or more minutes)

What kinds of vigorous exercise did you do? Check  all that apply:

- Walk
- Swimming class
- Swim laps
- Bike
- Land-based exercise class
- Other (what was it?) \_\_\_\_\_

Moderate Exercise makes your heart beat faster and makes you breathe a little harder. You can TALK easily while doing moderate exercise, but you may not be able to sing comfortably. Vigorous Exercise makes your heart beat much faster. You may not be able to talk comfortably without stopping to catch your breath. Intensity can be estimated using a scale of 0 to 10, where sitting is 0 and 10 is the highest level of effort possible. Moderate intensity exercise is a 5 or 6. Vigorous intensity exercise is a 7 or 8.

**Confidence to schedule and plan exercise**

These questions have to do with your confidence to schedule and plan your exercise. Please report your confidence in doing each of the following in the next 2 weeks (14 days):

	0 - Not at all confident	1	2	3	4	5 - Moderately confident	6	7	8	9	10 - Entirely confident
Make your planned exercise a value/priority each week	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Plan and prepare in advance so that nothing interferes with your planned exercise each week	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Rearrange your schedule so that you can fit your planned exercise into your day	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Make sure you do not miss a whole week of your planned exercise over the next 2 weeks (14 days)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	0 - Not at all confident	1	2	3	4	5 - Moderately confident	6	7	8	9	10 - Entirely confident
Take time out for yourself and exercise as planned regardless of your other commitments	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Find a time to do your planned exercise that	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

most suitably fits  
your lifestyle

Put in 4 or more planned exercise sessions in a week

Exercise at the times you have planned

Change your planned exercise when needed, such as when you have plans to walk for 30 minutes but you can only fit in a walk for 20 minutes

**Appendix D – Mean scores for those who completed all time points and those who did not  
in Study 3**

*Time 1 means for those that completed all time points and those that did not*

Dependent Variable	Completed all time points ( <i>n</i> = 130) <i>M</i> ± <i>SD</i>	Dropouts ( <i>n</i> = 36) <i>M</i> ± <i>SD</i>
Age	34.42 ± 14.80	33.03 ± 13.45
SRE-SP**	6.61 ± 2.53	5.13 ± 2.44
SRE-SP for guidelines levels of exercise**	6.38 ± 3.27	4.20 ± 3.40
SEE*	6.29 ± 2.37	5.14 ± 2.43
CPAQ-E total score**	67.29 ± 20.40	56.39 ± 22.78
CPAQ-E pain willingness	29.13 ± 10.43	25.31 ± 10.58
CPAQ-E activities engagement**	38.16 ± 12.77	31.08 ± 15.59
Pain intensity	5.49 ± 1.57	5.63 ± 1.89
MVPA absolute weekly minutes*	303.08 ± 371.48	163.17 ± 278.25
MVPA weekly minutes (vigorous minutes doubled)	419.91 ± 624.26	206.33 ± 385.91

Note: SRE-SP = Self-regulatory efficacy to schedule and plan exercise. SEE = Self-efficacy for exercise. CPAQ-E = Chronic pain acceptance questionnaire for exercise. MVPA = Moderate to vigorous physical activity. \* =  $p < .05$ , \*\* =  $p < .01$ .



**Appendix E – Factor loadings for CPAQ-E in Study 3 sample**

*Factor loadings for the CPAQ-E*

<b>Item description</b>	<b>Factor one</b>	<b>Factor two</b>
1. I am getting on with my exercise plans no matter what my level of pain is. <sup>a</sup>	<b>.90</b>	-.08
2. My exercise is going well, even though I have chronic pain. <sup>a</sup>	<b>.89</b>	.01
3. It's OK to experience pain during exercise. <sup>a</sup>	<b>.52</b>	.04
4. I would gladly sacrifice exercise to control this pain better. <sup>b</sup>	.28	<b>.36</b>
5. It's not necessary for me to control my pain in order to exercise. <sup>a</sup>	<b>.39</b>	.24
6. Although things have changed, I am able to exercise despite my chronic pain. <sup>a</sup>	<b>.84</b>	.06
7. I need to concentrate on getting rid of my pain before I can exercise. <sup>b</sup>	.33	<b>.42</b>
8. There are many activities I do when I feel pain, such as exercise. <sup>a</sup>	<b>.70</b>	-.15
9. I exercise even though I have chronic pain. <sup>a</sup>	<b>.89</b>	-.03
10. Controlling pain is less important than exercise. <sup>a</sup>	.13	.29
11. My thoughts and feelings about pain must change before I can exercise. <sup>b</sup>	.30	<b>.49</b>
12. Despite the pain, I am now sticking to my exercise plans. <sup>a</sup>	<b>.88</b>	.01
13. Keeping my pain level under control takes first priority, above exercising. <sup>b</sup>	.24	<b>.71</b>
14. Before I can make any serious exercise plans, I have to get some control over my pain. <sup>b</sup>	.36	<b>.62</b>
15. When my pain increases, I can still exercise. <sup>a</sup>	<b>.76</b>	.22
16. I will have better control over my exercise plans if I can control my negative thoughts about pain. <sup>b</sup>	-.23	<b>.43</b>

Item description	Factor one	Factor two
	$\lambda$	$\lambda$
17. I avoid putting myself in exercise situations where my pain might increase. <sup>b</sup>	.01	<b>.65</b>
18. My worries and fears about what exercise-related pain will do to me are true. <sup>b</sup>	-.05	<b>.74</b>
19. It's a relief to realize that I don't have to change my pain to get on with my exercise plans. <sup>a</sup>	<b>.60</b>	.09
20. I have to struggle to do exercise when I have pain. <sup>b</sup>	.00	<b>.80</b>

Note: Boldfaced coefficients represent loadings retained for each factor.

<sup>a</sup>Activities engagement subscale

<sup>b</sup>Pain willingness subscale

## **Appendix F – Study 3 measures**

## **Time 1 measures**

### **Exercise weekly personal goal**

Thank you for telling us about the planned physical activity you have done in a typical week during the past month. Now, we would like to know how much exercise you PLAN to do for each week over the next month. For this part of the study, we are still only asking about the exercise that you PLAN to do that lasts at least 30 minutes and is at least moderate intensity (see definition below). In this box, indicate the number of days you plan to exercise in a typical upcoming week (e.g., 3 days).

In this box, indicate the typical number of minutes you plan to do in a typical session of exercise on the days for which you are planning (e.g. 40 minutes)

### Definitions

Moderate Exercise makes your heart beat faster and makes you breathe a little harder. You can TALK easily while doing moderate exercise, but you may not be able to sing comfortably. Vigorous Exercise makes your heart beat much faster. You may not be able to talk comfortably without stopping to catch your breath. Intensity can be estimated using a scale of 0 to 10, where sitting is 0 and 10 is the highest level of effort possible. Moderate intensity exercise is a 5 or 6. Vigorous intensity exercise is a 7 or 8.

**Confidence to schedule and plan exercise**

These questions have to do with your confidence to schedule and plan your exercise. If you do not currently exercise, please imagine that you are planning to do so over the next 4 weeks. Then, provide your answer to these questions as if you have decided to exercise regularly over the next 4 weeks. Please report your confidence in doing each of the following:

	0 -	1	2	3	4	5 -	6	7	8	9	10 -
	Not					Moderately					Entirely
	at all					confident					confident
	confi					dent					
Make your planned exercise a value/priority each week	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Plan and prepare in advance so that nothing interferes with your planned exercise each week	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Rearrange your schedule so that you can fit your planned exercise into your day	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Make sure you do not miss a whole week of your planned exercise over the next 4 weeks (28 days)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	0 -	1	2	3	4	5 -	6	7	8	9	10 -
	Not					Moderately					Entirely
	at all					confident					confident
	confi					dent					
Take time out for yourself and exercise as planned regardless of your other commitments	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Find a time to do your planned exercise that most suitably fits your lifestyle

Complete all of your planned exercise sessions in a week

Exercise at the times you have planned

Change your planned exercise when needed, such as when you have plans to walk for 30 minutes but you can only fit in a walk for 20 minutes

### **Confidence to schedule and plan exercise at public health exercise recommendation levels**

Thank you for telling us about your confidence to schedule and plan YOUR weekly planned exercise. We would like you to think about your confidence for your planning and scheduling once more but this time to manage the following amount of exercise. You only need to answer with one value. Thinking about your planning and scheduling, how confident are you that you could complete 150 minutes of moderate to vigorous exercise in your typical week in the next 4 weeks (for example, 5 days at 30 continuous minutes per day). Please rate your confidence to manage this amount of exercise in your typical week

- 0 - Not at all confident
- 1
- 2
- 3
- 4
- 5 - Moderately confident
- 6
- 7
- 8
- 9
- 10 - Entirely confident



### **Chronic pain acceptance questionnaire for exercise**

Below you will find a list of statements. Please rate the truth of each statement as it applies to you and your chronic pain.

	Never true	Very rarely true	Seldom true	Sometimes true	Often true	Almost always true	Always true
I am getting on with my exercise plans no matter what my level of pain is.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My exercise is going well, even though I have chronic pain.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It's OK to experience pain during exercise.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would gladly sacrifice exercise to control this pain better.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	Never true	Very rarely true	Seldom true	Sometimes true	Often true	Almost always true	Always true
It's not necessary for me to control my pain in order to exercise.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Although things have changed, I am able to exercise despite my chronic pain.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I need to concentrate on getting rid of my pain before I can exercise.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

There are many activities I do when I feel pain, such as exercise.

I exercise even though I have chronic pain

Never true    Very rarely true    Seldom true    Sometimes true    Often true    Almost always true    Always true

Controlling pain is less important than exercise.

My thoughts and feelings about pain must change before I can exercise.

Despite the pain, I am now sticking to my exercise plans.

Keeping my pain level under control takes first priority, above exercising.

Before I can make any serious exercise plans, I have to get some control over my pain.

Never true    Very rarely true    Seldom true    Sometimes true    Often true    Almost always true    Always true

When my pain increases, I can still exercise.

- I will have better control over my exercise plans if I can control my negative thoughts about pain.
- I avoid putting myself in exercise situations where my pain might increase.
- My worries and fears about what exercise-related pain will do to me are true.
- It's a relief to realize that I don't have to change my pain to get on with my exercise plans.
- I have to struggle to do exercise when I have pain.

**Self-efficacy for exercise**

How confident are you right now that you could exercise three times per week for 20 minutes if:

	0 - Not confident	1	2	3	4	5	6	7	8	9	10 - Very confident
the weather was bothering you	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
you were bored by the program or activity	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
you felt pain when exercising	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
you had to exercise alone	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
you did not enjoy it	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
you were too busy with other activities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
you felt tired	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
you felt stressed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
you felt depressed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Time 2 measures**

**Coping Strategies – single item versions**

Thinking about your exercise over the last 2 weeks, how would you describe your style of managing exercise while in pain (please rate how well each describes you)?

If you do not currently exercise, please try to answer these questions as if you were exercising. It will help us understand how you might react to being in pain and trying to exercise.

	0	1	2	3	4	5	6	7	8	9	10
	Does not describe me at all										Describes me perfectly
To avoid exercise while in pain	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To exercise as planned anyway, making no changes to your plans	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To alter your exercise plans in some way that allows you to still exercise but just not as you originally planned (e.g., for less time, less intense, different type of exercise, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Coping strategies - scales**

We are now interested in what you do about your planned moderate to vigorous exercise when you are in pain. We would like you to rate the extent to which you do each of the following about your planned exercise when you have pain. Please think about your exercise over the past 2 weeks when answering. If you do not currently exercise, please try to answer these questions as if you were exercising. It will help us understand how you might react to being in pain and trying to exercise.

	0	1	2	3	4	5	6	7	8
	Never				Do				Always
	do this				this				do this
					about				
					half the				
					time				
ALTERNATE the TYPE of EXERCISE that you planned on doing (for example, swim one day, walk another day; do different exercises on the same day).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
You DO SOMETHING ELSE that you ENJOY (like watch tv, go to a movie, shop, listen to music, etc.).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Do ALL OF YOUR SCHEDULED/PLANNED exercise, regardless of your pain	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
You FEEL LIKE YOU CAN'T GO ON so you STOP doing your planned exercise.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
TAKE PAIN MEDICATION (e.g., ibuprofen, Tylenol, prescriptions, etc.) so that you do exercise as planned.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
You STOP doing ALL of your planned exercise.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Do LESS EXERCISE than you planned (for example, you exercise for 25 minutes instead of the originally planned 45 minutes).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
You ARE OVERWHELMED and you STOP doing your planned exercise.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

You DO OTHER THINGS WITH YOUR FRIENDS/FAMILY instead of your planned exercise.              

Change the TYPE of EXERCISE you planned (e.g., you choose exercises that are easier on your body, like walking instead of jogging; swimming instead of walking).              

You make efforts to relax to reduce tension, so that you can exercise.              

USE HEAT OR ICE before/after your planned exercise.

## Time 3 measures

### Exercise

We would like you to think about your exercise history. As an accurate reporting of your exercise is one key to our research, please carefully read the following: ONLY think about exercise that you planned to do in your free time during your day. This means that you scheduled/planned it and set time aside in your day to exercise. We also want you to think about your planned exercise that you did for AT LEAST 30 minutes or more at ONE TIME. Some examples of exercise: 1) You may be registered in a swim/aerobics class at a local gym – this means that you have plans to exercise on each day that your class takes place in a week. 2) Exercise may also be planned when you get up in the morning – you notice it is nice outside and you plan to walk outside. You could have done this continuously or may have taken short rests of 2 minutes before continuing. Whatever your method, we are interested in that planned 30 minutes that you set aside. The KEY is that you PLAN TO EXERCISE in ADVANCE and SET TIME ASIDE in your FREE TIME to EXERCISE FOR 30 minutes or more. What we are not investigating: We understand that you may do other types of physical activity, like walking while doing groceries, have a physically demanding job, or you may do planned exercise for less than 30 minutes at one time. These types exercise are not the focus of our research.

### Definitions

With this in mind, please think about 2 types of planned exercise: (1) Moderate and (2) Vigorous. Moderate Exercise makes your heart beat faster and makes you breathe a little harder. You can TALK easily while doing moderate exercise, but you may not be able to sing comfortably. Vigorous Exercise makes your heart beat much faster. You may not be able to talk comfortably without stopping to catch your breath. Intensity can be estimated using a scale of 0 to 10, where sitting is 0 and 10 is the highest level of effort possible. Moderate intensity exercise is a 5 or 6. Vigorous intensity exercise is a 7 or 8.

Please find definitions for moderate and vigorous physical activity at the bottom of this page if you wish to refer back to them

Think about the last 2 weeks (14 days). Did you do any planned moderate or vigorous exercise for at least 30 minutes at one time during your free time?

- Yes
- No

Consider a typical week (7 days) in the last 14 days. During that typical week, how many days did you actually do MODERATE exercise for at least 30 minutes continuous minutes during your free time? Check ✓one only: (we will ask about vigorous exercise in a later question so please only think about moderate exercise for this question)



- 0 days in a week
- 1 day in a week
- 2 days in a week
- 3 days in a week
- 4 days in a week
- 5 days in a week
- 6 days in a week
- 7 days in a week

In a typical day, how many TOTAL MINUTES were you doing planned moderate exercise ? For example, you may have done two walks of 30 minutes each – so you would put 60 minutes below. Or you may have walked or done another type of moderate exercise for 35 minutes at one time – so you would put 35 below.

Total minutes in a typical day (remember – only think about those times when you did 30 or more minutes)

What kinds of moderate exercise did you do? Check  all that apply:

- Walk
- Swimming class
- Swim laps
- Bike
- Land-based exercise class
- Other (what was it?) \_\_\_\_\_

Think about the last 2 weeks (14 days). Did you do any planned vigorous exercise for at least 30 minutes at one time during your free time?

- Yes
- No

Consider a typical week (7 days) in the last 14 days. During that typical week, how many days did you actually do VIGOROUS exercise for at least 30 continuous minutes during your free time? Check  one only:

- 0 days in a week

- 1 day in a week
- 2 days in a week
- 3 days in a week
- 4 days in a week
- 5 days in a week
- 6 days in a week
- 7 days in a week

In a typical day, how many TOTAL MINUTES were you doing your planned vigorous exercise?

Total minutes in a typical day (remember – only think about those times when you did 30 or more minutes)

What kinds of vigorous exercise did you do? Check  all that apply:

- Walk
- Swimming class
- Swim laps
- Bike
- Land-based exercise class
- Other (what was it?) \_\_\_\_\_

#### Definitions

Moderate Exercise makes your heart beat faster and makes you breathe a little harder. You can TALK easily while doing moderate exercise, but you may not be able to sing comfortably. Vigorous Exercise makes your heart beat much faster. You may not be able to talk comfortably without stopping to catch your breath. Intensity can be estimated using a scale of 0 to 10, where sitting is 0 and 10 is the highest level of effort possible. Moderate intensity exercise is a 5 or 6. Vigorous intensity exercise is a 7 or 8.