INVESTIGATING THE EFFECTS OF MODELING AND IMAGERY ON PSYCHOLOGICAL FACTORS IN THE CONTEXT OF A HYPOTHETICAL ANTERIOR CRUCIATE LIGAMENT INJURY

by

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Abstract

In 2009, 4.1 million Canadians over the age of twelve experienced an activity-limiting injury. Of these injuries 35% occurred from sport or physical activity (Canadian Community Health Survey, 2009). Although injuries occur most commonly in sport and exercise activities, it is difficult to study injured athletes with similar injuries all occurring within the same time frame. Therefore, a scenario protocol was used in the study which described the occurrence of an anterior cruciate ligament (ACL) injury. The purpose of this study was to compare a modeling, an imagery, and a control group on psychological factors related to a hypothetical injury. Healthy athletes (*N*=86; *M* age = 22.06 years; *SD* = 4.37) who had no recent experience of an injury and had not experienced an ACL injury were included in the study. At baseline, athletes read a scenario that described the occurrence of an ACL injury. Participants then completed questionnaires including, demographic information, expected pain, task and coping efficacy, projected rehabilitation adherence, and movement imagery ability. Within two weeks of completing the baseline testing, participants were randomly assigned to one of three conditions: control, modeling, or imagery. Participants either met with the primary researcher or were sent a link via email in order to complete the follow-up. At the beginning of the follow-up, all groups were given the scenario to read over. Then participants were given the respective treatment. The modeling condition consisted of a video of an athlete who described his experience of an ACL repair. The guided imagery condition involved a recorded script that detailed the recovery process of an ACL injury. The control condition only read the scenario. Afterwards, participants completed the questionnaires involving expected pain, task and coping efficacy, and rehabilitation adherence. Four separate 3 (group) x 2 (time) repeated measures ANOVAs and two ANCOVAs were conducted to examine between group differences in athletes' perceptions of pain, task and coping efficacy, and rehabilitation adherence before and after the intervention was administered. No group by time interactions were found for any of the dependent variables. However, there were changes over time for pain, $F(1, 81) = 5.97$, $p = .017$, $\eta^2 = .07$, task efficacy, $F(1, 79) = 193.23$, $p < .001$, $\eta^2 = .53$, coping efficacy, $F(1, 79) = 11.16$, $p = .001$, $\eta^2 = .08$, and frequency of adherence, $F(1, 32) = 5.17$, $p = .03$, $\eta^2 = .14$. Findings from manipulation check questions suggest that modeling and imagery could serve as pre-injury education tools for athletes to use if they are faced with an injury in the future.

Key Words: modeling, imagery, athletic rehabilitation, self-efficacy, scenario-based research

Co-Authorship

This thesis presents the original work of Renee L. Bolkowy in collaboration with her advisors, Dr. Barbi Law and Dr. Amy Latimer.

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Table of Contents

List of Figures

List of Tables

Chapter 1

Introduction

1.1 Overview

Injuries frequently occur in sport. In 2009, 4.1 million Canadians over the age of twelve experienced an activity-limiting injury. Of these injuries, 35% occurred from sport or physical activity (Canadian Community Health Survey, 2009). Injuries occur most commonly in sport and exercise activities (Canadian Community Health Survey). Physical recovery from a sports injury is important to focus on during rehabilitation; however, psychological recovery should be considered of equal importance. Being mentally ready to return to sport following an injury is essential for an athlete at any level.

It is well established that athletes who use psychological skills during training and competition show improvements in competitive performance (Van Raalte, Brewer, Rivera, & Petitpas, 1994), confidence (Vealey, Hayashi, Garner-Holman, & Giacobbi, 1998), and arousal regulation (Vadocz, Hall, & Moritz, 1997). Although the evidence is limited, researchers have found that implementing psychological skills during athletic injury rehabilitation may afford many benefits such as maintaining motivation to rehabilitation and positive attitudes towards recovery (Driediger, Hall, & Callow, 2006; Ievleva & Orlick, 1991). Two psychological strategies which are commonly used in sport are modeling (e.g., Wesch, Law, & Hall, 2007) and imagery (e.g., Arvinen-Barrow, Weigand, Thomas, Hemmings, & Walley, 2007). Modeling is learning through watching a desired behaviour. Imagery involves generating images within one's mind about desired behaviours or outcomes. Despite the common use of these two strategies in sport, there is minimal research conducted on the utility of these strategies within athletic rehabilitation. Furthermore, the two strategies have not been compared within a single study in sport injury research. Researchers have suggested these strategies share similar cognitive processes and may also produce similar psychological and physical performance benefits (Ram, Riggs, Skaling, Landers, & McCullagh, 2007). Despite the fact they share similarities, the two strategies are often studied separately and are rarely compared within a single study. Thus, a study comparing these two strategies will provide insight into whether both strategies are equally effective in the situation of a hypothetical injury. My thesis project addresses this gap in the literature by comparing a modeling and an imagery intervention for recovery from a hypothetical injury to a control condition.

Implementing psychological strategies such as modeling and imagery during rehabilitation may influence an athlete’s perception of an injury in a more positive manner. For example, the two strategies can increase levels of self-efficacy during rehabilitation (Bandura, 1997; Maddison, Prapavessis, & Clatworthy, 2006; Sordoni, Hall, & Forwell, 2002). Furthermore, if an injured athlete experiences increases in self-efficacy during rehabilitation, this may lead to improvements in other areas of rehabilitation such as, increased adherence to the rehabilitation program and reduced perceptions of pain. Adherence to rehabilitation is key for a successful recovery making low adherence to physiotherapy an issue (Scherzer, Brewer, Cornelius, Van Raalte, Petitpas, Sklar, Pohlman, Krushell, & Ditmar, 2001).

A difficulty that athletic injury researchers face is being able to recruit enough athletes who experience the same injury occurring within the same time frame in a single study. Many different types of sport-related injuries can occur and those injuries have varying levels of severity. The amount of time an injured athlete will spend receiving physiotherapy treatment varies due to the type of injury. In addition, different injuries can illicit different responses among individuals. To control for these factors, researchers have employed scenario-based studies to examine uninjured athletes' perceptions of injury recovery (e.g., Damato, 2007). Using a scenario protocol requires an individual to imagine the situation is happening to him or her and then make judgments about how he or she would respond in the specific situation. Because of the strengths of scenario-based research, I have selected to use this research method for my thesis.

1.2 Primary Objectives and Hypotheses

The purpose of this study was to compare the effects of a modeling intervention, an imagery intervention, and a control condition on athletes' perceptions of psychological and adherence outcomes associated with injury recovery in the context of a hypothetical scenario of sustaining an injury. This study examines the effects of modeling and imagery on athletes' perceptions of their ability to cope with an injury. Specifically, the aim of the study was to examine athletes' perceptions of pain, self-efficacy, and rehabilitation adherence when faced with a hypothetical anterior cruciate ligament (ACL) injury. It was hypothesized that participants who watched a coping model video or engaged in guided imagery would demonstrate increases in task and coping efficacy, whereas the control group that would not show changes. According to Bandura (1997) these strategies are sources of self-efficacy. Also, previous research findings indicate that modeling and imagery use during rehabilitation increase self-efficacy (Maddison et al., 2006; Milne, Hall, & Forwell, 2005). In addition, it was hypothesized that the two intervention groups would report greater rehabilitation adherence than participants in the control condition (Milne et al.). Finally, based on previous research findings (Law, Driediger, Hall, & Forwell, 2006; Maddison et al., 2006) it was expected the modeling group and the imagery group would have lower perceptions of expected pain compared to the control group. No distinct hypothesis was made between the modeling and imagery groups because of the limited amount of research comparing the two strategies.

1.3 Thesis Organization

This thesis conforms to the regulations outlined in the Queen's School of Graduate Studies and Research "General Forms of Theses." Chapter two provides an in-depth review of relevant literature. Chapter three details the methods used for the study. Results are discussed within chapter four, and chapter five describes the contributions of the study and the general conclusions that can be drawn from the thesis. All cited works are listed at the back of the document. The appendix section of this thesis includes the hypothetical anterior cruciate ligament (ACL) injury scenario, as well as materials used to conduct this study.

Chapter 2

Literature Review

2.1 Overview of Psychological Strategies and Athletic Injury

In 2009, 4.1 million Canadian over the age of twelve experienced an activity-limiting injury. More than a third of these injuries occurred from sport or physical activity (Canadian Community Health Survey, 2009). Injuries are more common in sport than at work, leisure, or home (Wilkins & Park, 2004). Despite preventive efforts, injuries will never entirely be eliminated. A common sport injury is a disruption or tear of the anterior cruciate ligament (ACL; DeCarlo, Sell, Shelbourne, & Klootwyk, 1994). The ACL is an important ligament in the knee that provides stability and minimizes stress on the knee joint. An ACL injury may occur in a variety of sports, particularly those that involve pivoting, jumping, and cutting (e.g., soccer, football, basketball). An ACL injury is considered to be one of the more devastating sport injuries (DeCarlo et al.; Derscheid & Fering, 1987). Often individuals who tear their ACL require reconstructive surgery and are unable to participate in sport for four to nine months (DeCarlo et al., 1994). In order to attempt to enhance an athlete's recovery from a debilitating injury such as an ACL tear, researchers have begun to investigate the potential to apply psychological strategies to the athletic rehabilitation realm.

Injuries not only cause physical damage, but they can also impact an individual psychologically. Research indicates that the use of psychological strategies (i.e., skills that improve performance, maintain focus, regulate arousal) during rehabilitation has both psychological and physical recovery benefits for injured athletes (e.g., Ievleva & Orlick, 1991). Among the strategies that have been examined are: goal-setting (e.g., Evans & Hardy, 2002), self-talk (e.g., Ievleva & Orlick), relaxation (e.g., Cupal & Brewer, 2001), modeling (Flint, 1991; Maddison et al., 2006), and imagery (e.g., Driediger et al., 2006). Using psychological strategies leads to increased self-efficacy for recovery, which is an important psychological factor when sustaining an injury (Evans & Hardy; Maddison, et al.; Milne et al., 2005; Sordoni et al., 2002). Self-efficacy is an individual's beliefs in his or her ability to execute the behaviour that is necessary to produce desired outcomes (Bandura, 1997). Other psychological recovery benefits from using strategies while injured include decreased perceptions of pain (Cupal & Brewer; Law et al., 2006; Maddison et al.) and greater satisfaction with a rehabilitation program (Law et al.). A behaviour that may be improved from using psychological strategies during recovery is increased adherence to the rehabilitation program (Evans & Hardy). Physical recovery benefits associated with using psychological strategies during athletic rehabilitation include shorter recovery times (Ievleva & Orlick) and increased functioning of the injured limb (Cupal & Brewer; Maddison et al.; Thomeé, Währborg, Börjesson, Thomeé, Eriksson, & Karlson, 2008). This range of successful outcomes from research studies suggests the importance of using psychological strategies during rehabilitation. This thesis focuses on two strategies, specifically modeling and imagery. Before I review each of the strategies, I describe the theoretical framework guiding my thesis.

2.2 Theoretical Framework

2.2.1 Stage Models

Some research within athletic rehabilitation has incorporated models and theories; however in some cases the models or theories have not been sport-specific. Researchers have attempted to describe athletes' responses to injuries through psychologically-based stage models (see Evans & Hardy, 1995, for a review). For example, Kübler-Ross' (1969) stage model describing terminally ill patients' reactions to their illness has been adapted to the area of athletic injury. Within this stage model there are five reactions: denial, anger, bargaining, depression, and acceptance (Figure 1).

There has been controversy about whether this model should be applied to sport injury because it was developed for patients who were facing life-threatening illnesses. Researchers have suggested that individuals who are facing a life-threatening illness experience different emotional responses, compared to athletes who are experiencing an injury (Morrey, Stuart, Smith, & Wiese-Bjornstal, 1999). The suggestion that athletes' responses differ from those of patient populations has led researchers to develop more appropriate sport injury models.

Through his work with injured athletes, Heil (1993) developed an affective cycle model (Figure 2). This model incorporates phases or cycles instead of stages, in which an athlete can skip phases based on his or her progress in rehabilitation. Heil's model suggests an athlete's recovery involves three processes: distress, denial, and determined coping. Heil suggests that this model is different from a stage model because athletes can go back and forth between phases based on their recovery process. Whereas in the stage model it is suggested that an individual strictly goes through the stages in order. Since the affective cycle model only describes three processes which athletes experience in rehabilitation, it fails to explain why individuals might experience other emotions aside from distress, denial, and determined coping. In addition, Heil's model does not explain how interventions may influence coping and adherence to rehabilitation; therefore, it is not useful in guiding intervention studies. Also, the affective cycle model does not describe how changes in cognitions and behaviours occur, or how emotions impact thoughts and behaviours.

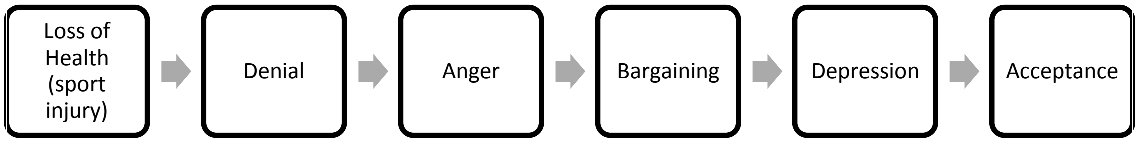

Figure 1. Kübler-Ross’ stage model (1969)

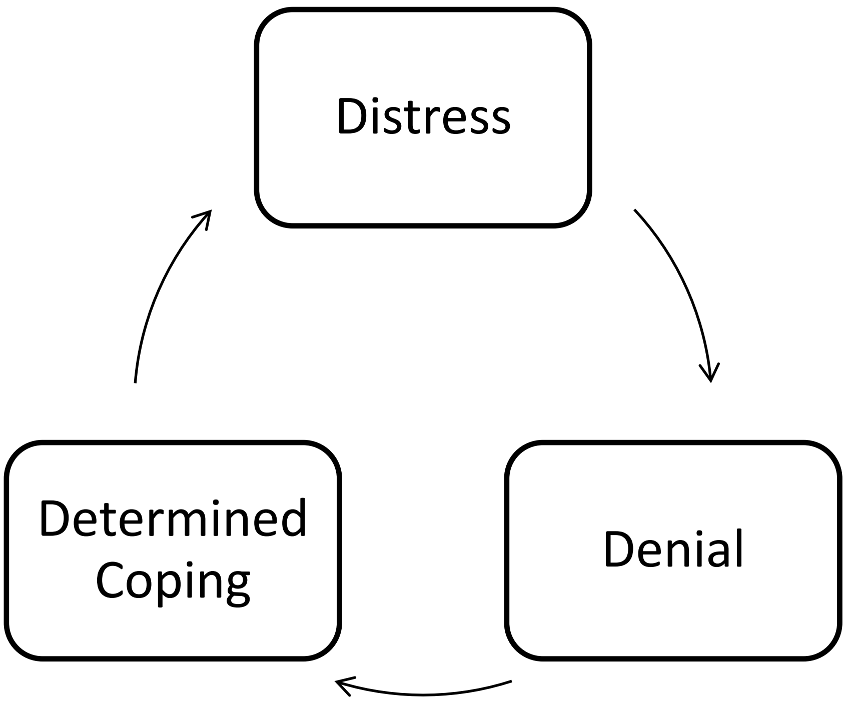

Figure 2. Heil’s affective cycle model (1993)

2.2.2 Cognitive Appraisal Model

In order to address limitations of previous models, Wiese-Bjornstal, Smith, Shaffer, and Morrey (1998) developed a cognitive appraisal model of response to injury (Figure 3). The model is considered to be more dynamic in describing responses to injuries compared to stage-like models of sport injury. The cognitive appraisal model incorporates individual differences in terms of the recovery process, whereas stage models explain that injured athletes experience specific responses at certain times. Within the cognitive appraisal model, the researchers suggest that personal (e.g., injury severity, personality) and situational factors (e.g., sport type, rehabilitation environment) influence how an injured athlete cognitively appraises his or her injury. For example, an athlete experiencing a minor sprain (i.e., low severity) will most likely be able to cope with the idea of missing a game or two compared to an individual who will be out for the entire season due to a complete tear of a ligament (i.e., high severity). On the other hand, a situational factor such as the level at which the athlete competes could affect his or her cognitive appraisal. For instance, an athlete who competes at the varsity or provincial level may feel that his or her injury is more devastating than an athlete who plays a sport for recreation. Personal and situational factors, in turn influence emotional (e.g., anger, depression) and behavioural (e.g., rehabilitation adherence, pain management) responses.

The centre of the model focuses on the cognitive, emotional, and behavioural responses that potentially influence psychosocial and physical recovery outcomes. Unlike stage or process models, Wiese-Bjornstal and colleagues' (1998) model portrays more of a mind-body approach to describing an athlete's response to injury. Within the model, the researchers suggest that interventions that are delivered before the actual occurrence of an injury can influence an athlete's stress response to an injury. For example, pre-injury interventions that target sources of self-efficacy for recovery could potentially influence cognitive aspects of recovery and increase physical and psychological recovery outcomes from a future injury. This central component of the model is the basis for this thesis.

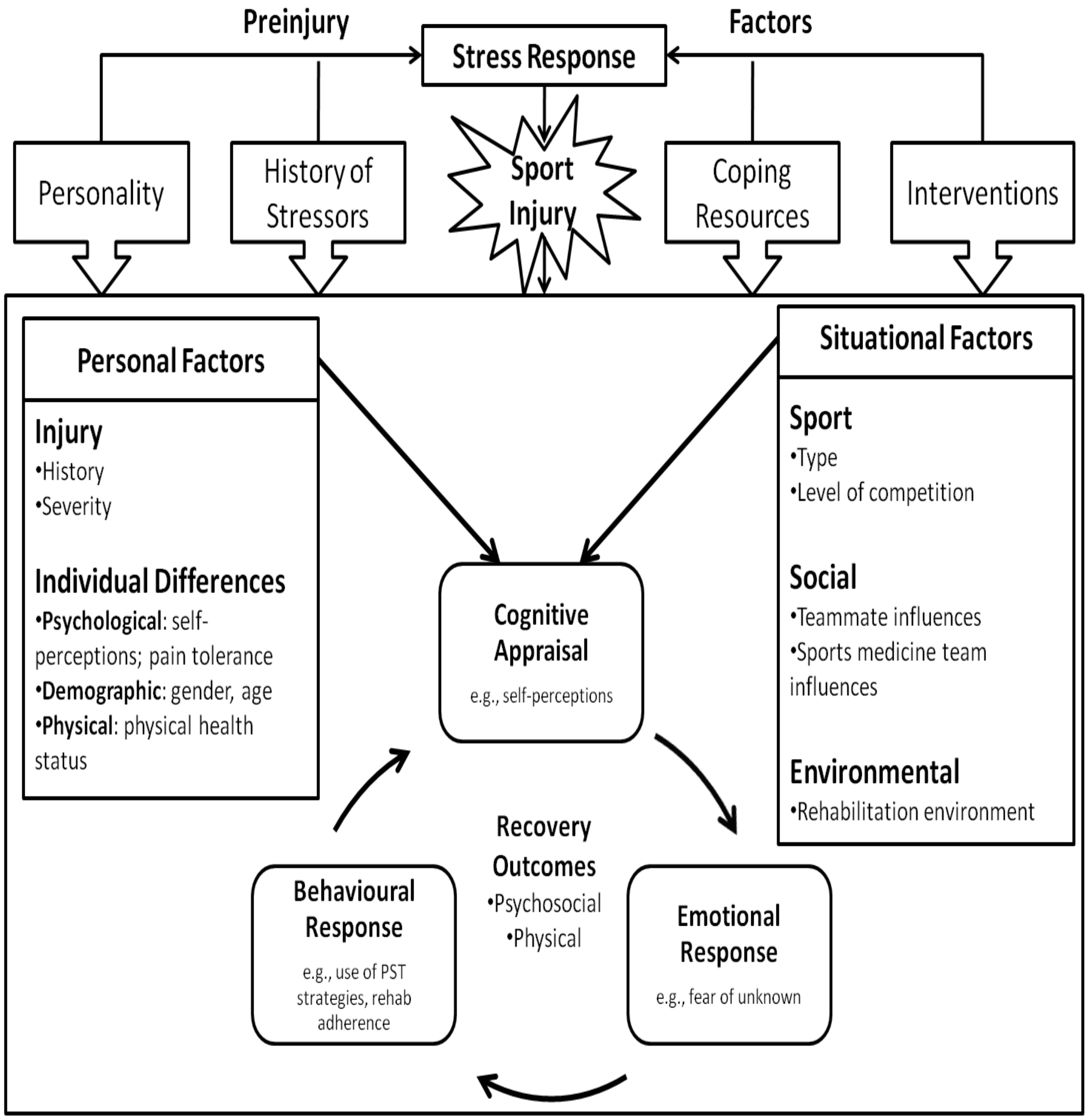

Figure 3. Response to injury model (Weise-Bjornstal, Smith, Shaffer, & Morrey, 1998)

Table 1. *Descriptions of models*

Model	Description
Stage Model	Predictable sequence of psychological responses
Cycle Model	May go back and forth between phases, based on progress in rehabilitation
Cognitive Appraisal Model	Dynamic factors which influence physical and psychosocial outcomes in response to injury

2.2.3 Self-Efficacy

In addition to the cognitive appraisal model, a component of social cognitive theory, self-efficacy, can also contribute to describing an injured athlete's progress during rehabilitation (Bandura, 1986; 1997). Self-efficacy is belief in one's ability to "organize and execute the courses of action required to produce given attainments" (Bandura, p. 3). Self-efficacy is considered to be confidence in a specific situation as opposed to self-confidence which is a more generalized belief. According to Bandura (1986), there are four sources of self-efficacy: mastery experiences, vicarious experiences, verbal persuasion, and physiological and affective states. Mastery experiences are based on an individual's past performances. Vicarious experiences include observing one's own behaviour or the behaviour of others and forming expectations of one's own behaviour. Verbal persuasion is often experienced through significant others expressing support for an individual's abilities. Physical and emotional states influence self-efficacy by how an individual interprets these states. For example, an athlete may interpret symptoms associated with a high arousal level (e.g., clammy hands, jitters) as nervousness because he or she is not prepared to compete. This perceived lack of preparation for competition may lead to decreases in self-efficacy. On the other hand, high arousal symptoms could be interpreted as positive energy because the athlete is excited to perform. This feeling of readiness may lead to greater levels of self-efficacy. The most influential source of self-efficacy is mastery experiences and secondly, vicarious experiences (Bandura, 1986).

Maddux (1995) stated that self-efficacy can take several forms in a given situation. Research conducted in Health and Exercise Psychology often uses measures of task and coping efficacy. Task efficacy is "an individual's confidence in the ability to perform the elemental aspects of a task" (Rodgers, Hall, Blanchard, McAuley, & Munroe, 2002, p. 406). For instance task efficacy is one's confidence in his or her ability to perform physiotherapist recommended rehabilitation exercises. Coping efficacy refers to "an individual's confidence in his or her ability to perform these tasks under challenging conditions" (Rodgers et al., p. 406). An example of coping efficacy is one's confidence in the ability to perform rehabilitation exercises through discomfort.

Self-efficacy is found to be associated with adherence to rehabilitation (Milne et al., 2005). Adherence is a rehabilitation-related outcome. According to Milne et al., rehabilitation adherence includes aspects of frequency, duration, and quality of physiotherapist recommended rehabilitation exercises. Both task and coping efficacy are predictors of duration of rehabilitation exercises (Milne et al.). Task efficacy is associated with quality of exercise and coping efficacy is associated with frequency (Milne et al.). Since task and coping efficacy show relationships linked to rehabilitation adherence, they are important to consider when assessing athletes' perceptions of an injury.

2.3 Overview of Modeling and Imagery

Two psychological strategies for increasing self-efficacy are modeling and imagery (Bandura, 1986; 1997). These two strategies are examined in this thesis and are reviewed thoroughly in the following sections. In sport, the use of modeling and imagery leads to increases in self-efficacy for performance among athletes (Beauchamp, Bray, & Albinson, 2002; Weiss, McCullagh, Smith, & Berlant, 1998). Modeling or observational learning is learning through watching a demonstration of a desired behaviour (i.e., external stimuli). In regards to sources of self-efficacy, modeling can be considered a mastery experience (e.g., watching a video tape of yourself), as well as a vicarious experience (e.g., watching someone else). Imagery, on the other hand, is generated internally, and can be defined as, "an experience that mimics real experience.

We can be aware of 'seeing' an image, feeling movements as an image, or experiencing an image of smell, tastes, or sounds without actually experiencing the real thing" (White & Hardy, 1998, p. 389). Imagery can also be considered both a vicarious experience (e.g., images of someone else, or the self succeeding in a new situation) and a mastery experience (e.g., images of past performances). Most often individuals will generate positive images of themselves performing a desired behaviour (Bandura, 1997).

2.3.1 Types of Models

Both modeling and imagery have been used as interventions in Health Psychology research. However, modeling has been examined less often even though it is considered to be a powerful learning strategy (McCullagh & Weiss, 2002). Through watching another individual's performance, an observer can acquire new thoughts and behaviours (Bandura, 1986). The individual who is performing a specific task represents a model. There are different types of models, including mastery and coping models. A mastery model demonstrates successful performance and positive beliefs. On the other hand, a coping model shows slower progress toward a certain task and provides ways to manage any frustrations. Eventually a coping model will show a more positive outlook. Studies that have used a modeling video within Health Psychology interventions mainly use a coping model (e.g., Maddison, Prapavessis, & Armstrong, 2008). In these videos the coping model verbalizes his or her thoughts and feelings about the particular situation. A coping model may discuss the fears he or she had and eventually expresses feelings of gaining confidence in regards to the situation. This type of model is effective for observers in situations where they have little or no prior experience, such as when athletes are rehabilitating from a sport injury (Bandura, 1997). An observer of a coping model may experience increased task efficacy (Clark & Ste-Marie, 2002). A coping model is especially beneficial if the observer perceives the model to be highly similar to him or herself. Whereas a mastery model may not be very effective in a situation for an observer that has no past experience of the situation and holds anxiety and fears toward a situation such as an injury. This thesis uses a coping model who describes an ACL injury and methods to deal with the impact the injury has on day to day life.

According to Bandura (1997), the two key characteristics that affect the observer's perceptions of a model's performance are gender and age. However, if the activity the model is performing is not stereotypically related to gender, then the model's skill level will be the deciding factor for the observer. Rehabilitating from a sport injury would not be considered an activity that is stereotypically related to gender (Milne et al., 2005) because both men and women are prone to injuries in sport. Therefore, a model should share similar characteristics to an observer, such as athleticism, age, and thoughts and feelings toward an injury. Rehabilitation studies in Sport and Health Psychology have included an equal number of men and women within a modeling video in order for participants to relate and attend to at least one coping model (Maddison et al., 2006; Maddison et al., 2008).

In a study that used a coping model, Maddison et al. (2008) investigated the effectiveness of a modeling video intervention among 20 participants with chronic heart failure on self-efficacy to walk and peak oxygen uptake (PVO_2). The video showed coping models (i.e., two men and two women) discussing increased confidence in performing the PVO_2 test and ways to cope with the side effects during the test (e.g., shortness of breath). After baseline testing, participants in the intervention group watched the coping video and then set a goal for the subsequent test. One week later participants underwent another PVO_2 test and responded to the measure of self-efficacy. The results of the study indicate that a modeling video was successful in improving participants' self-efficacy and PVO_2 test performance when compared to a control condition. A limitation of the video was the ages of the models were not provided. Consistent with athletic injury studies, another limitation within the study is the small sample size. Also, the participants in the modeling intervention were asked to set goals. Goal setting may be a confounding factor in which the changes in self-efficacy and PVO_2 were not strictly because of the modeling video.

2.3.2 Modeling in Athletic Rehabilitation

Modeling has also been used as an intervention in studies with injured athletes. However, there is a lack of published research on the topic. In an unpublished doctoral dissertation Flint (1991) examined the effects of modeling for enhancing psychological and physical outcomes in rehabilitation through the use of a video. The sample included 20 female basketball players, with ten participants in the modeling video intervention group and ten in the control group. The video detailed athletes' experiences of an ACL reconstruction process. Participants who watched the modeling video demonstrated an increase in self-efficacy for recovery three weeks post-ACL surgery compared to participants in the control group. There also were increases in physical outcomes such as, running and return to full function for the modeling group but not the control group. However, the researcher suggested these differences were non-significant due to a moderate sample size (Flint). Another limitation of the study is that the video was shown to participants post-operatively, thus the possibility of reducing patients' anxiety pre-operatively was not examined. Also, because the study only included female basketball players, findings can not be generalized to athletes from other sports or to men.

In a more recent study which included 58 participants seeking physiotherapy treatment for ACL reconstruction, Maddison et al. (2006) investigated the effects of a modeling intervention on psychological and physical outcomes. The measures included were: expected and perceived post-operative pain, anxiety, rehabilitation self-efficacy, crutch usage, and multiple functional outcomes including range of motion. The intervention consisted of two modeling videos which represented the first six weeks of post-operative rehabilitation. The first video focused on the early rehabilitation exercises, whereas the second video showed exercises that further improved range of motion. Participants in the modeling group watched the first video before their surgery and before being discharged from the hospital. The second video was viewed two weeks post-operatively and again at six weeks after surgery. The videos included four models who described their thoughts and feelings associated with the ACL injury. The study followed athletes from before their surgery to six weeks post-operative. Individuals in the experimental condition reported lower pre-operative expectations of pain than the control condition. Post-operatively, participants who watched the coping videos reported greater rehabilitation self-efficacy, and had higher objective functional scores. It would be interesting to examine the effects of a modeling video over a longer period of time because rehabilitating an ACL after reconstructive surgery takes longer than six weeks (DeCarlo et al., 1994). Showing a coping model video is effective in ACL reconstructive rehabilitation on various recovery outcomes, however comparing a modeling video to another strategy has not been examined. Another critique of the study is that participants varied in age from 15-53 years of age. According to Bandura (1997), in order for a coping model to be effective is to be perceived as high in similarity. In addition, Maddison et al. (2006) did not include follow-up questions regarding whether participants perceived the models to be similar to them. Perhaps the study would have been stronger if follow-up questions regarding the models' similarity were included and if the age range was smaller.

The studies by Flint (1991) and Maddison et al. (2006) are the only known examinations of modeling interventions within athletic rehabilitation. Despite the fact that modeling is a powerful instructional strategy, there is a need for more modeling intervention studies in athletic rehabilitation to contribute to this area. Experimental research in athletic rehabilitation that compares modeling to another strategy such as imagery will add to the limited research in the area. In addition, a study that compares modeling and imagery in sport injury will be beneficial.

2.4 Applied Imagery Model

Imagery is a similar strategy to modeling that is researched more often in sport psychology. Within sport, imagery has been reported to be the most widely used psychological strategy (Morris, Spittle, & Watt, 2005). Martin, Moritz, and Hall (1999) developed an applied model of mental imagery use in sport. The model was created through a comprehensive literature review of imagery studies within sport. Martin et al. recommend the applied imagery model is useful and helpful in guiding an intervention design, as well as developing guided imagery scripts for athletes. This thesis uses a guided imagery script based on the applied imagery model and details recovery from ACL reconstructive rehabilitation accordingly. The key factors of the applied model are: sport situation, imagery function, imagery ability, and outcome.

2.4.1 Sport Situation

The situations within the applied imagery model are competition, training, and rehabilitation. Athletes have reported using imagery more often in competition and training. Imagery use during rehabilitation is the least common situation reported (Sordoni, Hall, & Forwell, 2000).

2.4.2 Imagery Function

The functions of imagery within the model are based on Paivio's (1986) functions of imagery model. Paivio proposed that there are cognitive and motivational functions of imagery and each operate at a general or specific level. Cognitive general (CG) imagery is using imagery to learn or improve strategies, game plans, and routines. Cognitive specific (CS) imagery is using imagery to learn specific skills. Motivational specific (MS) imagery is using imagery to achieve one's goals. Motivational general (MG) imagery is using imagery for factors related to physical arousal and emotions. Hall et al. (1998) separated MG imagery into motivational general-arousal (MG-A; i.e., imagining factors related to arousal and stress) and motivational general-mastery (MG-M; i.e., imagining factors related to self-confidence).

Based on this applied imagery model, subsequent research has focused on the imagery functions that athletes employ while injured (Sordoni et al., 2000). Athletes who have been injured, reported using imagery more during competition and training than during the time of an injury (Sordoni et al.). Despite the potential positive outcomes associated with imagery use during rehabilitation, it is the least common situation reported (Sordoni et al.). Findings from correlational research examining outcomes of imagery use in rehabilitation have been consistent with predictions from the applied model. Sordoni et al. assessed the functions of imagery athletes employed while injured. The results indicated athletes used motivational imagery in rehabilitation more often than cognitive imagery. In addition to the cognitive and motivational functions of imagery, healing imagery is also a function within sport rehabilitation (e.g., Ievleva & Orlick, 1991). Healing imagery is generating images of physiological improvements of the injured area, such as visualizing the mending of a torn ligament. Research has demonstrated the use of healing imagery to be associated with higher levels of self-efficacy (Sordoni et al., 2002). Milne et al. furthered the findings of Sordoni and colleagues and found cognitive imagery use to be a predictor of task efficacy. Other correlational studies have found imagery use while experiencing an injury is associated with shorter recovery time (Ievleva & Orlick, 1991), greater satisfaction with a rehabilitation program (Law et al., 2006), and increased self-efficacy for rehabilitation (Milne et al., 2005).

However, a few limitations to emphasize among these studies are that the participants included had a wide variety of injuries, as well as the length of time in rehabilitation and severity of participants' injuries were not assessed. Another limitation to highlight of these correlational studies is that the researchers included both, participants who took part in sport at recreational and participants who took part at competitive levels. This may be an issue because high competitive level athletes may be more motivated to return to sport and utilize more strategies to help them return, compared to individuals who participate in sport at the recreational level. Therefore, studying only competitive athletes could provide a deeper understanding of athletes' perceptions of imagery use during rehabilitation.

Besides correlational studies, some of the research on injured athletes' imagery use has been qualitative. Driediger et al. (2006) interviewed ten athletes who were seeking physiotherapy for an injury about their imagery use during the time of their injury. The findings reveal imagery use during rehabilitation provides cognitive, motivational, and healing purposes. Specifically the athletes used cognitive imagery for learning and performing rehabilitation exercises correctly. Motivational imagery was used by injured athletes for setting goals, mental toughness, and maintaining concentration and a positive outlook. The athletes used imagery to manage pain. Overall, Driediger et al. suggest that athletes can benefit from using imagery while injured to speed up the recovery process, and more importantly to enhance the rehabilitation experience.

In addition, Evans, Hare, and Mullen (2006) interviewed four high-level athletes and also found imagery was used during rehabilitation for cognitive and healing purposes. Imagery also was used by the athletes to control pain. In a subsequent mixed methods approach involving a case study, Hare, Evans, and Callow (2008) interviewed an Olympic athlete and included three quantitative measures: the Athletic Injury Imagery Questionnaire-2 (AIIQ-2; Sordoni et al., 2000), the Vividness of Movement Imagery Questionnaire-2 (VMIQ-2; Roberts, Callow, Hardy, Markland, & Bringer, 2008) and the Visual Analogue Scale for pain (Huskisson, 1974). Through the interviews, they found that the athlete employed imagery during rehabilitation for cognitive and motivational purposes. Hare et al. suggest the athlete did not use imagery for pain management because of the athlete's history of coping with injuries. An important aspect to highlight is that a case study approach does not allow the findings to be generalized among athletes. Therefore, experimental studies involving interventions may provide further insight into imagery use and injury.

2.4.3 Outcomes for Imagery Use in Rehabilitation

Given that athletes use imagery less often during rehabilitation than in training or competition, athletes may not know what to imagine when they are injured (Sordoni et al., 2002). Therefore, developing an imagery script to help guide injured athletes to engage in the appropriate forms of imagery, has potential to be a useful strategy in the rehabilitation context. As well, because imagery is a strategy in which individuals create or re-create an experience, this could allow athletes to develop a positive outlook towards dealing with injuries in order to enhance coping. According to the applied imagery model, the situation will influence the functions of imagery employed, with each function having an influence on different outcomes. For example, using CS imagery in rehabilitation would aid in learning specific rehabilitation exercises. The use of CG imagery while injured is predicted to assist in rehabilitation planning. Motivational specific imagery use during rehabilitation is predicted to aid in goal setting and rehabilitation adherence. Increasing confidence and self-efficacy for recovery is associated with MG-M imagery. Finally, using MG-A imagery during rehabilitation is predicated to regulate arousal and anxiety levels (Martin et al., 1999).

2.4.4 Imagery Ability

Another component of the model is imagery ability. Imagery ability is considered to moderate the effects of imagery types or functions used on outcomes. For example, if an athlete employed CS imagery for rehabilitation exercises related to strength and had high imagery ability, a recovery outcome that may be improved is strength. Thus, it is important to assess athletes' imagery ability if a study includes imagery as an intervention (Roberts et al., 2008). An athlete with high imagery ability demonstrates improvements in physical performance over an athlete with lower imagery ability (Isaac, 1992). There are two aspects of imagery ability: vividness and controllability (Roberts et al.). Vividness of imagery is referred to as the clarity and realism of an image. Controllability is considered to be the ease with which an individual can regulate the images generated in his or her mind.

An instrument used to measure imagery ability is the Vividness of Movement Imagery Questionnaire-2 (VMIQ-2; Roberts et al. 2008). The VMIQ-2 measures aspects of vividness through three perspectives. These perspectives include, internal (i.e., first-person) and external (i.e., third-person) visual imagery, as well as kinaesthetic imagery (i.e., feeling a movement as an image). The items within the VMIQ-2 assess an individual's ability to image different basic movements, such as walking. The VMIQ-2 is easy to administer to participants, as well it does not require a lot of time to complete. When comparing the VMIQ-2 to another common measure of imagery ability, the Movement Imagery Questionnaire-Revised (MIQ-R; Hall & Martin, 1997), requires individuals to perform a movement and then visualize and rate the ease at which they can see themselves doing the movement. The VMIQ-2 does not involve an athlete to actually perform the movement. It would be difficult to assess an injured athlete's imagery ability through the MIQ-R because it requires an individual to perform various movements and an injury may limit an individual to perform certain movements. Therefore, the VMIQ-2 is a more suitable measurement to utilize among injured athletes. Roberts et al. recommend that the VMIQ-2 can be used with athletes prior to implementing an imagery intervention. Because this thesis includes an imagery intervention the VMIQ-2 is included to measure participants' imagery ability.

2.4.5 Imagery Interventions in Athletic Rehabilitation

In an athletic rehabilitation intervention study involving participants who were post-operative ACL reconstruction, Cupal and Brewer (2001) examined a combination of imagery and relaxation on pain, re-injury anxiety, and knee strength. In addition to an imagery condition, the study included a control group and a placebo group. The participants in the control group underwent normal physiotherapy treatment. The participants in the placebo group underwent usual physiotherapy treatment. In addition, the clinician provided attention, encouragement, and support and participants were asked to visualize once a day a scene that is peaceful. Participants in the imagery intervention condition received ten individual sessions involving relaxation and guided imagery throughout a six month recovery period in addition to regular physiotherapy treatment. The content within the sessions was matched for the stage of recovery. The imagery intervention was effective toward increasing knee strength and lowering levels of re-injury anxiety and pain at 24 weeks post-surgery compared to the placebo and control groups. However, it is difficult to distinguish the specific effects imagery had on its own. Relaxation was not the only confounding factor within the study. The participants were shown a video of their surgery in order to help them use healing imagery. Although including videos and relaxation techniques within imagery studies are common, it is unclear how much imagery alone contributed to the recovery effects. Another limitation within the study is that a measure of self-efficacy was not included as an outcome. As mentioned earlier, imagery is considered a vicarious experience and a source of self-efficacy; a controlled experiment that demonstrates the effects of imagery alone, on self-efficacy during athletic rehabilitation is needed. If an individual experiences increases in self-efficacy, in turn this will potentially lead to positive behaviours and recovery outcomes such as greater adherence to rehabilitation.

Another study which implemented imagery as an intervention among injured athletes, only examined the effects on physical outcomes (Christakou, Zarvas, & Lavallee, 2007). All 20 participants included within the study had an ankle sprain. In addition to participants' regular physiotherapy treatment, the imagery group received twelve individual imagery sessions. The researchers did not make references to the specific functions of imagery employed in the sessions. Each of these sessions lasted 45 minutes and participants imaged rehabilitation exercises performed earlier in their physiotherapy session. The control group received standard physiotherapy treatment. The results revealed a significant difference only for muscular endurance. It may be that the intervention led to improved adherence to physical rehabilitation which in turn resulted in improved muscular endurance. All the other variables, dynamic balance, functional stability test, and a subjective and functional follow-up evaluation did not demonstrate significant differences between the two groups. In addition to the fact that the study did not include any psychological response measures, the researchers failed to draw upon a theory or a model to guide the study. There were only three women included in the study, which makes it challenging to determine whether the intervention is differentially effective for men and women. All participants spent one hour in physiotherapy. Because the imagery sessions followed physiotherapy treatment and lasted 45 minutes, to some participants this may seem like a lot of time. Participants were also asked to keep an imagery diary of the sessions they performed at home. Perhaps there was no effect of the intervention due to a lengthy time commitment and dissatisfaction towards physiotherapy and imagery use.

In a similar study, Christakou and Zervas (2007) found no differences between the intervention group who participated in a relaxation and imagery intervention (*n*=9) and a control group (*n*=9) on pain, range of motion, and edema among participants with an ankle sprain. Similar to other injury rehabilitation studies, this study was limited by its sample size. The study only included 18 participants, which makes it challenging to find significant differences. All 18 participants included in the study were men. Perhaps if women were included in the sample the results may have been different. Moreover, the imagery intervention included aspects of relaxation, which makes it difficult to distinguish the effects of imagery alone.

Taken together, additional controlled experimental imagery studies within athletic rehabilitation are needed because much of the research has either been qualitative or correlational. Imagery use during rehabilitation has many benefits (e.g., Cupal & Brewer, 2001). Additional evidence will emphasize the need to educate athletes and professionals who are involved in the injury recovery process about the benefits of using imagery. This education for athletes could take place before the occurrence of an injury.

2.4.6 Comparing Modeling and Imagery

A study comparing modeling and imagery in sport injury is needed in order to clarify the contributions of each psychological strategy. Both strategies are vicarious experiences and sources of self-efficacy (Bandura, 1986; 1997). Some researchers suggest that modeling comes before imagery (Bandura, 1986; McCullagh & Weiss, 2001). This means that an athlete will form a cognitive representation from his or her observations. The representation is stored as images and used to translate the representation into action. Thus, modeling may be required before imagery (Bandura, 1986). Similarly, imagery use can involve generating images recalled from memory based on prior experiences.

It is possible that one strategy is more effective than the other in a given context. According to Bandura (1986) modeling is beneficial for an individual who has no previous experience or is in a new situation (e.g., first serious injury). Since imagery may involve an individual to form images based on prior experiences, modeling may be more effective in the situation of rehabilitation. Modeling provides the learner with information along with images that he or she may be lacking in terms of what to expect in rehabilitation. In turn, this representation from the model may make it easier to generate images compared to listening to an imagery script and forming images of rehabilitation exercises.

Both modeling and imagery have shown similar effects (e.g., Hall, Munroe-Chandler, Cumming, Law, Ramsey, & Murphy, 2009) and may involve similar cognitive processes (e.g., Cumming, Clark, Ste- Marie, McCullagh, & Hall, 2005; Hall et al., 1998). One key difference between the two strategies is that modeling involves external representation and imagery occurs internally (Bandura, 1986). In research, modeling can be presented via a live demonstration or a video (e.g., Maddison et al., 2006). On the other hand, imagery requires an individual to generate images from memory or through guided scripts (e.g., Cupal & Brewer, 2001). Often imagery studies are confounded by the use of modeling (e.g., Cupal & Brewer), making it difficult to tease apart the effects generated by each of them independently. On the other hand, modeling studies have not included manipulation checks to see if imagery was used following the modeling intervention (e.g., Maddison et al., 2006). Therefore, both types of studies have lacked controls for the other technique which could be contributing to success of the intervention.

Because these two strategies do have fundamental differences it is important to conduct comparative research in order to determine whether one is more beneficial over the other, especially in the situation of an injury. To date, there is no known examination within athletic injury research that compares modeling and imagery.

2.5 Behavioural Response to a Sport Injury

2.5.1 Rehabilitation Adherence

Recovery outcomes are influenced by the amount of effort an individual puts into his or her rehabilitation. Thus, an important aspect of research on athletic injury is adherence to a rehabilitation program. Adherence is considered a behavioural response in Wiese-Bjornstal et al.'s (1998) response to injury model. According to Brewer (1998), the majority of previous studies which assessed adherence to rehabilitation failed to incorporate theoretical frameworks. Adherence can be explained through both, the cognitive appraisal model (Wiese-Bjornstal et al., 1998), as well as self-efficacy (Bandura, 1986). With regards to the cognitive appraisal model, if an individual adheres to their rehabilitation program (i.e., attends all sessions, completes prescribed exercises) it will influence psychosocial and physical recovery outcomes positively. Moreover, the use of psychological skills (i.e., a behavioural response) during rehabilitation can contribute to greater adherence (Scherzer et al., 2001). In terms of self-efficacy, if an injured athlete believes he or she can perform all the rehabilitation exercises and actually does so, this will increase his or her task efficacy for rehabilitation exercises, and increase the likelihood of performing the prescribed exercises.

Milne et al. (2005) found that athletes high in task and coping efficacy also have higher adherence rates than those with lower levels of task and coping efficacy. In addition, cognitive imagery use is a predictor of task efficacy during athletic rehabilitation and is also associated with higher levels of adherence (Milne et al.). Specifically, task efficacy was a significant predictor of the quality of rehabilitation exercises, while coping efficacy was a significant predictor of frequency of rehabilitation exercises. Both, task and coping efficacy were significant predictors of duration of exercises. Milne et al. suggest that high task and coping efficacy will assist an injured athlete in adhering to his or her rehabilitation program. A gap in the literature is that adherence has not been examined within athletic rehabilitation modeling studies. Modeling is a strategy that can affect an observer's future behaviour. For example, if an injured athlete watched a video of athletes discussing how they coped with an injury and committed to their rehabilitation program, this may have potential to alter the observing athlete's behaviour towards rehabilitation in a positive way, such as better adherence and coping responses.

2.6 Psychological Recovery Outcomes

2.6.1 Perceived Pain

Physiotherapists continually assess pain with their patients; however, patients may not be aware of pain management techniques besides taking painkillers, icing, and performing rehabilitation exercises to aid in recovery. Modeling and imagery are strategies that have been found to reduce levels of pain perception (Maddison et al., 2006; Cupal & Brewer, 2001). Maddison et al. (2006) used a coping model video to examine the effectiveness of several factors during ACL rehabilitation. Expected pain was assessed at baseline and pre-operatively. Participants who viewed the coping model video reported lower levels of expected post-operative pain compared to the control group (Maddison et al.). Lower levels of expected pain may be linked to decreased levels of anxiety, which is important during the recovery process because an individual may be more positive and motivated to recover if they are less anxious (Maddison et al.). Further investigation is needed to confirm the effects of modeling and levels of pain due to a sport injury.

Studies within general Health and Sport Psychology have examined the effectiveness of imagery use and levels of pain. Researchers in Health Psychology have employed relaxation and imagery interventions as pain management tools among individuals with cancer (e.g., Syrjala, Donaldson, Davis, Kippes, & Carr, 1995). Syrjala et al. compared four conditions among patients receiving cancer treatment: normal treatment (i.e., control), support from a therapist, relaxation and imagery, and a package of different cognitive-behavioural skills which included relaxation, imagery, self-statements, distraction, and short-term goals. Patients who received only the relaxation and imagery intervention reported significantly lower levels of treatment-related pain compared to all the other groups. The package of cognitive-behavioural skills may have been too difficult for the participants to comprehend and apply in the short amount of time in which the study was conducted.

Within the Sport Psychology and athletic injury rehabilitation literature, Law et al. (2006) found athletes who implemented imagery for pain management of an injury were more satisfied with their rehabilitation than athletes who did not use imagery. Eighty-three participants were separated into one of two groups, imagery for pain use and no use of imagery for pain based on self-reported imagery use. Participants who used imagery to manage pain used more cognitive, motivational, and healing imagery than participants who did not utilize imagery for pain management. Future studies should include more aspects of an athlete's injury, such as injury severity and previous injury experience as these factors may influence imagery use and pain management.

Despite the findings of imagery as a method of pain management, there are a limited number of controlled intervention studies within athletic rehabilitation. For example, Cupal and Brewer (2001) found a relaxation and imagery intervention effective in reducing pain 24 weeks post-surgery among ACL reconstructive participants.

Both modeling and imagery are found to reduce levels of pain; however, the two strategies have not been compared in regards to expected pain. An athlete's rehabilitation may be enhanced if he or she is educated to use modeling and or imagery to cope with pain from an injury. Pre-injury interventions can include such strategies to help athletes if they are faced with an injury in the future. These strategies may change an injured athlete's expectations of pain by reducing the amount, and in turn contribute to a more positive rehabilitation experience.

2.7 Research Approach: A Hypothetical Scenario

There are many challenges to conducting injury rehabilitation intervention research. These include: a) recruiting a large amount of participants, b) forming a partnership with physiotherapy clinics, and c) controlling for variations of treatment strategies. To manage these challenges, I used a scenario-based approach for my thesis. A scenario-based approach requires participants to read and imagine either themselves or someone else experiencing a situation, and make judgements on how they would respond. In most cases, a scenario describes a situation in which individuals have no prior experience. A scenario involving a hypothetical injury can serve as a preliminary step towards an intervention study involving actual injured athletes.

In using this scenario-based approach, I was able to address each of the challenges related to injury rehabilitation research. With regards to recruitment, a scenario which details a specific injury can control for the type of injury if participants are healthy and have no prior experience with the injury in the scenario. With regards to creating partnerships with physiotherapy clinics, a scenario protocol does not require such partnerships. Finally, with regards to easily implementing, a scenario-based study with healthy athletes can be conducted at any location versus only during a physiotherapy session. Beyond these logistical matters, having healthy athletes image an injury situation may have benefits in the future. It may help them cope with an injury in the future. Including interventions within a hypothetical injury scenario-based study are linked to Wiese-Bjornstal and colleagues' (1998) cognitive appraisal model of response to injury as pre-injury factors. The interventions can serve as coping resources, which is another pre-injury factor. These pre-injury factors combined, along with personal and situational factors will affect how an athlete will cognitively appraise his or her injury.

In Psychology, there is a long history of using scenario-based research to examine phenomena such as: the risky shift phenomenon (e.g., Kogan & Wallach, 1964) attributions to causality (e.g., Weiner & Kukla, 1970), and leadership and gender bias (e.g., Eagly, Makhijani, & Konsky, 1992). Research using a scenario protocol has demonstrated that thoughts are strongly related to actual behaviour in a variety of areas including goal setting (e.g., Locke & Latham, 1990), learned helplessness (e.g., Dweck, 1986) and exercise (Cholewa, Law, & Carron, 2008). For instance, in Exercise Psychology, scenarios were used to investigate perceptions on the effect exercise partners had on adherence levels of an individual who is new to exercising (Cholewa et al.). Within sport, scenarios have examined group norms and perceived individual effort on the cohesion-performance relationship among team sports (Gammage, Carron, & Estabrooks, 2001).

In more relevant research, Damato (2007) used a scenario protocol to examine athletes' perceptions of the loss of a pivotal teammate versus a non-pivotal teammate due to a hypothetical injury. The findings demonstrated an athlete's mental collective efficacy (i.e., the confidence athletes have towards their team's ability to face adversity) decreased following the loss of any player. Another finding was that an athlete's physical collective efficacy (i.e., the confidence one has towards his or her team's physical ability) was not altered due to the loss of a teammate. Research which examines an athlete's own perceptions of a hypothetical injury on aspects of self-efficacy related to rehabilitation is needed in order to develop a greater understanding of strategies that may enhance self-efficacy in the particular situation. Together, these studies demonstrate the utility and acceptability of scenario protocols within Psychology research.

One criticism of scenario-based research involves the findings and whether or not they can be transferred to an actual situation described within the scenario. However, results from a scenario-based sport injury study were consistent with results from a study involving interventions with actual injured athletes to examine the same relationships (Grove, Hanrahan, & Stewart, 1990; Laubach, Brewer, Van Raalte, & Petipas, 1996). Grove et al. implemented two different hypothetical injury scenarios with 276 undergraduate Physical Education students. Participants were asked to read a scenario and imagine having an injury and either recovering very slowly or rapidly. Those participants who read the rapid recovery scenario attributed their recovery to stable, personal, and internal factors more than participants who read the slow recovery scenario (Grove et al.). Laubach et al. replicated the findings of Grove et al. with participants who were actually experiencing a knee injury. Thirty-four participants were asked about their perceived rate of recovery in rehabilitation. Similarly, Laubach et al. found participants who perceived themselves to be recovering rapidly, attributed their recovery to stable, internal, and external controllable factors. These two studies provide strong support for the use of scenarios in injury research. An exploratory study that includes a hypothetical scenario is an appropriate method to investigate potential effects before the occurrence of an actual injury.

Another example which demonstrates the effectiveness of using a scenario is a study that included two experiments on perceptions of interventions within rehabilitation (Brewer, Jeffers, Petitpas, & Van Raalte, 1994). The first experiment involved non-injured participants and the other included injured participants. In the first experiment, 161 undergraduate Psychology students were randomized to conditions: imagery, goal setting or counselling. Participants read a hypothetical scenario about an injured athlete who was working with a sport psychologist on one of the psychological strategies during his rehabilitation after surgery. Participants then rated their perceptions towards the certain strategy. The researchers found that participants viewed all the strategies positively; however goal setting was favoured the most. In the subsequent experiment involving 20 injured participants, all participants received introductory sessions on the same three strategies, imagery, goal setting or counselling. Following the sessions, participants rated the intervention strategies. Injured participants' perceptions were similar to those in the first experiment; all interventions were perceived positively with goal setting having a higher preference. A limitation to note is that within the first experiment, the researchers included participants who were non-athletes. However, almost half (48%) were involved in sport at the college level. Also, in the second experiment all participants were not competitive athletes and the types of injuries ranged from knee, back, shoulder and other body parts. The first experiment required participants to provide responses based on what they thought the injured athlete in the scenario would prefer during rehabilitation. This differs from asking participants to imagine themselves in the scenario and providing responses based on their own preferences. In addition, examining preferences to strategies is different than examining the effects of interventions on outcomes.

Because similar results were found in studies with non-injured and injured participants (Grove et al., 1990; Brewer et al., 1994; Laubach et al., 1996) this shows a strong support to using a scenario protocol. In addition, modeling and imagery interventions have been implemented among injured athletes; yet the two strategies have not been compared. Since the strategies have not been compared in athletic rehabilitation research, a more feasible step would be to conduct a study using a scenario protocol with non-injured athletes. The many challenges in athletic rehabilitation can be reduced by making use of a hypothetical injury scenario approach. A scenario-based study could include modeling and imagery interventions which serve as pre-injury education. In the event an athlete becomes injured, he or she may be better prepared to cope and have a more positive view on whether they will be able to successfully recover because of practicing imagery or being exposed to modeling.

2.8 Study Purpose and Hypothesis

The purpose of this study was to compare the effects of a modeling intervention, an imagery intervention, and a no intervention control condition on athletes' perceptions of psychological factors related to injury rehabilitation. The psychological factors examined in the study were task and coping efficacy, predicted perceptions of rehabilitation adherence, and expected pain when faced with a hypothetical scenario of sustaining an ACL injury. It was hypothesized that participants in both intervention groups would report greater increases pre-post intervention in task and coping efficacy, projected rehabilitation adherence, and lower levels of expected perceptions of pain compared to participants in the attention control condition. A hypothesis that involves a distinction between the two intervention groups was not made due to the lack of research comparing modeling and imagery within athletic rehabilitation. In addition, the two strategies are considered to be the same source of self-efficacy in the particular situation of sustaining an ACL injury where the individual has no previous experience (i.e., a vicarious experience).

Chapter 3
Method

3.1 Participants

To recruit participants I contacted coaches and athletes of varsity teams at universities and colleges in eastern Ontario (e.g., Queen's University, Royal Military College). I also contacted coaches from other competitive teams within Kingston (e.g., Cataraqui Clippers, Barrhaven Scottish Rugby Football Club) and across Canada to recruit athletes. Convenience and snowball sampling was used to obtain a sample size of (n = 86). All participants were healthy competitive athletes (i.e., not experiencing an injury). The mean age of participants was 22.06 years (SD = 4.37). Athletes represented 10 different sports: basketball, hockey, volleyball, soccer, football, field hockey, lacrosse, ball hockey, rugby, and baseball. The majority of athletes were male (62%), rugby players (57%), and competed at the varsity level (63%). Demographic information for each group is presented in Table 1. Potential participants were excluded if they had experienced an ACL injury in the past or had experienced any type of injury and had received physiotherapy treatment within the last six months. This exclusion criterion was used because participants' recent experience and recovery in rehabilitation might have influenced their perceptions of a hypothetical injury. According to Bandura (1997), individuals who have previous experience in a specific situation will demonstrate greater self-efficacy compared to individuals without experience.

Table 2. *Athlete demographic information by group*

Variable	Control Group %(n)/*M*(*SD*)	Modeling Group %(n)/*M*(*SD*)	Imagery Group %(n)/*M*(*SD*)
Total	33.7 (29)	31.4 (27)	34.9 (30)
Age (years)	21.48 (3.77)	21.96 (4.49)	22.70 (4.84)
Sex			
Male	55.2 (16)	74.1 (20)	60.0 (18)
Female	44.8 (13)	25.9 (7)	40.0 (12)
Sport			
Rugby	62.1 (18)	44.4 (12)	63.3 (19)
Other sports	37.9 (11)	55.6 (15)	36.7 (11)
Hours of Training per week (hours)	8.57 (6.23)	8.93 (4.06)	7.20 (3.10)
Highest Level Of Competition			
Varsity	69.2 (18)	60.0 (15)	60.0 (18)
Provincial	27.8 (5)	38.9 (7)	33.3 (6)
National	7.7 (2)	8.0 (2)	16.7 (5)
International/Professional	3.8 (1)	4.0 (1)	3.3 (1)
Time of Season			
Pre-season	3.4 (1)	18.5 (5)	10.0 (3)
Competitive season	24.1 (7)	22.2 (6)	20.0 (6)
Off-season	72.4 (21)	59.3 (16)	70.0 (21)
Number of Previous Injuries	2.0 (0.66)	1.89 (0.51)	1.97 (0.77)

Note. Other sports include: football, soccer, field hockey, basketball, lacrosse, baseball, hockey, ball hockey, and volleyball

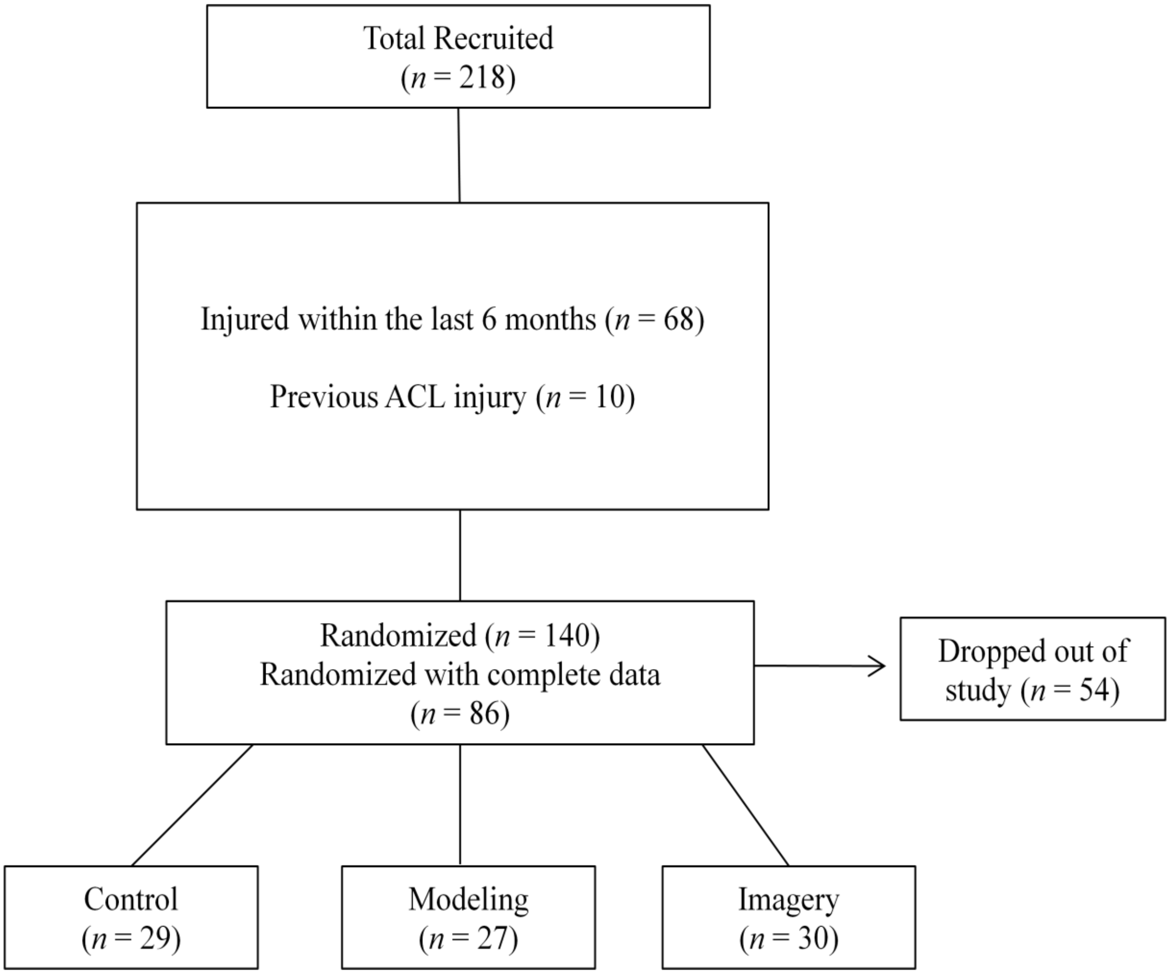

Figure 4. Participant flow chart

3.2 Measures

At the beginning of each testing session prior to responding to any questions or engaging in any intervention activities, participants read a hypothetical scenario (Appendix B). The scenario described a situation of an ACL injury. The scenario began with a description of a game situation where an athlete experienced an ACL tear and needed to leave the game. Then the scenario stated that the athlete had been to a doctor who recommended reconstructive surgery. The scenario included a typical rehabilitation program that described the first three weeks of exercises. Finally the scenario included a short description of a physiotherapist recommended criteria of returning to sport.

3.2.1 Demographic Questionnaire

Through online questionnaires, participants were asked to indicate their gender, age, and provide details about their injury history, sport type, and length of playing experience (Appendix A).

3.2.2 Imagery Ability

An assessment of participants' imagery ability was conducted using the Vividness of Movement Imagery Questionnaire-2 (VMIQ-2; Roberts et al., 2008; Appendix C). The VMIQ-2 consists of 12 items where each item is evaluated three times, once for each of the three imagery perspectives: a) internal visual imagery ability b) external visual imagery ability, and c) kinesthetic imagery ability. Most items are movements related to everyday life, such as walking. The internal visual imagery (IVI) subscale reflects participants' ability to imagine the actions as if they are looking out through their own eyes. The external visual imagery (EVI) subscale asks participants to imagine the items as if they are watching themselves perform the movement from an external view. Lastly, the kinaesthetic (KIN) subscale asks participants to imagine feeling themselves doing the movement. Responses for each item are rated on a 5-point scale, ranging from 1 (perfectly clear and vivid as normal vision) to 5 (no image at all, you only know that you are thinking of the skill). Roberts et al. suggest that the VMIQ-2 is an effective tool when considering an individual's ability to use imagery before implementing an imagery intervention. Thus, the use of this measurement served as a screening tool to determine whether participants had adequate imagery ability. The scores on the subscales were summed. The possible range for a subscale is 12-48.

Roberts et al. reported acceptable concurrent validity, as the VMIQ-2 was compared to another imagery ability measurement tool, the MIQ-R (Hall & Martin, 1997). As well, internal consistencies were acceptable for each of the subscales. Cronbach's alpha for each subscale were: IVI = .95, EVI = .95, KIN = .93 (Roberts et al.). Cronbach's alpha for the current study were: IVI = .95, EVI = .93, KIN = .94.

3.2.3 Task and Coping Efficacy

Task and coping efficacy were measured using the Athletic Injury Self-Efficacy Questionnaire (AISEQ; Milne, Hall, & Forwell, 2005; Appendix D). The AISEQ consists of 7 items. Task efficacy is represented by 3 items (e.g., "I am confident that I can perform all of the required rehabilitation exercises"). The remaining 4 items represent coping efficacy (e.g., "I am confident that I can do my rehabilitation exercises when I feel I do not have the time"). Each item is rated on a scale from 0% (no confidence) to 100% (completely confident). The questionnaire was scored by calculating separate means for task and coping efficacy. The possible range of scores could be from 0-100. Milne et al. demonstrated internal consistency above .70 for both subscales. Cronbach's alpha were: task efficacy = .81and coping efficacy = .80. The two factors of the AISEQ, task and coping efficacy, were confirmed through factor analysis. For the current study Cronbach's alpha were: task efficacy = .91 and coping efficacy = .94.

3.2.4 Rehabilitation Adherence

Rehabilitation adherence was assessed according to three dimensions: frequency, duration, and quality (Milne et al., 2005; Appendix D). Frequency and duration were each assessed by two questions. The frequency questions were: "How often does your physiotherapist want you to do your rehabilitation exercises (e.g., once per day)?" and "How often do you actually do your rehabilitation exercises?" The duration questions were: "How long (minutes) does your physiotherapist want you to spend on your exercises each time you do them?" and "How long (minutes) do you actually spend on your exercises each time you do them?" Responses to the frequency and duration questions were calculated by percentage scores based on the difference between what was prescribed and what participants thought they would actually do. Participants were able to score higher than 100% if they believed they would do more exercise than what was recommended. For example, if a physiotherapist recommended to his or her patient to perform rehabilitation exercises once daily, and the patient reported he or she does exercises twice a day, the patient's score would be 200%. The one question concerning quality of rehabilitation adherence was, "What percentage (%) of the time do you believe that you perform your rehabilitation exercises correctly?" These rehabilitation adherence questions have been previously used and have shown sensitivity to change (Milne et al.).

3.2.5 Pain

Expected perception of pain was assessed by one item, adapted from the study by Maddison et al. (2006) (Appendix D). Participants were asked to rate how much pain they think they would have two weeks after knee surgery on a scale ranging from 0 (no pain) to 100 (pain as bad as it could be). Information about how much pain the average athlete reported to have two weeks post-surgery was given to participants within the instructions. The information was given to help participants rate expected pain based on the fact that they had no experience with an ACL injury. This pain measure has been used previously and shows sensitivity to pain in the context of having an ACL injury (Maddison et al.).

3.2.6 Manipulation Check

The purpose of including manipulation check questions (Appendix E) was to ensure that participants understood the condition they were randomly assigned to and attended to the content of the video or the imagery script. Participants responded to questions associated with their randomly assigned condition. Participants in all groups answered a question regarding whether or not they responded to the questionnaires based on a friend or teammate's experience of an ACL injury. Responses were simply given by selecting 'yes' or 'no.' Participants in the control condition reported on a scale from 1 (no image at all) to 5 (perfectly vivid) regarding how vividly they envisioned the injury scenario within their mind. The control condition was given a definition of imagery and asked to respond how often they generated images of recovery during the testing. Responses to this question were given on a scale from 1 (not at all) to 5 (often).

Participants within the modeling condition were asked whether they perceived the model to share similar characteristics as themselves. Responses to this question were given on a scale from 1(very low) to 5 (extremely similar). The modeling condition was given a definition of imagery and responded to the same question as the control condition regarding imagery use for recovery. The participants who received the imagery intervention were asked how clearly they generated images from the script and responded on a scale from 1 (no image at all) to 5 (perfectly vivid). The imagery condition responded to how often they could control the images generated from the script and responses were given on a scale of 1 (not at all) to 5 (often). The imagery condition responded to how closely they could follow the imagery script and provided responses on a scale from 1 (not closely) to 5 (very closely). Both intervention groups were asked if they would use the strategy if they were faced with an ACL injury in the future. Responses to these questions were given on a scale from 1 (strongly disagree) to 5 (strongly agree).

3.3 Conditions

3.3.1 Modeling Intervention

A coping model video (6:30 min) was developed to represent a patient's progress through a typical ACL reconstructive rehabilitation program. The content of the video was based on videos developed by Maddison et al. (2006). The video included edited interviews with a model discussing his thoughts and feelings about his injury and how he coped with the injury during the rehabilitation process. The model was selected specifically because he shared many similar characteristics as potential study participants. He was athletic, played many of the same sports as the participants and was around the same age. The key characteristic of a coping model is that he be high in perceived similarity to the participants (Bandura, 1997).

The model detailed his experience of an ACL injury which occurred during a rugby match. The coping model discussed how his life at the time was affected. He detailed the problems he had with getting around the university campus and the fact that he was majoring in Physical Education and was unable to take part in many of his classes. Most importantly the model described how he felt about not being able to play rugby. Also, the video detailed action shots of two athletes (one male, one female) completing various physiotherapy-related tasks, such as walking with crutches and rehabilitation exercises to improve strength and range of motion. Throughout the video, a physiotherapist provided the viewer with information about physical recovery. Finally, the video displayed the model returning to full training to be ready for competition. To ensure the content within the video was accurate it was shown to the physiotherapist who was in the video.

3.3.2 Imagery Intervention

A guided imagery script (9 min) was recorded onto a CD and directed participants through experiences they would face during the recovery process of an ACL injury (Appendix G). The script was based on Martin and colleagues' (1999) applied model of imagery use and their recommendations for how to develop an intervention. The situation described within the script was sustaining an injury and the process of making a full recovery, and return to competition. The imagery script detailed information regarding coping and managing the pain from the injury. The script directed the athlete to imagine the thoughts and feelings he or she would have associated with an ACL injury. Participants generated images of a relaxing place that would push away any pain and negative thoughts. Next the script directed participants to imagine themselves taking their first steps with crutches under their arms, as a nurse assisted them. From there, the script focused on imagining the correct technique of rehabilitation exercises for improving range of motion and strength. After participants imaged rehabilitation exercises, they were guided to visualize the injured knee and then the physiological healing aspects of it. Participants then, generated images of increasing confidence in the functional ability of the injured area and eventually returning to full training and sport. The content described throughout the script targeted the use of imagery for cognitive specific imagery, motivation general mastery functions, as well as healing imagery. Table 3 provides a summary comparing the content of each intervention.

3.3.3 Attention Control

Participants in the attention control group received the information within the scenario for a second time.

Table 3. *Comparison of interventions*

Content	Video	Imagery Script
Pain Management	Model discusses icing and using a cryocuff	Cryocuff, icing, imagining a peaceful place
Physiotherapy Tasks/Exercises	Individuals are shown walking with crutches, straight leg lift, heel slide, assisted leg extension, single-leg squat	Given descriptions of walking with crutches, straight leg lift, heel slide, assisted leg extension, single-leg squat
Psychological Healing	Physiotherapist states how the injured knee will be immediately post-surgery, 2 and 6 weeks post-surgery	Asked to image the injured knee and given a description of physiological aspects of healing
Return to Training	Model shown doing a cutting drill and heavy barbell squats	Descriptions of a cutting drill and barbell squats
Adherence to Rehabilitation	Model talks about the importance of "sticking to rehab"	Asked to imagine stacking with rehabilitation program
Length	6:26 min	9:07 min

3.4 Procedure

The study was a randomized, controlled, experiment. Participants received the information about the study and the link for the online questionnaire from their coach or me via email. At baseline participants completed an online demographic questionnaire. After the demographic questionnaire was completed, participants read a scenario describing a hypothetical ACL injury occurring to them (Appendix B). After participants read the hypothetical scenario they responded to one question regarding expected pain, the AISEQ, the rehabilitation adherence questionnaire, and the VMIQ-2. Upon completion of the baseline questionnaire, participants were asked to provide their contact information and up to three dates within the next two weeks in which they were available to complete the follow-up. Participants were reassured that their contact information could not be connected to the responses they provided on the questionnaires.

Participants were randomly assigned to one of the three conditions: modeling, imagery, or attention control via a computer randomization website (i.e., www.randomizer.org). Within two weeks of completing the online questionnaire, participants who lived in Kingston met with the researcher to complete the second part of the study. Alternatively, participants who did not reside in Kingston were able to complete the second part online. All participants were asked to re-read the injury scenario in order to refresh their memory. Then participants watched a coping model video, engaged in imagery as directed by the guided script, or only received the scenario. Directly after, participants completed the AISEQ, rehabilitation adherence questionnaire, and reported the level of expected pain via an online survey. Afterwards, participants completed manipulation check questions and then were debriefed about the purpose of the study, informed about the different groups, and given the option to watch the video or listen to the imagery script.

Participants were informed that if they wished to obtain the results, they were available upon request from the researcher and lastly they were thanked for their participation.

3.5 Data Analyses

Data was analyzed using Predictive Analytics SoftWare (PASW) Statistics. To test for between group differences, I conducted Chi square tests on categorical variables including sex, sport, highest level of competition, and time of season to determine if there were any differences between the three conditions. Separate analysis of variance (ANOVA) were conducted to determine if differences existed between groups on age, number of previous injuries, and hours of training per week. To test my hypothesis I conducted six separate 3 (condition) x 2 (time) repeated measures (ANOVAs). The dependent variables for these include expected pain, task and coping efficacy, and the three components of rehabilitation adherence: a) frequency, b) duration, and c) quality.

Chapter 4

Results

4.1 Randomization Check

Chi square tests were conducted across the three conditions to compare the frequencies for categorical variables including sex, sport type, competitive level, and time of season. These analyses revealed that there were no significant differences between the three groups ($p > .05$). Separate ANOVAs were conducted to compare continuous demographic variables across groups. The results revealed no significant differences among groups for age, number of previous injuries, and hours of training per week ($p > .05$). Refer to Appendix I for results from analyses.

4.2 Testing for Covariates

A covariate is a variable that has the potential to be associated with outcome variables measured. For this study, the demographic variables (sex, number of previous injuries, and sport type) were tested as covariates. Also, imagery ability and whether participants completed the follow-up in the lab or online were tested as covariates. To test for covariates, I conducted separate repeated measures ANOVAs with experimental condition and each covariate as independent variables. Perceptions of pain, task and coping efficacy, and frequency, duration and quality of adherence to rehabilitation were included as dependent variables. The covariates only had effects in the analyses of task and coping efficacy.

In the analysis testing follow-up method (lab vs. online) as a covariate affecting task efficacy, the main effect for time was significant, $F(1, 77) = 89.82$, $p < .001$, $\eta^2 = .54$. Participants who came into the lab to complete the follow-up reported higher levels of task efficacy than participants who completed the entire study online.

In the analysis testing sex as a covariate affecting coping efficacy, the main effect for time for time was significant, $F(1, 79) = 6.77$, $p = .01$, $\eta^2 = .08$. Over time, women reported higher levels of coping efficacy than men. The variables that emerged as covariates imply that over time those participants who completed the study in the lab reported higher task efficacy and women reported higher coping efficacy than men over time.

4.3 Hypothesis Testing

Four separate 3 (group) x 2 (time) repeated measures ANOVAs and two ANCOVAs were conducted to analyze between group differences in athletes' perceptions of pain, task and coping efficacy, and the three components of rehabilitation adherence a) frequency, b) duration, and c) quality, before and after the intervention was administered.

4.3.1 Pain

The repeated measures ANOVA revealed a significant main effect for time on levels of expected pain, $F(1, 81) = 5.97$, $p = .017$, $\eta^2 = .07$ (Table 4). Participants' responses increased from baseline to post-intervention. Thus, at follow-up participants believed they would have more pain than they initially thought. The main effect for condition and the condition by time interaction were not significant.

4.3.2 Task and Coping Efficacy

The repeated measures ANCOVA controlling for follow-up method revealed a significant main effect for time, $F(1, 79) = 193.23$, $p < .001$, $\eta^2 = .53$ (Table 5). Participants' task efficacy increased from baseline to post-intervention. The main effect for condition and the condition by time interaction were not significant.

The repeated measures ANCOVA controlling for sex indicated a significant main effect for time, $F(1, 79) = 11.16$, $p < .001$, $\eta^2 = .08$ (Table 5). Coping efficacy increased for participants across all conditions. The main effect for condition and the condition by time interaction were not significant.

4.3.3 Frequency, Duration, and Quality of Adherence to Rehabilitation

The repeated measures ANOVA for frequency adherence revealed a significant main effect for time, $F(1, 32) = 5.17$, $p = .03$, $\eta^2 = .14$ (Table 6). All participants' perceptions of frequency adherence to rehabilitation increased. The main effect for condition and the condition by time interaction were not significant. The results for duration adherence indicated no main effects for time or condition and the condition by time interaction was not significant (Table 6). The results for quality adherence revealed no significant differences for time, condition, and condition by time (Table 6).

4.4 Manipulation Check

Descriptives and frequencies were calculated in order to examine the manipulation check questions for each group.

4.4.1 Control Group

Results revealed that the participants were able to envision themselves in the scenario relatively well (Table 7). The mean score for vividness of the scenario was 3.43 (*SD* = .84) out of a possible 5. The modal score was 3. The control group indicated using imagery of the recovery process while they were completing the questionnaires. The mean score was 3.44 (*SD* = .87) out of a possible 5, and the modal score was 3. Also, the majority of the participants indicated that they did not base their responses on a friend or teammate's experience (76% reported 'no'; Table

10). This is an important finding because it supports that participants were responding to the questionnaires based their perceptions of how they would experience the injury.

4.4.2 Modeling Group

The results indicate that participants in the modeling condition believed the model was fairly similar to themselves (*M* = 4.04, *SD* = .59; Table 8). The modal score was 4. No participants responded less than 3 (moderately similar) out of a possible 5. The modeling group used imagery of the recovery process while responding to the questionnaires (*M* = 3.50, *SD* = .89, out of a possible 5). The modal score for using imagery for recovery was 4. The majority of the participants reported that they did not base their responses on a friend or teammate's experience of an ACL injury (70% reported 'no'; Table 10). Participants generally indicated that if they were faced with an ACL injury in the future, they would make use of modeling (*M* = 4.48, *SD* = .85, out of a possible 5). The modal score was 5.

4.4.3 Imagery Group

The imagery group was asked three questions regarding their ability to image the content from the guided script (Table 9). These questions were on a 5-point scale. The results revealed participants could generate clear images (*M* = 3.83, *SD* = .81, mode = 4), had control of images (*M* = 4.03, *SD* = 1.02, mode = 4) and followed along with the script closely (M = 4.10, *SD* = 1.01, mode = 5). Also, the majority of the participants indicated that they did not base their responses on a friend or teammate's experience (67% reported 'no'; Table 10). Participants generally indicated that if they were faced with an ACL injury in the future, they would use imagery (*M* = 3.62, *SD* = .73). The modal score was 4 out of a possible 5.

Table 4. *Pre and post means and standard deviations for expected pain by group*

	Total *M* (*SD*)	Control Group *M* (*SD*)	Modeling Group *M* (*SD*)	Imagery Group *M* (*SD*)
Pain (/100)				
Baseline	49.52 (16.86)	47.59 (14.06)	44.62 (18.16)	55.86 (16.86)
Follow-up	54.64* (16.97)	54.83 (15.73)	51.15(17.28)	57.59 (17.86)

* $p < .05$ within-group comparison

Table 5. *Pre and post means and standard deviations for self-efficacy by group*

	Total *M* (*SD*)	Control Group *M* (*SD*)	Modeling Group *M* (*SD*)	Imagery Group *M* (*SD*)
Task Efficacy (/100)				
In lab baseline	61.76 (12.71)	62.82 (15.20)	62.59 (12.15)	61.10 (11.93)
In lab follow-up	85.74* (14.27)	87.12 (10.50)	88.00 (15.08)	82.38 (16.37)
Online baseline	79.77 (16.32)	75.00 (17.56)	79.52 (18.60)	84.17 (16.04)
Online follow-up	79.55 (20.63)	75.24 (20.54)	74.76 (28.21)	87.50 (15.06)
Coping Efficacy (/100)				
Baseline - Women	67.83 (19.51)	65.58 (20.64)	72.08 (25.22)	68.33 (15.26)
Follow-up - Women	76.25* (15.49)	74.81 (16.53)	85.71 (14.84)	73.41 (13.71)
Baseline - Men	74.24 (19.31)	75. 17 (21.66)	74.00 (17.74)	73.75 (20.02)
Follow-up - Men	75.80 (20.70)	74.36 (19.09)	77.38 (21.83)	74.58 (21.44)

* $p < .05$ within group comparison

Table 6. *Pre and post means and standard deviations for rehabilitation adherence by group*

	Total *M* (*SD*)	Control Group *M* (*SD*)	Modeling Group *M* (*SD*)	Imagery Group *M* (*SD*)
Frequency (%)				
Baseline	93.33 (28.85)	96.15 (24.68)	102.08 (34.47)	79.17 (23.32)
Follow-up	111.43* (47.75)	101.28 (33.65)	137.50 (63.51)	93.33 (27.44)
Duration (%)				
Baseline	82.28 (24.91)	80.77 (23.17)	87.13 (27.16)	79.13 (24.55)
Follow-up	85.73 (22.89)	81.18 (18.33)	90.17 (29.20)	86.01 (19.87)
Quality (%)				
Baseline	82.27 (12.13)	80.79 (12.25)	84.04 (9.06)	82.27 (9.70)
Follow-up	83.67 (10.88)	81.03 (12.13)	85.96 (10.96)	84.29 (9.10)

Note. *$p < .05$ within-group comparison. Participants were able to score more than 100% if they believed they would do more exercise than what was prescribed by the physiotherapist

Table 7. *Manipulation check for control group*

Question	*M* (*SD*)
Vividness of scenario	3.34 (.83)
Imagery of recovery	3.45 (.93)

Note. Questions were rated on a 5-point scale

Table 8. *Manipulation check for modeling group*

Question	*M* (*SD*)
Similarity to model	4.04 (.59)
Imagery of recovery	3.56 (.87)
Future use of modeling	4.48 (.85)

Note. Questions were rated on a 5-point scale

Table 9. *Manipulation check for imagery group*

Question	*M* (*SD*)
Clear image	3.83 (.81)
Control image	4.03 (1.02)
Follow script	4.10 (1.01)
Future use of imagery	3.62 (.73)

Note. Questions were rated on a 5-point scale

Table 10. *Manipulation check question for all groups*

Others' experience of an ACL injury	Control Group % (n)	Modeling Group % (n)	Imagery Group % (n)
Yes	24.1 (7)	29.6 (8)	30.3 (9)
No	75.1 (22)	70.4 (19)	66.7 (20)

Chapter 5

Discussion

The purpose of this study was to compare a modeling, an imagery, and a control condition on psychological factors in the context of a hypothetical ACL injury. Our hypothesis that the participants in the modeling and imagery groups would have more positive perceptions of pain, task, and coping efficacy, and better hypothetical rehabilitation adherence than the control condition was not supported. No condition effects were found. Although there were no differences between groups, there were some changes over time on perceptions of pain, task, and coping efficacy, and frequency of adherence to rehabilitation. Also, from the manipulation check questionnaire we determined that athletes would use modeling and imagery in the future if they are faced with an ACL injury. Below we discuss the project findings in the context of the study limitations and contributions.

There are three major study limitations that must be considered before addressing the specific study findings. First, the sample size was small and lead to our study being under powered (see Appendix H for power calculations). Consequently, it was difficult to detect differences among groups. Another important aspect to address is the inclusion of healthy athletes rather than conducting the study with injured athletes. Even though sport injuries commonly occur (Canadian Community Health Survey, 2009), conducting research that involves injured athletes is challenging. Past research has been successful in improving psychological factors related to injury among healthy athletes in the situation of a hypothetical scenario (Grove et al., 1990). However, this study was not successful when implementing interventions among healthy athletes in the context of a hypothetical ACL injury. It could be that the athletes found it challenging to imagine themselves in a negative situation in the current study (Damato, 2007).

Finally, we found that participants in the control group used imagery for recovery when completing the study. Therefore, we may not have had a true control group, instead we had a spontaneous imagery control group. The implications for having a spontaneous imagery control group may suggest that we made comparisons between a modeling group, a guided imagery group, and an un-guided imagery group. Our discussion of the findings is in light of these three major limitations.

5.1.1 Pain

Interestingly, all participants reported an increase in perceptions of pain from baseline to post-intervention. Conversely, our hypothesis was that participants in the modeling and imagery groups would report lower perceptions of pain at follow-up compared to the control group. Perceptions of pain may have changed for participants in the modeling and imagery groups because of the emphasis on pain in both the video and script. The model in the video described ways to manage the pain, and the guided imagery script asked participants to "feel the pain..." A possible explanation for the control group reporting higher levels of pain may be because of the time between testing and reading the scenario for a second time. Since a control group can provide indication of the reliability of the measures in a repeated measures study, the response at the second time point may be a more accurate perception because participants had more time to think about the amount of pain associated with an ACL injury.

The finding that all participants increased in level of expected pain is not consistent with previous research among people with injuries (Maddison et al. 2006; Cupal & Brewer, 2001). Cupal and Brewer implemented a relaxation and imagery intervention among participants who were post-operative ACL reconstructive surgery and found the intervention was effective in decreasing pain. Maddison et al. found that a modeling intervention was also effective in decreasing pain among post-operative ACL reconstructive patients. Participants in both studies received the intervention at more than one time point. The imagery and relaxation sessions were administered ten times throughout the length of the study and participants were also asked to listen to the scripts at least one more time each day (Cupal & Brewer). In the modeling study, the videos were viewed at four different time points (Maddison et al.). Because both studies administered the interventions more than once, this could explain participants' decreases in amount of pain. Whereas this thesis implemented each intervention once. Perhaps if there were additional follow-ups with different information portrayed in the interventions, participants may have reported lower levels of expected pain.

Even though this study included a manipulation check of whether participants based their responses to the questionnaires on others' experiences with an ACL injury, participants could have remembered the amount of pain a teammate or friend had with the specific injury and then rated the pain to be higher at follow-up. Another explanation of why we found increases in pain may be that after the baseline session participants thought back to their own past injuries and the pain associated with them. They may have realized that their previous injuries were not as serious as an ACL injury and therefore rated the level of pain higher at follow-up.

5.1.2 Task Efficacy

Despite increases in perceptions of pain over time, all participants' task efficacy beliefs increased. Perhaps this increase is because of being exposed to more information about the injury. Participants in the intervention groups either watched others performing exercises or generated images of themselves doing the necessary rehabilitation exercises; in turn these images may have lead to greater task efficacy. On the other hand, the control group only read the scenario again that included a short list of the first three weeks of rehabilitation exercises. Simply re-reading the scenario produced greater task efficacy. The manipulation check questions indicate that the majority of the participants in the control used imagery for recovery when completing the questions, this use of imagery in turn could have contributed to increases in task efficacy.

When controlling for whether participants completed the study in the lab or online, those who came into the lab for the follow-up reported higher task efficacy than participants who completed the study online. There was no difference in how participants completed the baseline testing. However, meeting with the experimenter to complete the follow-up seemed to have an effect on participants' task efficacy. A possible explanation for this finding could be due to social desirability bias (Fisher, 1993). The participants who came into the lab to complete the follow-up may have answered more favourably because of the presence of the researcher. Also, the participants who completed the follow-up online may not have paid as much attention as those who came into the lab. This decrease in attention may be due to the lack of control an experimenter has over participants' environments who complete studies through the Internet (Gosling, Vazire, Srivastava, & John, 2004). An individual who completes a research study in the comfort of his or her home may be attending to multiple stimuli. In contrast to someone who comes into the lab to complete a study, he or she will most likely focus solely on the experiment.

5.1.3 Coping Efficacy

In addition to the observed increase in task efficacy, all participants' coping efficacy beliefs increased over time. Again, our hypothesis for coping efficacy was that participants who received the modeling or imagery intervention would report greater scores in coping efficacy than the control group. Further testing revealed that women reported larger increases in coping efficacy than men over time. This finding is not consistent with previous research. Milne et al. (2005) found no gender differences in terms of coping efficacy among injured athletes. Despite not having injured participants in this study, women were found to have higher levels of coping efficacy than men in the situation of a hypothetical ACL injury. This difference in coping efficacy among women and men may be explained through the socialization model, in that men and women respond differently to stressors because of sex role stereotypes (Ptacek, Smith, & Zanas, 1994). The socialization model suggests that women use more emotion-focused strategies and seek social support, whereas men use more problem-focused strategies. It could be argued that modeling and imagery serve as emotion-focused strategies and those women in the modeling condition considered the video to represent a form of social support.

5.1.4 Frequency, Duration, and Quality of Adherence to Rehabilitation

Over time all participants increased their perceived frequency of adherence. Milne et al. (2005) found that coping efficacy predicts frequency of adherence. In our study we found that coping efficacy increased in all groups, this may have translated into increased perceptions of adherence frequency. Strong coping efficacy beliefs may be related to performing rehabilitation exercises more frequently. No group or time effects were found for duration of rehabilitation adherence. An explanation for finding no effects for duration of adherence may be that the instructions for this measure might not have been clear. Participants were asked, “How long (minutes) does your physiotherapist want you to spend on your rehabilitation exercises each time you do them?” and “How long (minutes) do you actually spend on your rehabilitation exercises each time you do them?” Some participants may have been confused and thought they were being asked the same question twice, if they did not spend time reading each question. In addition to the idea that the instructions may not have been clear is that the majority of the participants included in the study competed at the varsity level and have busy schedules. Perhaps the participants thought they would not be able to spend more time on exercises than what was prescribed by the physiotherapist.

An additional explanation of finding no differences in quality of rehabilitation exercises may be due to a ceiling effect. Because the participants in the study were competitive athletes and were most likely familiar with the rehabilitation exercises listed in the scenario, they reported a somewhat high level of quality to rehabilitation at baseline and follow-up. Thus, there was little room to detect improvement.

5.1.5 Manipulation Check

The inclusion of manipulation check questions helped to provide useful information about the study. Previous injury intervention research did not include manipulation checks about the specific intervention (e.g., Maddison et al., 2006; Cupal & Brewer, 2001). Overall, athletes seemed to recognize the use of modeling and imagery in injury rehabilitation. The materials (i.e., modeling video and imagery script) were well put together and were based on content from past research (Maddison et al.). The modeling group responded favourably in regards to perceiving the model to have similar characteristics. All participants reported a score of at least 3 out of 5 on the perceived similarity scale. These scores indicate that participants were able to relate to the model in the video. In addition, the majority of the modeling group reported that they would use that psychological strategy if they were faced with an ACL injury in the future. This response provides some suggestion that viewing the video may have been effective in teaching participants the role of modeling in injury rehabilitation. The imagery group also indicated that they would use imagery in the future if they were faced with an ACL injury. Because both interventions groups agreed to use the respective strategy in the future, this provides useful information about the strategies and allows for additional investigations of modeling and imagery within athletic rehabilitation.

In addition, the imagery group responded to manipulation check questions based on their ability to: envision clearly, control images, and follow the script. These three manipulation checks provide information about how participants generated images from a guided script. The majority of the participants in the imagery group perceived that they could generate the images clearly, have control over the images and follow along closely to the script.

Both the control and modeling groups used some imagery of recovery when they responded to the questionnaires. It is not surprising that the modeling group used imagery because according to Bandura (1986; 1997), modeling serves as representations for imagery. The participants in the modeling group most likely formed images based on the information in the video while completing the questionnaires. The rationale for the control group using imagery may be that those who have had previous experience in rehabilitation used stored images from that experience. This finding may imply that the study did not have a true control group because the participants used imagery and what may be here is a guided imagery versus a spontaneous imagery comparison. The athletes included in the study competed at a high level and may have been taught to use imagery, and therefore utilized the skill while completing the study. Perhaps, spontaneous imagery would have been less likely with recreational athletes who may not have learned about imagery and may not have used the strategy for recovery to the same extent as would have used it to a lesser extent if they were included in the study (Hall, Rodgers, & Barr, 1990).

Most of the participants reported that they did not respond to the questionnaires based on a friend or teammate's experience of an ACL injury. This question was asked because the injury is quite common and a participant could have known someone who recently injured his or her ACL (i.e., modeling). With the majority of participants responding favourably to this question, it ensures that they were basing their perceptions only on what they were exposed to in this study, along with their own perceptions.

5.2 Study Limitations

Aside from the three major limitations previously mentioned, there are several more to highlight. Even though the scenario was realistic, participants may not have fully grasped the idea of responding to the questionnaires based on the hypothetical injury. For instance, the measurement used for adherence (i.e., frequency, duration, and quality) and the instructions may not have been clear to some participants and therefore they may have been confused about how to respond. Also, the adherence questionnaire was used in previous correlational research and had not been used in an experimental study involving a hypothetical injury. It may be that the specific adherence measurement was not well suited for this study. In order to improve this measurement, the instructions could be clearer, specifically highlighting the contrast between participants' perceptions of projected rehabilitation adherence and what is prescribed by the physiotherapist.

In addition to the adherence measure, our inclusion criteria and demographic questionnaire were study limitations. We excluded athletes who had experienced any type of injury within the last six months. Perhaps asking specifically what injury an athlete had experienced in the last six months instead of excluding every type of injury would have allowed for more participants. For example, if an athlete had an upper body injury, such as a wrist injury, he or she could still participate because the rehabilitation is not similar to that of an ACL injury. Also, we could have asked about a participant's perceived severity of his or her previous injury. The severity level of an ACL injury is thought be quite high (DeCarlo et al., 1994; Derscheid &

Fering, 1987), thus an athlete who rated his or her thumb injury as low in severity could have participated in the study.

Another demographic characteristic we did not inquire about was the participant's program of study or occupation. For instance, if a participant was studying to become a physiotherapist or athletic therapist, he or she may have been more willing and interested in participating versus athletes who were not in this field. As well, this exposure to rehabilitation because of studying or working in a clinic may have influenced participants' perceptions of an injury.

Although not only varsity athletes were recruited, recruitment started at the end of January and most of the outdoor team sports (i.e., soccer, field hockey, rugby, football, lacrosse) were in the off-season and not regularly training as a team which made recruitment challenging. Athletes competing at a high level, especially those at the varsity level, have minimal free time. It could be that some athletes perceived the study to be a time commitment and could not fit it into their schedule. In an attempt to gain more participants, we allowed some participants to complete the entire study online. Creating this option did not improve recruitment, only a few participants fully completed the study using that method. Some participants who completed the study online might not have fully attended to the study (Gosling et al., 2004).

5.3 Study Strengths & Contributions to Athletic Injury Research

Despite the study's limitations, there are some strengths to highlight. This study is the first known study to compare imagery and modeling within injury rehabilitation using a scenario. Implementing a scenario is beneficial to control for the many challenges when studying injured athletes. This study controlled for participants' perceptions of one injury. Many sport injury studies include athletes with a wide range of injuries (e.g., Milne et al., 2005; Sordoni et al., 2002). Because injuries commonly occur (Canadian Community Health Survey, 2009) investigating healthy athletes' perceptions of an ACL injury is worthwhile.

The majority of previous sport injury research has been correlational or qualitative whereas this study was a randomized, controlled experiment. The inclusion of a control group was a strength of this study. Cupal and Brewer (2001) stated that many studies of sport injury that implement psychological interventions do not include an attention control. It is important in experimental research to compare intervention groups to a control in order to determine whether the treatments had any effect on outcomes measured. The results from the manipulation check indicate that not only the imagery group used the skill while completing the study. The modeling and control groups both reported to use imagery, perhaps the increases in task and coping efficacy, and frequency of rehabilitation adherence can be attributed to imagery use. Therefore the control group represented a spontaneous imagery group. Given that athletes at this level are apt to use imagery (Salmon, Hall, & Haslam, 1994), the control versus imagery group may be a comparison of guided imagery versus spontaneous imagery as opposed to imagery versus no imagery. Based on our findings physiotherapists should encourage imagery use to their patients in order to enhance aspects of recovery.

Including manipulation check questions allowed for further inquiry regarding the interventions. The findings from the manipulation check questions indicate that participants who were in the modeling and imagery groups agreed to use the strategy in the future. Thus, the interventions can serve as pre-injury education and possible coping tools if the athlete is faced with an ACL injury in the future.

Despite no differences among the groups, physiotherapists should be made aware of the potential benefits modeling and imagery may have for injured athletes. In this study, modeling and imagery served as a vicarious experience, which is the second most influential source of self-efficacy (Bandura, 1997), and could be useful resources to help prepare athletes for coping with an injury. These two strategies are easy to implement, cost effective, and may decrease the amount of physiotherapy visits. Future studies could further support the use of modeling and imagery in athletic rehabilitation.

5.4 Future Directions

There are many different avenues to take when studying athletic injury because there are plenty of gaps to fill within this area. Future researchers should replicate this study with injured athletes. Modeling and imagery are influential sources of self-efficacy (Bandura, 1997) and could have the potential to enhance an injured athlete's recovery process. Further investigations examining these strategies within sport injury would not only be beneficial for injured athletes, but also for coaches and those who work with athletes during recovery.

Besides replicating this study with injured athletes, it would be ideal in a future study to implement a longitudinal design. Initially the study could measure uninjured athletes' perceptions of a hypothetical injury and implement a modeling or imagery intervention. The study could follow athletes over the length of a season. In the event that an athlete experiences an injury, the intervention could be administered again, and then a comparison of perceptions to actual behaviour could be made.

Although this study did not support that modeling or imagery was more effective than the other in the situation of a hypothetical ACL injury, studies should still compare the psychological strategies. This study only looked at the situation of an ACL injury. Perhaps examining the strategies among different injuries (e.g., upper body or broken bones) one could be more effective than the other in a different situation. In addition, the majority of sport injury studies include athletes who are over 18 years old (e.g., Sordoni et al., 2002; Cupal & Brewer, 2001). Future injury studies could include younger athletes who have less experience with injuries and sport psychological skills to investigate whether modeling or imagery would be more effective among younger athletes.

Aside from comparing modeling and imagery within athletic rehabilitation, a study that involves a combination of the strategies would be interesting. Due to the limited amount of research in athletic rehabilitation, there are many other strategies that could be compared such as goal setting, self-talk, and social support. In addition to comparing strategies in experimental studies, future research could involve qualitative interviews or a mixed methods approach with injured athletes to find out which strategies are preferred during rehabilitation.

Another suggestion for future research is to compare individual sport athletes to team sport athletes. This study only included athletes from team-based sports where an ACL injury is common. A future study could include a common sport injury that occurs across all sports and examine differences in individual sport athletes to team sport athletes on perceptions of an injury in terms of coping. Sport type is included as a situational factor in the cognitive appraisal model (Weise-Bjornstal et al., 1998). Finding potential differences in emotional reactions to an injury among athletes from different sports may be beneficial for a physiotherapist or sport psychologist who is working with an injured athlete. An athlete who plays a team-based sport may have more contact for social support compared to an athlete who competes at an individual level (Johnson, 1997).

Future imagery and modeling research that draws upon the cognitive appraisal model could include aspects related to life stressors. Aside from experiencing an injury due to sport and the negative consequences affecting an athlete's sport season, other aspects of the athlete's life may be impacted by the injury. For example, the model in our video discussed how his ACL injury affected his school life. Therefore, investigating an athlete's life outside of the sport situation may be beneficial for others who are influential people (i.e., significant other, parents, friends) in an athlete's life. Thus, the history of stressors factor of the injury model and an injured athlete's present stressors need to be examined further.

5.5 Conclusion

To our knowledge this study was the first to compare modeling and imagery within sport injury research. This exploratory study investigated healthy athletes' perceptions of an ACL injury. Our hypothesis that both intervention groups would respond more positively compared to a control condition was not supported. Further research needs to be conducted on psychological interventions in athletic injury in order to better understand which strategies can enhance the rehabilitation process.

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Appendix A

Recruitment, Electronic Consent and Letter of Information, Demographic Questionnaire

Recruitment Materials

Email to Coaches

Dear Coach,

I am writing to request permission to recruit your athletes for a research project examining factors related to a hypothetical injury. The ultimate goal of our research is to understand how we can prepare athletes to cope when faced with an injury in the future. This research is being conducted by Renee Bolkowy, a graduate student in the School of Kinesiology & Health Studies under the supervision of Drs. Amy Latimer (Queen's University) and Barbi Law (Nipissing University). This study has been granted clearance according to the recommended principles of Canadian ethics guidelines and Queen's policies.

For this study, we are looking for healthy athletes over the age of 18 years, currently competing at the varsity level or higher. Athletes' participation in this study would involve reading an injury scenario and completing an online questionnaire package which would take approximately 15 minutes. The online questionnaire will be completely confidential. After athletes complete the online questionnaire, they will be required to come into the lab to finish the remainder of the study. This will involve the athletes completing an experimental task and another questionnaire package. There are no known risks associated with participation in this study.

Your athletes' participation in this study will not interfere with your regular training or competition schedules. If you consent to us recruiting your athletes, please forward the attached athlete information letter to your athletes. Alternatively, the primary researcher could also meet with your team in order to recruit athletes, at a time that is convenient. If you consent to us recruiting your athletes, please indicate if this is your preference.

Also, if you have further questions, please contact the primary researcher, Renee Bolkowy, renee.bolkowy@queensu.ca, or Dr. Amy Latimer, amy.latimer@queensu.ca, (613) 533-6000 ext. 78773, or Dr. Barbi Law, barbil@nipissingu.ca (705) 474-3450 ext. 4147.

Thank you for your time and consideration,

Renee Bolkowy, (M.A. Student), Dr. Barbi Law, & Dr. Amy Latimer

Email to Athletes

Dear Athlete,

I am writing to invite you to participate in a research study examining factors related to a hypothetical injury. The ultimate goal of our research is to help prepare athletes to cope when faced with an injury in the future. This research is being conducted by Renee Bolkowy, a graduate student in the School of Kinesiology & Health Studies under the supervision of Drs. Amy Latimer (Queen's University) and Barbi Law (Nipissing University). This study has been granted clearance according to the recommended principles of Canadian ethics guidelines and Queen's policies.

For this study, we are looking for healthy (uninjured) athletes 18 years old and over, currently competing at the varsity level or higher. Your participation in this study would involve reading a scenario of an injury and completing a questionnaire package online which would take approximately 15 minutes. Within a week of completing the online questionnaire you will be asked to come into a lab in the School of Kinesiology and Health Studies to complete a brief experimental task and a questionnaire package. This would take approximately another 15 minutes to complete. The types of questions included within the questionnaire package are related to your sport experience, injury history, and your perceptions related to the injury scenario. The questionnaires will be completely confidential and there are no known risks associated with participation in this study. The data collected will be kept for five years in a password protected electronic file. Following the five years all records will be destroyed by deleting them from the hard drive and any paper will be shredded.

If you consent to participate in this study, the link to the online questionnaire is below. Also, if you have further questions, please contact the primary researcher, Renee Bolkowy, renee.bolkowy@queensu.ca, or Dr. Amy Latimer, amy.latimer@queensu.ca (613) 533-6000 ext. 78773, or Dr. Barbi Law, barbil@nipissingu.ca (705) 474-3450 ext. 4147.

Thank you for your time and consideration,

Renee Bolkowy, (M.A. Student), Dr. Amy Latimer, & Dr. Barbi Law

http://ca.studentvoice.com/queens/hypotheticalinjury2010

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Letter of Information and Consent Form

Thank you for your interest in participating in this study. This project is about examining factors that are related to a situation of a hypothetical injury. This research is being conducted by Renee Bolkowy, a graduate student under the supervision of Dr. Amy Latimer (Queen's University) and Dr. Barbi Law (Nipissing University).

If you agree to participate in this study, you will read a scenario that describes the occurrence of a sport injury and complete an online questionnaire. The first part of the questionnaire will include demographic information, as well as sport experience and injury history. Also, information that is directly related to the injury scenario will be gathered. Responses to questions will involve writing short answers, checking tick boxes, and rating statements on a scale. You will be asked to come into a lab in the School of Kinesiology and Health Studies of Queen's University up to one week after completing the online questionnaire to participate in an experimental task. The task will involve receiving information about athletic injury and you will be required to complete another brief online questionnaire.

There are no known risks to participation in the study. A potential benefit is that you may learn how to cope if you are faced with an injury in the future. Participation in this study is voluntary and you are free to withdraw at any time. You are also not obliged to answer any questions which you find objectionable or which make you feel uncomfortable. We will gather information from you through a series of online questionnaires and only the researcher and her supervisors will have access to the data. You will be asked to provide your email address in order for us to contact you for the second part of the study. Your email address will not be linked to your questionnaire in any way and will be deleted once you complete the study. Your anonymity will be protected by asking you to create a unique identifying code and having you record only this code on your questionnaire. The data will be kept for five years in a password protected electronic file. Following the five years all records will be destroyed by deleting them from the hard drive and any paper will be shredded. The results of the study will be grouped to prevent any individual's data from being made known. The data from the study may be used in academic presentations and publications.

If you have any questions, comments, concerns, please feel free to contact Renee Bolkowy, renee.bolkowy@queensu.ca, the project supervisors, Dr. Amy Latimer, amy.latimer@queensu.ca (613) 533-6000 ext 78773, Dr. Barbi Law, barbil@nipissingu.ca (705) 474-3450 ext 4147, Dr. Jean Cote, Director of the School of Kinesiology and Health Studies, jc46@queensu.ca, (613) 533-6601, or the Chair of the General Research Ethics Board, Dr. Joan Stevenson, (613) 533-6081, email: chair.GREB@queensu.ca.

If you accept and understand these conditions, please indicate your electronic consent by selecting yes or no.

- Yes, I consent to participate.
- No, I do not consent.

Demographic Questionnaire

In order for us to create a unique identifier code for you that will appear on your data in place of your name please provide the following details:

Provide the day and month of your birthday: Day: _______ Month: ________

Last four digits of your telephone number: ☐ ☐ ☐ ☐

Instructions: Please complete the following questionnaire by filling in the blanks or ticking the appropriate box for each of the questions below. Thank you for your participation!

Part 1: Demographic Information

Gender:

- ❑ Female
- ❑ Male

Current Age: _______ years

Injury History:

How many previous injuries have you successfully rehabilitated (i.e., sought physiotherapy treatment for)?

- ❑ 0
- ❑ 1-2
- ❑ 3+

Have you experienced an injury and spent time seeking physiotherapy treatment within the last six months?

- ❑ Yes
- ❑ No

If yes, what was the length of time you spent in rehabilitation?

- ❑ 1-3 weeks
- ❑ 4-6 weeks
- ❑ 7+ weeks

Have you ever experienced an ACL injury before?

- ❑ Yes
- ❑ No

If yes, how long did it take you to rehabilitate your ACL?

- ❑ 1-3 weeks
- ❑ 4-6 weeks
- ❑ 7+ weeks

Was reconstructive surgery required?

- ❑ Yes
- ❑ No

Sport Information:

Current Sport: ______________________________

Number of seasons on this team (including the current season): ___________

Position played on this team (indicate if it is Not Applicable): __________________

Highest competitive level in this sport (on this team or on another team):

- ❑ Varsity
- ❑ Provincial
- ❑ National
- ❑ International/Professional

Current Phase of Competitive Season:

- ❑ Pre-season
- ❑ Competitive season
- ❑ Off-season

Hours spent in training per week: ______________________

Appendix B

Hypothetical Injury Scenario

You are about to play in a very important game against a rival. Your team is coming off a great win last week. The bleachers are packed with very loud fans, and luckily it is a home game where your record is 5-1. You are in great shape, healthy and ready to play. You are extremely excited about this game because you have improved since the beginning of the season and you truly enjoy playing. Your team has been up the entire game and everything seems to be going in your favour. There are 10 minutes left in the game and all off a sudden a player on the other team runs into you. You hear a pop sound and immediately you feel an excruciating pain in your knee. You go down, letting out a terrible scream. As you lie there your vision starts to go blurry and you recognize all of the earlier sounds of the game have disappeared. You need to be taken off the field and realize that you will not be back in the game or any game in the near future. You hear the sound of clapping as one of your teammates and the athletic therapist helps you off the field. Another player must replace you.

After seeing a doctor your diagnosis is a complete tear of the anterior cruciate ligament (ACL) in your right knee. (The ACL is a very important ligament in your knee that connects the bones of the knee joint. The function of the ACL is to provide stability to the knee and minimize stress of the knee joint.) The doctor recommends reconstructive surgery for your ACL tear. After your surgery, you will begin a rehabilitation program. Within a few days after your surgery, you attend your first physiotherapy appointment, and your physiotherapist states you will need 4-6 months to recover – this means you are *out for the season*. Also at the time of your appointment, the physiotherapist mentions the exercises you should do.

Week 0-2 post-operation

Ice before and after exercises:

- Heel slides (slide heel toward buttocks)
- Wall slides (foot on the wall and allow the foot to slide down the wall by bending the knee)
- Quad sets (contracting quad muscles)
- Straight leg raise
- Hamstring and calf stretches

These should take you about 30-60 minutes to do. Although the exercises may be uncomfortable, you must keep in mind that they will help strengthen and improve range of motion of your knee. Also using the correct form is important.

Week 2-3

- Low resistance stationary cycling
- Double leg squat or leg press
- Step-ups
- Heel raises on surgical leg and calf stretches
- Single leg stand on surgical leg

Following week 3 post-operation, you should be able to perform more intense exercises related to strength as well as agility. As you progress throughout your rehabilitation program, your physiotherapist will adjust your exercises accordingly. Eventually after a structured and supervised rehabilitation program you should gain full confidence in your knee. Depending on your speed of recovery, you could return to sport after 4-6 months of rehabilitation. The criteria for returning to your sport includes 80% overall knee strength, full range of motion, and completion of a sport-specific exercise program.

Appendix C

Vividness of Movement Imagery Questionnaire

Movement Imagery Ability

Movement imagery refers to the ability to imagine a movement. The aim of this questionnaire is to determine the vividness of your movement imagery. The items of the questionnaire are designed to bring certain images to your mind. You are asked to rate the vividness of each item by reference to the 5-point scale. After each item, circle the appropriate number in the boxes provided. The first column is for an image obtained watching yourself performing the movement from an external point of view (External Visual Imagery), and the second column is for an image obtained from an internal point of view, as if you were looking out through your own eyes whilst performing the movement (Internal Visual Imagery). The third column is for an image obtained by feeling yourself do the movement (Kinaesthetic imagery). Try to do each item separately, independently of how you may have done other items. Complete all items from an external visual perspective and then return to the beginning of the questionnaire and complete all of the items from an internal visual perspective, and finally return to the beginning of the questionnaire and complete the items while feeling the movement. The three ratings for a given item may not in all cases be the same. For all items please have your eyes CLOSED.

Think of each of the following acts that appear on the next page, and classify the images according to the degree of clearness and vividness as shown on the RATING SCALE.

RATING SCALE. The image aroused by each item might be:

Perfectly clear and as vivid (as normal vision or feel of movement)	……………	RATING 1
Clear and reasonably vivid	……………	RATING 2
Moderately clear and vivid	……………	RATING 3
Vague and dim	……………	RATING 4
No image at all, you only “know” that you are thinking of the skill.	……………	RATING 5

	Watching yourself performing the movement (External Visual Imagery)					Looking through your own eyes whilst performing the movement (Internal Visual Imagery)					Feeling yourself do the movement (Kinaesthetic Imagery)				
Item	Perfectly clear and vivid as normal vision	Clear and reasonably vivid	Moderately clear and vivid	Vague and dim	No image at all, you only know that you are thinking of the skill	Perfectly clear and vivid as normal vision	Clear and reasonably vivid	Moderately clear and vivid	Vague and dim	No image at all, you only know that you are thinking of the skill	Perfectly clear and vivid as normal feel of	Clear and reasonably vivid	Moderately clear and vivid	Vague and dim	No image at all, you only know that you are thinking of the skill
1.Walking	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
2.Running	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
3.Kicking a stone	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
4.Bending to pick up a coin	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
5.Running up stairs	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
6.Jumping sideways	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
7.Throwing a stone into water	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
8.Kicking a ball in the	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5

air																
9.Running downhill	1	2	3	4	5		1	2	3	4	5		1	2	3	4	5
10.Riding a bike	1	2	3	4	5		1	2	3	4	5		1	2	3	4	5
11.Swinging on a rope	1	2	3	4	5		1	2	3	4	5		1	2	3	4	5
12.Jumping off a high wall	1	2	3	4	5		1	2	3	4	5		1	2	3	4	5

Appendix D

Questionnaires

Athletic Injury Self-Efficacy Questionnaire

Instructions: Based on the scenario, consider that you are **2 weeks post-ACL reconstructive surgery**, please rate the following statements based on the scale below:

0 10 20 30 40 50 60 70 80 90 100

No confidence Somewhat confident Completely Confident

1. I am confident that I can perform all the required rehabilitation exercises.

   0 10 20 30 40 50 60 70 80 90 100

   No confidence Somewhat confident Completely Confident

2. I am confident that I can follow directions from my physiotherapist.

   0 10 20 30 40 50 60 70 80 90 100

   No confidence Somewhat confident Completely Confident

3. I am confident that I can remember all of my rehabilitation exercises.

   0 10 20 30 40 50 60 70 80 90 100

   No confidence Somewhat confident Completely Confident

4. I am confident that I can do my rehabilitation exercises when I am in a bad mood.

   0 10 20 30 40 50 60 70 80 90 100

   No confidence Somewhat confident Completely Confident

5. I am confident that I can do my rehabilitation exercises when I feel I do not have the time.

   0 10 20 30 40 50 60 70 80 90 100

   No confidence Somewhat confident Completely Confident

6. I am confident that I can do my rehabilitation exercises even though I am feeling some discomfort.

0	10	20	30	40	50	60	70	80	90	100

No confidence Somewhat confident Completely Confident

7. I am confident that I can follow the rehabilitation schedule outlined by my physiotherapist.

0	10	20	30	40	50	60	70	80	90	100

No confidence Somewhat confident Completely Confident

Projected Rehabilitation Adherence

Instructions: Please refer to the following questions as if you were **actually** experiencing the injury described in the **scenario**. You are **2 weeks post-ACL reconstructive surgery**. Your physiotherapist has mentioned that you are required to attend an appointment once a week for an hour. Your physiotherapist also asks that you do 3-5 exercises at least once day on your own time, which would take you a total of 45 min. While you answer the following questions, please keep in mind the **activities you do in your daily life.** Please respond to the following questions:

1. a) How often does your physiotherapist want you to do your rehabilitation exercises (e.g., once per day)? ________________________

   b) How often do you **actually** do your rehabilitation exercises?

   ____

2. a) How long (minutes) does your physiotherapist want you to spend on your rehabilitation exercises each time you do them? _________________

   b) How long (minutes) do you **actually** spend on your rehabilitation exercises each time you do them? ________________________

3. What percentage (%) of the time do you believe that you perform your rehabilitation exercises correctly? ________________________

Perception of Pain

Instructions: Athletes who were scheduled for ACL reconstructive surgery generally support their expected pain to be 50/100 before actually having the surgery. Please circle a number on the scale ranging from 0 (no pain) to 100 (pain as bad as it could be) that best describes how much pain *you* think you will experience **2 weeks after knee surgery:**

0	10	20	30	40	50	60	70	80	90	100

No pain Moderate pain Pain as bad as it could be

Appendix E
Manipulation Check

Control Condition Manipulation Check Questions

1. How vividly could you imagine the injury scenario?

1	2	3	4	5

No image at all   Moderately Vivid   Perfectly Vivid

For the following question please keep in mind the definition of **imagery**. Imagery is "an experience that mimics real experience. We can be aware of 'seeing' an image, feeling movements as an image, or experiencing an image of smell, tastes, or sounds without actually experiencing the real thing."

2. Did you engage in imagery of the recovery process?

1	2	3	4	5

Not at all   Sometimes   Often

3. Did you base your ratings on the questionnaires on a friend/teammate's experience with an ACL injury?

- ❑ Yes
- ❑ No

Modeling Condition Manipulation Check Questions

1. Rate the athlete who was interviewed in the video in terms of **similarity** to yourself.

1	2	3	4	5
Very Low		Moderately		Extremely Similar

For the following question please keep in mind the definition of **imagery**. Imagery is "an experience that mimics real experience. We can be aware of 'seeing' an image, feeling movements as an image, or experiencing an image of smell, tastes, or sounds without actually experiencing the real thing."

2. Did you engage in imagery of the recovery process?

1	2	3	4	5
Not at all		Sometimes		Often

3. Did you base your ratings on the questionnaires on a friend/teammate's experience with an ACL injury?

- ❑ Yes
- ❑ No

Rate your response based on the statement :

4. If I am faced with an ACL injury in the future, I would seek support from someone that has already experienced the injury?

1	2	3	4	5
Strongly Disagree				Strongly Agree

Imagery Condition Manipulation Check Questions

1. How clear was the image you generated from the description of the script?

1	2	3	4	5
No image at all		Moderately Vivid		Perfectly Vivid

2. Do you feel that you could control the image?

1	2	3	4	5
Not at all		Sometimes		Often

3. How closely could you follow the script in your images?

1	2	3	4	5
Not Closely		Somewhat Closely		Very Closely

4. Did you base your ratings on the questionnaires on a friend/teammate's experience with an ACL injury?

   - ❑ Yes
   - ❑ No

Rate your response based on the statement:

5. If I am faced with an injury in the future, I would use imagery during my recovery process.

1	2	3	4	5
Strongly Disagree				Strongly Agree

Appendix F
Guided Imagery Script

Using imagery while injured can help an athlete reflect on themselves in life and sport. The information that will be described is associated with the anterior cruciate ligament or ACL injury scenario you read earlier. Imagine that you are the athlete in the scenario. I will guide you through the process of recovery from your initial ACL injury in your right knee, up to the point when you can return to sport. Please close your eyes until you are told to open them. Try to imagine the following descriptions as vividly as possible. Should you experience any problems imaging, take a deep breath, relax and follow the description as closely as possible.

Start by taking a few slow, deep breaths. Push all thoughts from your mind. I am going to start by asking you to form images of your experiences in the days immediately after your ACL injury. You are counting the days until your surgery and the pain in your right knee is becoming unbearable. Feel the pain in your knee. To deal with the pain you focus your attention on pleasant images. As vividly as you can, try to imagine the most relaxing place. This place can be whatever you wish, perhaps a beach, the woods, or your home – wherever the place is, it should allow you to be totally at peace with yourself. Now pay attention to the sounds that are around you. **[pause briefly]** Take a deep inhale; with that inhale bring your awareness to the smells in your relaxation place. **[pause briefly]** Try to lose yourself in this place. Feel the warmth and comfort that this place provides. Imagine the pain slowly flowing out from your knee. Feel any distracting worries you have about your upcoming surgery leaving your mind. Take your time now to enjoy the calm and beautiful surroundings that force the pain in your knee away. **[longer pause]**

Now, imagine that you are immediately post-surgery. Your doctor has told you it was a success and your knee has been repaired. A nurse is helping you use crutches so you can be mobile as soon as possible. Visualize yourself with crutches under your arms. Notice of how they feel. See yourself taking your first steps. You are aware of the extreme stiffness in your knee. You are able to regulate any pain you experience using the painkillers you were given, but you know that the drugs will wear off and you must figure out a way to cope with the pain. Your doctor has also given you a device called a cryocuff. This fits over your knee and is filled with ice cold water. You have been told that the cryocuff will help with swelling and any bleeding in your knee joint. Take a moment and feel the cooling sensation as you place it around your knee for the first time. **[pause briefly]**

Remember, if you have any problems imaging, take a deep breath, relax and follow the script as closely as possible.

As you progress through recovery, your physiotherapist will give you a series of exercises to help strengthen your knee and increase your range of motion. Your physiotherapist has given you a list of exercises to complete at home and has helped you through them at the clinic. As you look over the list with your physiotherapist, you tell yourself that you are determined to stick with your rehabilitation program. Now imagine yourself at home, completing your prescribed exercises. I will walk you through some of these. First, imagine yourself doing a straight leg raise. Picture yourself lying on your back with both legs extended, and slowly raise your injured right leg. Repeat this two more times. **[pause briefly]** Another exercise that you must do is a heel slide. Again, you are lying down; this time, bend your right knee while sliding your heel toward your bum. Slowly return to a slight bend. As you repeat this movement, try to focus on the range of motion in your knee and the feeling of the exercise. Now, imagine yourself doing is an assisted leg extension. You are holding the ends of a towel and it is looped under the bottom of your right foot. Imagine yourself sitting on a stool or bench that is so high your feet do not touch the ground. Slowly extend your leg out in front of you and then lower it to the starting position. Repeat this two more times. **[pause briefly]** As you perform your rehabilitation exercises you may feel discomfort. Imagine yourself coping with the discomfort and focusing on how the exercises are becoming easier; leading to increased strength and range of motion in your injured leg. Imagine yourself doing your rehabilitation exercises throughout the entire 4-6 month rehabilitation program. Tell yourself you are confident. Imagine the blood flowing through the muscles in your right leg and strengthening every time you perform your rehabilitation exercises. Visualize yourself sticking with your rehabilitation program throughout the entire 4-6 months. **[pause briefly]** You are determined to recover successfully and work hard on your exercises, mentally and physically. Another exercise to perform is a single leg squat. Imagine yourself standing with your left foot off the ground. Slowly bend your right knee to a point that is comfortable. Return to standing with a straight leg, repeat this single leg squat.

You are now close to full recovery of your knee. Imagine the process of how it has healed since your surgery. Create an image of your injured right knee. Think of the color of the injury. Think of oxygen and tons of white blood cells arriving at the injury to help it heal. Feel the white blood cells penetrating deeply into your knee. See tissues becoming healthier and fusing together. Now imagine the ligaments in your knee completely healed and even stronger than before the injury. See the muscles in your leg growing and becoming stronger. Go inside your whole body and feel how relaxed and healthy you are. **[pause briefly]**

Just over 5 months has passed since the day of your surgery. Your physiotherapist has told you that you have gained all the strength back in your knee and are ready to return to full training. Visualize yourself in the weight room performing barbell squats. **[pause briefly]** The amount of weight on the bar is more than you have ever done before. This fills you with great pride. Feel how strong your knee is. The pain from your injury is gone. Another sport specific skill you must be able to do is cutting movements. Visualize yourself making strong, fast cuts as you run the length of your practice field. **[pause briefly]** You are now ready to return to sport. All of the effort you put into your rehabilitation has paid off. To prepare for your first game back, imagine yourself feeling confident in your abilities. Think back to one of your best performances in your sport. **[pause briefly]** Remember the feeling of competence you had towards your skills. Imagine how healthy and good you felt about yourself. Remember all the praise you received from your coach and teammates. See and hear all the high-fives you were given. Now visualize your fully healed knee and the confidence you have in it to perform at your best. Think of the time off you had as a positive experience and that you were able to reconnect with your body in a way like never before. You are ready to play again.

When you are ready, you can open your eyes.

Appendix G

PASW Output

Table 11. *RM-ANOVA comparing expected pain over time and across conditions*

Source	ss	df	ms	*F*	*p*
			Within-Subjects		
Time	1118.78	1	1118.78	5.97	.017*
Time*Condition	258.62	2	129.31	.69	.51
Error	15190.78	81	187.54		
			Between Subjects		
Intercept	452000.04	1	452000.04	1228.162	.000
Condition	2210.42	2	1105.211	3.00	.06
Error	29810.41	81	368.03		

Note. * p < .05

Table 12. *RM-ANCOVA comparing task efficacy, controlling for follow-up method (lab or online) over time and across conditions*

Source	ss	df	ms	*F*	*p*
			Within-Subjects		
Time	10452.45	1	10452.45	193.23	.00*
Time*Lab or Online	4735.12	1	4735.12	87.54	.00*
Time*Condition	8.71	2	4.357	.08	.92
Error	4273.39	79	54.094		
			Between Subjects		
Intercept	82800.54	1	82800.54	203.39	.000
Lab or Online	1133.42	1	1133.42	2.78	.01
Condition	6.84	2	3.42	.01	.99
Error	32161.45	79	407.11		

Note. * $p < .05$

Table 13. *RM-ANCOVA comparing coping efficacy, controlling for sex over time and across conditions*

Source	ss	df	ms	*F*	*p*
		Within-Subjects			
Time	833.44	1	833.44	11.16	.00*
Time*Sex	505.38	1	505.38	6.77	.01*
Time*Condition	116.84	2	58.42	.78	.46
Error	5900.01	79	74.69		
		Between Subjects			
Intercept	61750.40	1	61750.40	91.48	.000
Sex	224.43	1	224.43	.33	.57
Condition	302.76	2	151.38	.22	.80
Error	53328.33	79	675.04		

Note. * $p < .05$

Table 14. *RM-ANOVA comparing frequency of rehabilitation adherence over time and across conditions*

Source	ss	df	ms	*F*	*p*
		Within-Subjects			
Time	5750.78	1	5750.78	5.17	.03*
Time*Condition	2970.30	2	1485.15	1.34	.27
Error	35605.10	32	1112.66		
		Between Subjects			
Intercept	713745.52	1	713745.52	91.48	.00
Condition	12828.20	2	6414.10	. 377	.03
Error	54413.86	32	1700.43		

Note. * p < .05

Table 15. *RM-ANOVA comparing duration of rehabilitation adherence over time and across conditions*

Source	ss	df	ms	*F*	*p*
		Within-Subjects			
Time	474.48	1	474.48	1.86	.18
Time*Condition	286.27	2	143.14	.56	.57
Error	19680.48	77	255.59		
		Between Subjects			
Intercept	1.13	1	1.13	1266.69	.00
Condition	1730.44	2	865.22	. 97	.38
Error	68706.64	77	892.29		

Table 16. *RM-ANOVA comparing quality of rehabilitation adherence over time and across conditions*

Source	ss	df	ms	*F*	*p*
		Within-Subjects			
Time	85.37	1	85.37	1.97	.16
Time*Condition	30.74	2	15.37	.35	.70
Error	3461.29	80	43.27		
		Between Subjects			
Intercept	1.14	1	1.14	6786.01	.00
Condition	462.85	2	231.43	1.37	.26
Error	13467.50	80	168.34		

Appendix H

Power Calculations

Assuming a power of 0.8, small effect size (f^2) of 0.1, and $\alpha = 0.05$, an a priori sample size calculation was computed using the statistical program G*Power. A sample of 225 was needed, with 75 participants in each group. I was unable to recruit 225 participants to fully power this study. A post-hoc power calculation indicated the current study achieved 35% power.

Appendix I

Randomization Analyses

Table 17. *Chi-Square for Sex by Condition*

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2.29	2	.32

$p > .05$

Table 18. *Chi-Square for Sport Type by Condition*

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	18.47	18	.43

$p > .05$

Table 19. *Chi-Square for Competitive Level by Condition*

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2.13	6	.91

$p > .05$

Table 20. *Chi-Square for Time of Season*

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3.56	4	.47

$p > .05$

Table 20. *ANOVA for Age by Condition*

	ss	df	ms	*F*	*p*
Between Groups	22.21	2	11.10	.58	.57
Within Groups	1600.50	83	19.28		
Total	1622.71	85			

p > .05

Table 21. *ANOVA for Number of Previous Injuries by Condition*

	ss	df	ms	*F*	*p*
Between Groups	.18	2	.09	.21	.81
Within Groups	35.63	83	.43		
Total	35.81	85			

p > .05

Table 22. *ANOVA for Hours of Training per Week by Condition*

	ss	df	ms	*F*	*p*
Between Groups	48.10	2	24.05	1.13	.33
Within Groups	1749.51	82	21.34		
Total	1797.60	84			

p > .05