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AN EXAMINATION OF EXERCISE-RELATED COGNITIONS AND THE IMPACT OF MENTAL IMAGERY INTERVENTIONS IN EXERCISE

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AN EXAMINATION OF EXERCISE-RELATED COGNITIONS AND THE IMPACT OF MENTAL IMAGERY INTERVENTIONS IN EXERCISE

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ABSTRACT

The purpose of this dissertation was to test the effectiveness of mental imagery interventions for enhancing exercise-related cognitions during long-term exercise programs. In order to ensure the integrity of the imagery intervention, a secondary purpose of this dissertation was to test the dependent variables within the context of their respective theories to confirm their distinctive nature and therefore suitability as targets of an imagery intervention. To achieve these purposes, four studies were conducted using a multi-dimensional conceptualization of self-efficacy for exercise (Rodgers & Sullivan, 2001) and Self-Determination Theory (SDT; Deci & Ryan, 1985) as theoretical frameworks.

In Study 1 the multi-dimensional conceptualization of SE for exercise was examined in order to demonstrate the distinctive nature of task, coping, and scheduling SE in an exercise context. Study 2 examined the effectiveness of a mental imagery intervention within the context of SE theory. Specifically, Study 2 sought to determine if three types of SE could be differentially influenced using guided imagery interventions in an experimental design controlling for overt mastery experiences. Studies 3 and 4 employed self-determination theory as the framework for testing the effectiveness of an imagery intervention. The purpose of study 3 was to examine how different types of motivation contribute to various characteristics of exercise behaviour. Finally, Study 4 examined the effects of a mental imagery intervention designed to enhance integrated regulation.

The results of Study 1 revealed that scheduling SE was the strongest predictor of exercise frequency, duration and weekly METS for males and females. Coping SE added to the prediction of frequency and weekly METS for males and females, as well as

duration and number of years of exercising for males only. Task SE added to the prediction of duration for males and females and was a unique predictor of number of years for females only. The findings revealed that task, coping, and scheduling SE for exercise can differentially predict various components of regular exercise supporting the contention that the three types of SE are distinct. All three types of SE were determined to be important for both males and females however, the relative importance of each type might be gender specific.

Study 2 demonstrated that targeting each type of SE through an imagery intervention has separable effects that are primarily restricted to the targeted SE type. Furthermore, the imagery intervention was successful in enhancing task, coping, and scheduling SE beyond the levels that occurred as a result of overt experience. The results of Study 2 provided support for the use of imagery interventions for influencing SE for exercise.

The results of Study 3 supported previous research and demonstrated that integrated and identified regulations predicted exercise frequency for males and females. Integrated regulation was found to be the only predictor of exercise duration across both genders. Finally, introjected regulation predicted exercise intensity for females only. These findings suggested that exercise regulations that vary in their degree of internalization can differentially predict characteristics of exercise behaviour.

Study 4 provided additional support for the effectiveness of imagery interventions for enhancing exercise-related cognitions. Specifically, participants in the imagery group experienced greater changes in integration compared to control participants.

Overall these four studies offer practical considerations and directions for future exercise imagery research. This dissertation demonstrates that imagery interventions can be employed to enhance exercise-related cognitions among female exercise initiates in a laboratory setting. Future research should examine whether or not imagery-induced changes in SE and motivation as conceptualized in SDT can translate into increases in exercise behaviour or physical activity.

Keywords: imagery, exercise, self-efficacy, integrated regulation, self-determination

CO-AUTHORSHIP STATEMENT

This dissertation contains my original work. However, I would like to acknowledge the contributions of three co-authors who were integral in helping to complete this work. First, I would like to thank my advisor; Dr. Craig Hall for his guidance, assistance, and suggestions pertaining to all aspects of the four studies included in this dissertation. Second, I would like to thank Dr. Wendy Rodgers for her guidance with the theoretical components of the four studies, particularly with respect to self-efficacy. Dr. Rodgers assisted in critically revising the imagery scripts, as well as conducting the data analysis and interpretation for Study 2. Dr. Rodgers also contributed to the conceptualization and design of Study 4. Finally, I would like to acknowledge Dr. Philip Wilson for his assistance with the conceptualization and design of the imagery interventions. Dr. Wilson provided guidance pertaining to self-determination theory employed in Studies 3 and 4.

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INTRODUCTION

Engaging in regular physical activity is an important for the maintenance of good health. Among the many benefits of regular exercise are; lower rates of type II diabetes (Uusitupa, Luheranta, Lindstrom, Valle, Sundvall, Eriksson et al., 2000), heart disease (Katzmarzyk, Church, & Blair, 2004; Katzmarzyk & Janssen, 2004), and some forms of cancer (Magnusson et al., 1998) as well as lower rates of depression and anxiety, and increased positive mood (Scully, Kremer, Meade, Graham, & Dudgeon, 1998). A recent review of the physical activity recommendations put forth by various public health agencies outlined that healthy adults should engage in 30 minutes of moderate intensity physical activity each day in order to obtain the health benefits associated with regular physical activity. The report also stated that individuals who engage in more than 30 minutes of physical activity per day will obtain additional health benefits. Furthermore, the authors noted that engaging in a variety of exercise modes including resistance training and flexibility will enable long-term physical activity participation as well as enhanced quality of life (Blair, LaMonte, & Nichaman, 2004).

While the benefits of regular exercise are widely acknowledged, more than half of adults do not engage in enough exercise to obtain these health benefits (e.g., Breuer, 2005; King, Castro, Wilcox, Eyler, Sallis, & Brownson, 2000). Physical inactivity poses considerable risk to the health of the population. The U.S. Centres for Disease Control and Prevention have estimated that physical inactivity (in combination with poor diet) is responsible for approximately 365,000 deaths (16 percent of all deaths) each year (Mokdad, Marks, Stroup, & Gerberding, 2005). In Canada it has been estimated that approximately $2.1 billion of the total direct health care costs were a consequence of physical inactivity (Katzmarzyk, Gledhill, & Shephard, 2000). Furthermore, Katzmarzyk et al. (2000) found that direct health care expenditures could be cut by $1.5 million per annum if a 10% reduction in physical inactivity is achieved. Importantly, physical inactivity is considered a modifiable risk factor. Therefore, researchers and practitioners devote considerable attention to the problem of increasing physical activity levels within the population. Perceived self-efficacy and self-determined motivation are two variables which have received considerable research attention and have been found to be robust predictors of physical activity.

Self-Efficacy and Exercise

Self-efficacy (SE) refers to an individual's confidence that he or she can organize and execute the courses of action required to produce a desired outcome (Bandura, 1986; 1997). Bandura (1997) contends that self-efficacy refers not only to individual's perceived efficacy to engage in specific skills, but also the efficacy to perform these skills when faced with challenging circumstances (p. 43). In an exercise context, a substantial body of literature has supported this contention (Bandura, 1986, 1997, 2004; Dishman, Motl, Sallis, Dunn, Birnbaum, Welk et al., 2005; McAuley, Jerome, Elavsky, Marquez, & Ramsey, 2003; McAuley, Elavsky, Motl, Knopak, Hu, & Marquez, 2005).

Many conceptualizations of SE have been put forth in the exercise literature (e.g., Maddux, 1995; Rodgers & Sullivan, 2001; Schwarzer & Renner, 2000). One popular conceptualization that has been proposed is a phase-specific model of SE (Luszczynska & Schwarzer, 2005; Luszczynska, Mazurkiewicz, Ziegelmann, & Schwarzer, 2007; Schwarzer, Luszczynska, Ziegelmann, Scholz, & Lippke, 2008). The phase-based conceptualization of SE identifies specific types of SE that are matched with different phases of behaviour adoption. Each type of SE involves the confidence associated with the specific tasks required during each phase. For example Scholz, Sniehotta, and Schwarzer (2005) describe pre-action, maintenance, and recovery SE. Pre-action SE is relevant before a behaviour is adopted and refers to the confidence required to make a decision to engage in a health behaviour. Maintenance SE is relevant once the behaviour has been initiated and refers to the confidence to maintain the required levels of a behaviour. Recovery SE is important following a lapse and refers to the confidence to return to the required level of a behaviour once the behaviour has been interrupted.

Another conceptualization of SE pertaining to exercise was put forth by Maddux (1995) who proposed a two factor model including task (i.e., SE for performing the elemental aspects of a task) and coping (i.e., SE for performing the behaviour in the face of challenges). Subsequently, the coping component of this model was further divided into scheduling SE (i.e., SE for engaging in exercise on a regular basis) and coping SE (i.e. SE for overcoming relevant obstacles to regular exercise) yielding a three factor model. In contrast to the phase-based model, the multidimensional conceptualization of SE (e.g., Rodgers et al., 2008) proposes that all three types of SE are required throughout behaviour adoption. According to this conceptualization, however, the relative importance of each type of SE changes depending on the phase.

This three-dimensional conceptualization of SE for exercise has been supported by a considerable body of research (Rodgers & Sullivan, 2001; Rodgers, Hall, Blanchard, McAuley, & Munroe, 2002; Rodgers, Wilson, Hall, Fraser, & Murray, 2008; Rodgers, Murray, Courneya, Bell, & Harber, 2009). For example, Rodgers et al. (2008) recruited 58 females to engage in a 12-week weight training program in order to demonstrate that the three types of SE changed differently in response to overt experience with an exercise task. No significant changes in task SE were noted from baseline to 12 weeks (although task SE among the participants was high at baseline). Scheduling SE increased between baseline and six weeks, and coping SE increased from baseline to six weeks and continued to increase between six and twelve weeks. The results of this study supported the notion that the three types of SE are distinct and change at different rates.

One aim of this dissertation was to further the research supporting this multi-dimensional conceptualization of SE for exercise. In Study 1, an examination of the roles of task, coping, and scheduling SE in predicting various components of exercise behaviour (i.e., frequency, duration, and number of years as an exerciser) was conducted to provide further evidence for the specificity of task, coping, and scheduling SE for exercise (Study 1). Study 2 determined if three types of SE (i.e., task, coping, scheduling) can be differentially influenced using guided imagery interventions in an experimental design controlling for overt mastery experiences.

Self-Determination and Exercise

Self-Determination Theory (SDT; Deci & Ryan, 1985) is a broad theory of human motivation which has frequently been employed to explore and explain motivation to exercise. SDT proposes that motivation can be intrinsic, extrinsic, or amotivated. Intrinsic motivation is derived entirely from within the self and involves engaging in a behaviour because the participant derives inherent pleasure or satisfaction from the behaviour itself. Individuals who are intrinsically motivated for example, may swim because they enjoy the feeling of being in the water. Extrinsic motivation is derived from outside the self and is said to involve external contingencies. Four types of extrinsic motivation are described in SDT. These motives are proposed to lie along an internalization continuum (i.e., some forms of extrinsic motivation are thought to be more controlled and are consequences of coercion while some forms are thought to be more autonomous, or self-determined). The most controlled type of extrinsic motivation is external regulation which involves feelings of external pressure. For example, individuals are said to be externally regulated if they engage in exercise in order to appease their spouse or physician. While still considered a controlled type of motivaton, introjected regulation represents motivation which is more internalized. Introjection involves feelings of internal coercion such as the desire to relieve feelings of shame or to obtain feelings of pride. Individuals who are introjected in their motivation might exercise because they feel guilty if they do not. Identified and integrated regulations represent motivation which is increasingly more autonomous in nature. Identified regulation refers to goal-related motivation in which the outcome of the behaviour is valuable to the individual. Individuals who demonstrate identification might exercise because they have defined health and fitness goals. The most autonomous extrinsic regulation, integration, involves identity-based motivation. An individual might exercise because they believe that being “an exerciser” is consistent with their sense of “who they are”. In addition to the intrinsic and extrinsic motives, individuals may engage in behaviour despite a lack of motivation for that behaviour. This is termed amotivation and involves behaviours such as paying a parking fine since it is the law to engage in this behaviour despite a strong desire to do otherwise.

One important contention of SDT is that intrinsic motivation leads to positive motivational consequences while the external regulations and amotivation are less adaptive in nature while. Research has shown that autonomous regulations are linked to greater persistence, positive affect, and psychological well-being and controlling regulations are linked to behavioural disengagement and negative psychological conditions (Ryan & Deci, 2000). In an exercise context, autonomous motivation has frequently been linked to adherence to regular exercise (e.g., Li, 1999; Matsumoto & Takenaka, 2004; Mullan & Markland, 1997; Thogersen-Ntoumani & Ntoumanis, 2006; Wilson & Rodgers, 2004), and adaptive patterns of behaviour, cognitions, and self-evaluation (e.g., Li, 1999; Thogersen-Ntoumani & Ntoumanis, 2006; Wilson & Rodgers, 2002).

While intrinsic motivation is often considered the most important type of motivation for behavioural persistence (e.g., Li, 1999), Frederick and Ryan (1993) noted that individuals often engage in regular sports and exercise despite being extrinsically motivated. Frederick and Ryan explained that even among regular exercisers, exercise may not be considered inherently enjoyable however the benefits of regular exercise are valuable, and this motivates adherence to regular exercise. Research has supported this observation. For example, Wilson, Rodgers, Fraser, and Murray (2004) examined the motivation of a large university-aged sample exercisers and found that identified regulation was the most important predictor of current exercise behaviour, intentions to continue exercising in the next 4 months, and effort and importance associated with exercise.

Compared to regular exercisers, exercise initiates report less self-determined motives for exercise (e.g., Daley & Duda, 2006; Li, 1999; Mullan & Markland, 1997). Recently, Hall, Rodgers, Wilson, and Norman (2010) examined the motivation of regular exercisers, non-exercisers who intended to begin exercising, and non-exercisers who did not intend to begin exercising. The pattern of motivation reported by the participants was consistent with previous research in that the regular exercisers reported the most self-determined motives while non-intenders reported the least self-determined motives. However, the patterns of motivation reported by each group were not consistent. This is a theoretically important finding which suggests that the various behavioural regulations may develop independently and may also have independent influences on behaviour.

As non-exercisers begin and adhere to an exercise program, their motivation changes to more closely resemble that of a regular exerciser; that is, they experience an increase in autonomous motivation. Rodgers, Hall, Duncan, Pearson, and Milne (2010) conducted a review of four longitudinal exercise studies. They found that exercise initiates reported increases in identified regulation and intrinsic motivation within the first 8 weeks of participation. Importantly, it was also noted that even after six months in an exercise program, the levels of autonomous motivation reported by the initiates did not meet the levels reported previously by regular exercisers (Duncan, Hall, Wilson, & O, 2010). Rodgers et al. suggested that in order to increase the probability of long term adherence among exercise initiates, future interventions should explore ways of enhancing autonomous motivation.

The exercise motivation literature employing SDT has been limited in that the majority of this research has not assessed integrated regulation. One of the primary reasons for this is that the Behavioural Regulation in Exercise Questionnaire (Mullan, Markland, & Ingledew, 1997) and the subsequent Behavioural Regulation in Exercise Questionnaire- version 2 (BREQ-2; Markland & Tobin, 2004) do not include subscales assessing integrated regulation. This is a common occurrence in SDT research across all domains because integration is a complex construct that is difficult to assess using only a few items (e.g., Pelletier & Sarrazin, 2007, p.149-150). Recently, Wilson, Rodgers, Loitz, and Scime (2006) created a four-item measure of integrated regulation that matches the format of the BREQ and BREQ-2 and can be used in conjunction with the BREQ-2 to assess the full spectrum of motivation. From a psychometric perspective the integrated subscale has held up well (Wilson et al., 2006). Using the integrated subscale, Wilson et al. found that of the extrinsic motives, integrated regulation was the strongest predictor of exercise behaviour (measured in terms of weekly METS; Godin & Shephard, 1985) and physical self-concept. In addition, a test-retest reliability analysis revealed that integrated regulation was stable in magnitude across a two-week time period.

Given some initial evidence that integrated regulation plays a role in health behaviours (including exercise) but the relative shortage of research in this domain, one purpose of this dissertation was to examine the role of integrated regulation in an exercise context. Study 3 was conducted in order to examine the role that integrated regulation plays in determining exercise behaviour (i.e., frequency, intensity, and duration). Study 4 examined whether or not integrated regulation can be targeted and enhanced using a mental imagery intervention.

Exercise Imagery

Imagery has been described as an experience that mimics real experience. We can be aware of seeing, feeling, hearing, smelling or tasting without actually experiencing the real thing. Imagery differs from dreams in that we are awake and conscious when we form an image (White & Hardy, 1998). Mental imagery can be an effective vehicle for changing an individual's thoughts and feelings. It is hypothesized that mental imagery is an important medium for information processing and that vivid mental images can closely represent an object, emotion, or psychological state and consequently link closely with perception (Farah, 1989). Research has demonstrated that visual images are most common, while images using other senses (i.e., kinaesthetic, auditory, and gustatory images) are less common (Kosslyn, 1994). Using multiple sensory modalities to create mental images, however, has been found to be most effective in physical activity settings (Hall, 2001).

In certain contexts, such as sport, it has been well documented that imagery can be employed to develop, maintain, and even regain the motivation to train and compete (Hall, Mack, Paivio, & Hausenblas, 1998; Harwood, Cumming, & Hall, 2003). Athletes use imagery to learn and perfect new skills and strategies, stay motivated towards a goal, and control arousal and anxiety levels (Martin, Moritz, & Hall, 1999). In light of the influential role of imagery in a sports context, Hall (1995) proposed that imagery may be an important determinant of exercise behaviour. Subsequent research has confirmed that regular exercisers frequently use imagery (Gammage, Hall, & Rodgers, 2000). By employing imagery exercisers can, for example, become energized, learn exercise tasks, set appearance related goals, cope with exercise barriers, and increase their SE (Gammage et al., 2000; Giacobbi, Hausenblas, Fallon, & Hall, 2003; Hausenblas, Hall, Rodgers, & Munroe, 1999).

Preliminary evidence strongly supports the possibility that the power and influence of imagery can be used to improve exercise behaviours and cognitions. First, exercise imagery is related to both exercise intention (Milne, Rodgers, Hall, & Wilson, 2008) and exercise frequency (Gammage et al., 2000). Second, exercise imagery has been shown to be related to self-efficacy (Wesch, Milne, Burke, & Hall, 2006). Finally, more self-determined exercise regulations have been associated with appearance and technique imagery (Wilson, Rodgers, Hall, & Gammage, 2003). This suggests that the nature of imagery use can be understood within the framework of SDT. To date, however, most of the research regarding the effects of imagery in exercise has not had a strong theoretical basis and the limited research that has been heavily guided by theory has been correlational in nature. It would be worthwhile to develop theory-based imagery interventions to positively influence exercise cognitions and increase exercise behaviour.

Purpose of the Dissertation

The overall purpose of this dissertation was to explore the roles of various exercise-related variables in an exercise context and to examine the utility of mental imagery interventions for enhancing those cognitions during long-term exercise programs. Kerlinger (1986) suggested that the purpose of science is to build and test theories in order to explain and predict human behaviour. The imagery interventions employed in this research were heavily guided by two theories, SE and SDT. Imagery interventions were used to enhance three types of SE for exercise as well as integrated regulation (in the context of SDT). The use of theory provided a solid foundation for the interventions and also enabled the testing of some key components of the theories being used. A secondary purpose of the dissertation was to demonstrate that the various dependent variables assessed were distinct and could be individually targeted and influenced.

Study 1 was designed to examine the roles of task, scheduling, and coping SE in regular exercise behaviour. This study involved a cross-sectional analysis of the exercise behaviour and SE of a broad sample of regular exercisers. Previous research provided preliminary evidence that task, coping, and scheduling SE for exercise were independent from one another, were all present throughout the phases of behaviour adoption, and that the relative importance of each type varied according to the phase of behaviour adoption. Study 1 sought to provide support for these findings and to determine whether or not task, coping, and scheduling SE could differentially predict various aspects of exercise behaviour.

While the primary goal of Study 1 was to examine and test the multidimensional conceptualization in a cross-sectional exercise context, the purpose of Study 2 was to determine if task, coping, and scheduling self-efficacy (SE) for exercise could be influenced using guided imagery interventions in an experimental design controlling for overt exercise experiences. This is the first study to employ an imagery intervention to examine cognitions during a long-term exercise program. The impact of the imagery intervention was investigated with a sample of female exercise initiates. Study 1 demonstrated that while the three types of SE are important for both males and females, the relative importance of each type throughout behaviour adoption and maintenance might be gender specific. More specifically, it seems that task SE might play a bigger role in determining exercise participation for females. Furthermore, there is some empirical evidence to suggest that gender acts as a moderator on imagery use (Gammage, Hall, & Rodgers, 2000; Gammage, Hall, & Martin, 2004; Hausenblas, Hall, Rodgers, & Munroe, 1999) therefore it was decided to focus our investigation on females only.

Study 3 laid the theoretical foundation for the imagery intervention in Study 4. The purpose of Study 3 was to examine the relationships between three exercise behaviours (frequency, intensity, and duration) and the various behavioural regulations proposed in SDT. This was among the first studies to include a measure of integrated regulation in an exercise context, allowing for a comprehensive description of the role of autonomous motivation in exercise behaviour. Study 4 was based on the findings from Study 3 which highlighted the distinctiveness of the behavioural regulations and the importance of integrated regulation as a predictor of exercise behaviour, as well as the effectiveness of the imagery intervention conducted in Study 2. The purpose of Study 4 was to examine the effects of a mental imagery intervention designed to enhance integrated regulation.

The studies within this dissertation are presented using the integrated-article format. Each chapter is written as a manuscript and focuses on a specific research question. Therefore, some of the information presented in the general introduction is repeated within the chapters.

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STUDY 1

AN EXAMINATION OF THE ROLES OF TASK, COPING, AND SCHEDULING SELF-EFFICACY IN VARIOUS COMPONENTS OF REGULAR EXERCISE

Engaging in regular physical exercise is important for maintaining good health. The benefits of regular exercise are numerous and include; the prevention of cardio-vascular disease, hypertension, certain types of cancer, type 2 diabetes, obesity, osteoporosis, and depression (Warburton, Nicol, & Bredin, 2006).

A review of current physical activity recommendations put forth by various public health agencies indicated that in order to obtain substantial health benefits adults should engage in 30 minutes of moderate intensity physical activity each day. The report also stated that individuals who engage in more than 30 minutes of physical activity per day will obtain additional health benefits. Furthermore, the report identified that engaging in a variety of exercise modes including resistance training and flexibility will enable long-term physical activity participation as well as enhanced quality of life (Blair, LaMonte, & Nichaman, 2004). It is important to note that these recommendations were presented in terms of frequency, intenstity, and duration, all of which are important components of a regular regimen of physical activity. Additionally, the report identified the need for healthy individuals to engage in physical activity on a long term basis, across the entire lifespan.

Despite the known positive influence of regular exercise, more than half of adults do not engage in enough exercise to obtain these health benefits (e.g., Breuer, 2005; King, Castro, Wilcox, Eyler, Sallis, & Brownson, 2000). Physical inactivity is considered a modifiable risk factor and has therefore received extensive consideration from researchers and health practitioners who hope to increase physical activity levels within the population. One variable which has been found to be a robust predictor of health behaviour, including physical exercise, is perceived self-efficacy.

Self-efficacy (SE) refers to an individual's confidence that he or she can organize and execute the courses of action required to produce a desired outcome (Bandura, 1986; 1997). Bandura (1997) contends that not only is an individual's perceived efficacy to engage in specific skills an important component of SE, but also the efficacy to perform these skills when faced with challenging circumstances (p. 43). The positive link between SE and exercise behaviour, particularly when individuals are faced with challenges, has been supported by a substantial body of research (Bandura, 1986, 1997, 2004; Dishman, Motl, Sallis, Dunn, Birnbaum, Welk et al., 2005; McAuley, Jerome, Elavsky, Marquez, & Ramsey, 2003; McAuley, Elavsky, Motl, Knopak, Hu, & Marquez, 2005).

A two factor model of SE for exercise including task (i.e., SE for performing the elemental aspects of a task) and coping (i.e., SE for performing the behaviour in the face of challenges) components was proposed by Maddux (1995). Subsequently, this model was subdivided to include three types of SE for exercise: task SE (as described by Maddux), scheduling SE (i.e., SE for engaging in exercise on a regular basis) and coping SE (i.e. SE for overcoming relevant obstacles to regular exercise). A considerable body of research supporting this multidimensional conceptualization of SE for exercise has been established (Rodgers & Sullivan, 2001; Rodgers, Hall, Blanchard, McAuley, & Munroe, 2002; Rodgers, Wilson, Hall, Fraser, & Murray, 2008; Rodgers, Murray, Courneya, Bell, & Harber, 2009; Duncan, Rodgers, Hall, & Wilson, 2010).

Some researchers have proposed a phase-specific conceptualization of SE (Luszczynska & Schwarzer, 2005; Luszczynska, Mazurkiewicz, Ziegelmann, & Schwarzer, 2007; Schwarzer, Luszczynska, Ziegelmann, Scholz, & Lippke, 2008). The phase-based conceptualization of SE suggests that specific types of SE are associated with specific tasks required during the different phases of behaviour adoption. For example Scholz, Sniehotta, and Schwarzer (2005) describe three phase-specific types of SE. Pre-action SE refers to the confidence required to make a decision to engage in a health behaviour and is relevant before a behaviour is adopted. Maintenance SE, on the other hand, refers to the confidence to maintain the required levels of a behaviour once it has been initiated. Finally, recovery SE is important following a lapse and refers to the confidence to return to the required level of a behaviour once the behaviour has been interrupted.

In contrast to the phase-based approach, the multidimensional conceptualization of SE (e.g., Rodgers, Wilson, Hall, Fraser, & Murray, 2008) proposes that all three types of SE are required during all phases of behaviour adoption and maintenance however the relative importance of each type of SE changes depending on the phase. Although the multidimensional conceptualization of SE does not forward any resolutions regarding the type of SE that is more important during a given stage of change, some predictions can be made. For example, task SE is likely to be most important during early phases of behaviour adoption when skills must be learned, whereas the importance of scheduling SE may be consistent across phases of adoption. At the core of both conceptualizations is the notion that in order to complete a behaviour, specific sub-sets of skills must be performed.

The body of literature supporting the multidimensional conceptualization of SE for exercise is growing. In order to demonstrate that the three types of SE changed differently in response to overt experience with an exercise task, Rodgers et al. (2008) recruited 58 females to engage in a 12-week weight training program. Over the course of the exercise program, no significant change in task SE was noted (although task SE among the participants was high at baseline). The participants did report an increase in scheduling SE which occurred between baseline and six weeks. Coping SE increased from baseline to six weeks and continued to increase between six and twelve weeks. The results of this study supported the notion that the three types of SE are distinct and change at different rates.

Another study conducted by Rodgers and her colleagues (2009) examined the specificity of self-efficacy for two types of exercise. Individuals were randomized into a 24-week walking program, either to a traditional exercise program or a lifestyle maintenance control condition. Quadratic patterns of change were observed for each type of SE according to the specific type of behaviour engaged in supporting the idea that SE is behaviour specific.

Consider the recommendations for physical activity presented earlier. Recall that the recommendations were presented in terms of frequency, intensity, duration, and long-term maintenance of behaviour. In the context of the SE literature, it seems logical to suppose that task, coping, and scheduling SE play differential roles in regulating the various components of exercise behaviour. For example, it seems that the frequency with which someone exercises would heavily depend on the confidence that they can arrange their schedule to include regular exercise, therefore scheduling SE might be the most salient in this case. Likewise, it seems that individuals who engage in longer workouts might have higher efficacy for fitting those workouts into their schedule compared to individuals who engage in shorter workouts. Exercising for longer durations however, could also be linked to task SE. Previous research examining task SE has measured level (how much you can do; e.g., jog for 20 vs. 60 minutes) and strength (e.g., how confident you are that you can jog for 20 or for 60 minutes). Increasing the duration of a workout (e.g., from 20 minutes to 60 minutes) would change the elemental aspects of that behaviour and therefore task SE would be important in this case.

The purpose of this study was to examine the relationships between three types of SE and various exercise behaviours including frequency, duration, and the number of years individuals have been exercising regularly. In addition, exercise behaviour was considered in terms of a fourth variable, weekly METS, which is determined using a composite measure of strenuous, moderate, and light intensity exercise conducted during an individual's leisure time. It was hypothesized that the three types of SE for exercise would differentially predict the four behavioural outcome measures. Specifically, we predicted that scheduling SE would be the strongest predictor of frequency, duration, and number of years as a regular exerciser and that coping SE would predict frequency and number of years as a regular exerciser. Task SE was hypothesized to play a role in exercise duration.

Methods

Participants

The participants (N=1116) were recruited on campus at a large Canadian university. The mean age of the participants was 21.74 (SD=5.47) which is reflective of samples recruited in this setting. The objective of the present research was to examine the link between SE and physical activity for regular exercisers so participants were eligible if they typically exercised two or more times per week. On average, participants reported exercising 4.30 times per week (*SD*=1.73) for an average of 64.25 minutes per session (29.36). The participants also indicated that on average, they had been exercising regularly for 7.55 years (*SD*=5.14). The participants were asked to indicate the exercise activities in which they participated most frequently. The majority of the participants (65.2%) reported running as one of their most common exercise activities. Many participants also reported engaging in weight training (62.2%) and sports participation (e.g., intramurals; 40.3 %). Other exercise modes reported by the participants included swimming, cycling, yoga, and dance.

Measures

Demographics and exercise behaviour. The participants completed a demographic and exercise behaviour questionnaire which was created for the current study. The participants indicated their age, gender, occupation, marital status, and whether or not they were responsible for childcare. The exercise behaviour items assessed frequency and duration of typical exercise sessions as well as the number of years individuals had been exercising regularly. The participants also listed the exercise activities in which they engaged most frequently. In addition, the participants were asked to indicate whether or not they exercised as training for a competitive sport.

Leisure time exercise. The participants completed the Godin Leisure-Time Exercise Questionnaire (LTEQ; Godin & Shephard, 1985) to assess their leisure time exercise behaviour during a typical week. The participants are asked to consider a typical week and indicate the number of times they engage in strenuous (i.e., heart beats rapidly), moderate (i.e, not exhausting), and light (i.e., minimal effort) exercise for more than 15 minutes during their free time. An overall weekly METS score is calculated using the formula: (9 x strenuous) + (5 x moderate) + (3 x light). The participants are also asked to indicate (on a 3-point scale with 1="often", 2="sometimes", and 3="rarely/never") how often they engage in activity long enough to work up a sweat during a typical week. Previous studies have found the LTEQ to be a valid and reliable measure of leisure time exercise (Godin & Shephard, 1985; Jacobs, Ainsworth, Hartman, & Leon, 1993; Miller, Freedson, & Kline, 1994).

Self-Efficacy for Exercise. The Multidimensional Self-Efficacy for Exercise Scale (MSES; Rodgers, Wilson, Hall, Fraser, & Murray, 2008) was used to assess three types of SE for exercise. Following the root "how confident that you can..." the questionnaire includes nine items assessing task (*n*=3; e.g., complete your exercise using proper technique), coping (*n*=3; e.g., exercise when you lack energy), and scheduling (*n*=3; e.g., arrange your schedule to include regular exercise) SE. Each item is rated on a 100% confidence scale. The MSES has been found to possess adequate validity and reliablility (Rodgers et al., 2008). Cronbach's alpha coefficients in the present study for the three SE variables for males and females were all deemed acceptable (Table 1).

Procedure

All study procedures were approved by the Research Ethics Board at the host institution. The participants were approached by the researchers or data collection assistants at the campus recreation facility prior to or following their workouts. Once informed consent was obtained, the participants completed the demographic and behaviour questionnaire, the LTEQ, and the MSES.

Results

Preliminary Data Screening

The data were screened in order to identify outliers and missing values as well as to ensure that the data conformed to the assumptions of multiple regression (i.e., normality, linearity, and homoscedasticity). No missing values were revealed. Two cases of extreme responses (values > 4 standard deviation units from the mean) were identified for the METS (leisure time physical activity composite) variable and were removed from the analysis. An examination of the distribution properties and histograms indicated that no variables deviated substantially from normality. An examination of scatterplots of the residual did not reveal any violations to the assumptions of linearity or homoscedasticity, therefore the data were deemed suitable to undergo regression analyses.

Descriptive Statistic and T-tests

Descriptive statistics for the male (*n*=500) and female (*n*=616) participants are presented in Table 1. The mean exercise frequency scores were 4.46 (SD=1.68) for males and 4.16 (SD=1.74) for females, confirming that all of the participants were highly active. The mean exercise duration and weekly METS reported by the participants were consistent with previous research using a university-aged sample of regular exercisers (Duncan, Hall, Wilson, & O, 2010). With respect to the SE variables, the participants reported the strongest perceptions of task SE followed by scheduling SE and coping SE, respectively. This pattern is consistent with previous research examining these three types of SE for exercise (Rodgers et al., 2008; 2009).

A series of t-tests was conducted to determine if differences existed between male and female participants on the exercise behaviour and SE variables. The t-tests revealed that the exercise frequency reported by males was significantly higher than that of females ($t(1116)=2.90$, $p=.004$) however, the effect size for this difference was small (Cohen's $d=0.18$). No significant differences were found between males and females for exercise duration, weekly METS, or number of years exercising regularly. With regard to the SE variables, significant differences were revealed between males and females on task ($t(1114)=4.54$, $p<.001$, $d=.27$), coping ($t(1114)=5.53$, $p<.001$, $d=.33$), and scheduling SE ($t(1114)=4.30$, $p<.001$, $d=.26$). Although the effect sizes were somewhat small, the fact that differences existed between males and females on all of the SE variables, it was determined that the regression analyses should be conducted separately for each gender.

Bivariate Correlations

Correlations were calculated between the three types of SE and the various exercise behaviours (frequency, METS, duration, and years; Tables 2 and 3). Moderate correlations were found between the three types of SE for both males and females with the strongest correlations being between coping and scheduling SE.

For males, exercise frequency was correlated with all three types of SE. The strongest relationship was found between frequency and scheduling SE followed by coping and task SE respectively. The correlations between the three types of SE, weekly METS, and exercise duration demonstrated the same pattern of correlations in which scheduling SE was most strongly related to behaviour followed by coping and task SE. No significant relationship was found between number of years of regular exercise and scheduling SE however weak positive correlations were found for coping and task SE. The correlations between SE and behaviour for males are presented in Table 2.

For females, a similar pattern of correlations was revealed. Exercise frequency, weekly METS, exercise duration, and years of regular exercise were most strongly related to scheduling SE followed by coping and task SE respectively. The correlations between SE and behaviour for females are presented in Table 3.

Simultaneous Multiple Regression Analyses

Regression analyses were conducted to examine the relationships between self-efficacy and exercise behaviour. With respect to frequency, scheduling SE was the strongest predictor followed by coping SE for both males and females. Task SE contributed to the prediction of exercise frequency for females only (Table 4). In the prediction of weekly METS, scheduling and coping SE were significant predictors for males and females. Task SE was not a predictor of METS for either gender (Table 5). Scheduling SE was the strongest predictor of exercise duration for both males and females. For males, both coping and task SE also contributed significantly to the equation. For females, coping SE was not a significant predictor; however, task SE did have a significant effect (Table 6). Number of years as a regular exerciser was predicted by coping SE only for males, and task SE only for females (Table 7).

Discussion

The purpose of this study was to determine the role that task, coping, and scheduling play in the prediction of four different characteristics of exercise behaviour. The results confirmed our hypothesis in that task, coping, and scheduling SE differentially predict exercise frequency, weekly METS, average workout duration, and years as a regular exerciser for both males and females. The results provided partial support for the specific predictions that were made regarding the influences that task, scheduling, and coping SE would have on the behavioural outcome measures. In addition, it was found that the role of each type of SE in predicting exercise behaviour is gender specific.

Previous research has demonstrated that regular exercisers and non-exercisers who intend to begin exercising cannot be distinguished based on task SE alone and that coping and scheduling SE must be considered in order to differentiate these two groups (Rodgers et al., 2008). In this regard, the present findings are consistent with previous research. Specifically, scheduling SE was found to be the greatest predictor of exercise frequency among males and females. This result is consistent with the multidimensional conceptualization of SE for exercise. Scheduling SE is a time-oriented construct which represents an individual's confidence that he or she can engage in exercise on a regular basis. Our measure of frequency was essentially an indication of the regularity with which the participants engaged in exercise. Therefore, we would expect scheduling SE to be the strongest predictor of exercise frequency.

For both males and females, coping SE also contributed to the prediction of exercise frequency. Once again, this is theoretically viable in that barriers to exercise participation not only threaten an individual's ability to engage in a single exercise session, but also their ability to exercise on a regular basis. For example, one barrier to exercise may be limited access to workout facilities which would presumably be a consistent challenge. The current results demonstrate that individuals with higher SE for dealing with such challenges are more likely to be able to overcome these challenges and exercise more frequently.

For males and females, the strongest predictor of weekly METS was scheduling SE, followed by coping SE. Task SE was not found to be a significant predictor of weekly METS. This result may be explained by the measures used to assess weekly METS and task SE for exercise. The GLTEQ instructs the participants to indicate the number of times they engage in activities of various intensities in a typical week during their leisure time. The task SE subscale of the MSES includes items such as “how confident are you that you can perform all of the required movements”. It seems that the MSES taps into planned and prescribed exercise more than leisure time exercise.

Average workout duration was predicted most strongly by scheduling SE for both males and females. Individuals with higher scheduling SE were more likely to exercise for longer durations. This is not surprising considering the time-oriented nature of both constructs. For males, coping SE was a positive predictor of workout duration indicating that for males, the length of their typical workout is dependent on their belief that they can overcome the barriers to regular exercise. Finally, task SE was a positive predictor of workout duration for males and females. This is consistent with the exercise SE literature in that SE has primarily been operationalized as task SE (i.e., SE for performing the elemental aspects of a behaviour). Duration can be considered an elemental aspect of the behaviour. Many task scales have measured level (how much you can do, which could be considered in terms of duration) and strength (how confident you are that you can do the highest level you checked off). Therefore, our finding that individuals with higher task

SE reported longer average workout duration is consistent with traditional operationalizations of task SE.

The number of years that the participants had been exercising regularly was predicted by coping SE only for males and task SE only for females. The role of coping SE in predicting years of exercise is in line with the conceptualization of coping SE. While it seems that task SE might be an important type of SE early in an exercise program as individuals learn the proper techniques and strategies, coping SE is generally thought to play a stronger role throughout the exercise program. For example, Rodgers et al. (2008) examined the changes in task, coping, and scheduling SE of a group of female exercisers as they engaged in a 12-week weight training program. Throughout the program the participants did not report any increases in task SE, while scheduling SE increased from baseline to six weeks. Coping SE increased from baseline to six weeks and then continued to increase from six to twelve weeks. This finding demonstrates that coping SE is important throughout an entire exercise program and the current result emphasizes this point by showing that coping SE is important, not only during the first 12 weeks of exercise, but over the course of many years.

Interestingly, coping SE was not a predictor of number of years of exercise for females (although a trend toward significance was observed), however task SE was a significant predictor. In the current study, two variables (frequency and years) were predicted by task SE for females but not for males. This suggests that task SE, and the need to enhance task SE, is a more salient concern for females.

The present results should be taken with some degree of caution considering two primary limitations. First, this study was cross-sectional in nature which imposes some limits on our ability to fully explain the role of task, coping, and scheduling SE on behaviour. For example, in our analysis we examined the role that three types of SE play in predicting the number of years during which the participants had been exercising regularly. A more thorough way to conduct such an examination could involve following the participants over the course of several years and assessing their behaviour and SE throughout. This type of study, however, would be extremely resource intensive and we believe that our cross-sectional design has been an adequate means to conduct a preliminary analysis of these relationships. Second, our data was entirely self-report. In order to obtain accurate measures of exercise behaviour it is useful to employ motion sensing devices such as pedometers or accelerometers. Future research would to do well to examine the relationships between three types of SE and objectively measured exercise behaviour.

Despite the limitations, this research does have important implications for future research and practice. This research provides evidence supporting the distinctiveness of task, coping, and scheduling SE for exercise. The results of this study showed that task, coping, and scheduling SE have differential influences on various characteristics of exercise behaviour. Understanding the unique roles of each type of SE is important for informing exercise interventions. It is important for exercise practitioners to understand when each type of SE is most important, and how each type of SE contributes to exercise behaviour. For example, the results of this study suggest that if a personal trainer would like to help a client increase the duration of his or her exercise sessions, it would be helpful for them to focus on building both scheduling and task SE. This has some important implications from a practical perspective. It seems that it would be quite a bit easier for a personal trainer to help a client focus on task SE (compared to scheduling SE) since challenging situations related to the task would most likely occur in the presence of the trainer. Scheduling challenges, however, would likely occur outside the exercise setting. The trainer would need to consider ways of helping the client increase his or her self-efficacy both inside and outside the exercise facility.

Two main conclusions can be drawn from the present study. First, different types of SE play a role in influencing different types of behaviour. The pattern by which the different types of SE predict various behaviours related to regular exercise is somewhat predictable. For example, scheduling SE is more strongly related to time-oriented characteristics such as frequency, and duration, whereas task SE is more closely related to the elemental aspects of the task such as duration (and presumably, intensity). There does appear to be some overlap in the types of SE that predict various characteristics of behaviour (i.e., duration was predicted by scheduling and task SE among females and all three types of SE among males). This supports the multidimensional conceptualization of SE which proposes that all three types of SE are important throughout behaviour adoption and maintenance; however the relative importance of each type of SE will vary under different circumstances.

This finding also supports the use of the MSES in assessing task, coping, and scheduling SE in an exercise context. In this study, task, coping, and scheduling SE were found to be related to the behaviours in a theoretically consistent manner. For example, time-oriented behaviors such as exercise frequency and duration were strongly related to a time-oriented type of SE (i.e., scheduling SE) and behaviours which were more closely related to exercise tasks (i.e., exercise duration) were linked to task SE. These findings provide evidence that the MSES can effectively capture three different subsets of self-efficacy for exercise.

The second conclusion that can be derived from this study is that the three types of SE are important for both males and females however, the relative importance of each type throughout behaviour adoption and maintenance might be gender specific. More specifically, it seems that task SE might play a bigger role in determining exercise participation for females. More research is needed to examine the differences in task, coping, and scheduling SE among males and females.

The results of this study have important implications for the overall purpose of this dissertation. In order to examine the impact of imagery interventions designed to target task, coping, or scheduling SE for exercise it is important to know that the three types of SE are unique. Since the current results demonstrate that task, coping, and scheduling SE differentially predict exercise behaviour and that the relative importance of each type of SE may vary throughout behaviour adoption it follows that it would be useful to understand if and how the individual types of SE can be manipulated. Therefore, Study 1 helped to establish and important theoretical foundation on which to base the intervention in Study 2.

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Table 1.

Descriptive statistics for age, frequency, duration, METS, and SE variables

Variables	Females (n=594)			Males (n=460)		
	M	*SD*	α	*M*	*SD*	α
Age	21.86	6.23		21.58	4.35	
Frequency (times/week)	4.16	1.75		4.46	1.68	
Duration (mins)	62.88	30.36		65.82	27.96	
METS	57.48	26.54		58.08	24.80	
Task SE	80.17	12.79	.82	83.64	12.61	.70
Coping SE	59.65	19.90	.84	66.34	20.28	.82
Scheduling SE	79.48	16.74	.86	83.63	15.13	.79

Note. *M*= Mean; SD = standard deviation; SE = Self-efficacy; METS derived from the LTEQ (Godin & Shephard, 1985).

Table 2

Bivariate Correlations between SE and behaviour for males

Variable	1	2	3	4	5	6	7
1. Task SE	-						
2. Coping SE	.43*	-					
3. Scheduling SE	.57*	.61*	-				
4. Frequency	.27*	.45*	.59*	-			
5. Weekly METS	.27*	.39*	.43*	.53*	-		
6. Duration	.27*	.31*	.34*	.32*	.24*	-	
7. Years	.09	.17*	.12*	.14*	.11*	.20*	-

* $p<.001$.

Table 3

Bivariate Correlations between SE and behaviour for females

Variable	1	2	3	4	5	6	7
1. Task SE	-						
2. Coping SE	.49*	-					
3. Scheduling SE	.53*	.64*	-				
4. Frequency	.24*	.44*	.51*	-			
5. Weekly METS	.23*	.35*	.46*	.55*	-		
6. Duration	.22*	.21*	.25*	.28*	.34*	-	
7. Years	.20*	.17*	.14*	.24*	.18*	.20*	-

* $p<.001$.

Table 4

Multiple regression analysis predicting exercise frequency from self-efficacy variables

Variable	*F*	*Df*	R^{2adj}	B	SE B	*β*	*t*
Males	80.25***	3, 496	.32				
Task SE				-.01	.01	-.09	-.19
Coping SE				.02	.01	.19	4.16
Scheduling SE				.05	.01	.48	9.34
Females	82.79***	3, 612	.29				
Task SE				-.01	.01	-.09	-2.20
Coping SE				.02	.01	.20	4.37
Scheduling SE				.05	.01	.43	9.20

*$p < .05$.

** $p < .01$.

*** $p < .001$.

Table 5

Multiple regression analysis predicting weekly METS from self-efficacy variables

Variable	*F*	*Df*	R^{2adj}	B	SE B	β	*t*
Males	43.97***	3, 496	.21				
Task SE				.04	.10	.02	.39
Coping SE				.25	.06	.20	3.95***
Scheduling SE				.49	.09	.30	5.34***
Females	56.93***	3, 612	.21				
Task SE				-.09	.09	-.04	-.99
Coping SE				.13	.06	.10	2.02*
Scheduling SE				.67	.08	.42	8.53***

*$p < .05$.

** $p < .01$.

*** $p < .001$.

Table 6

Multiple regression analysis predicting average workout duration from self-efficacy variables

Variable	*F*	*Df*	R^{2adj}	B	SE B	*β*	*t*
Males	26.75***	3, 496	.13				
Task SE				.22	.11	.10	1.98*
Coping SE				.21	.07	.15	2.90**
Scheduling SE				.35	.11	.19	3.26**
Females	15.98***	3, 612	.07				
Task SE				.26	.11	.11	2.30*
Coping SE				.10	.08	.06	1.21
Scheduling SE				.27	.10	.15	2.72**

*$p < .05$.

** $p < .01$.

*** $p < .001$.

Table 7

Multiple regression analysis predicting years as a regular exerciser from self-efficacy variables

Variable	*F*	*Df*	R^{2adj}	B	SE B	β	*t*
Males	5.13**	3, 496	.02				
Task SE				.01	.02	.01	.27
Coping SE				.04	.02	.16	2.92**
Scheduling SE				.00	.02	.01	.08
Females	9.70***	3, 612	.04				
Task SE				.06	.02	.15	3.18**
Coping SE				.02	.01	.09	1.76
Scheduling SE				.00	.02	-.00	-0.02**

*$p < .05$.

** $p < .01$.

*** $p < .001$.

STUDY 2

THE USE OF IMAGERY INTERVENTIONS TO ENHANCE THREE TYPES OF SELF-EFFICACY FOR EXERCISE[1]

Physical activity is associated with numerous physical and psychological health benefits including; lower rates of type II diabetes (Uusitupa, Luheranta, Lindstrom, Valle, Sundvall, Eriksson et al., 2000), heart disease (Katzmarzyk, Church, & Blair, 2004; Katzmarzyk & Janssen, 2004), and some forms of cancer (Magnusson et al., 1998) as well as lower rates of depression and anxiety, and increased positive mood (Scully, Kremer, Meade, Graham, & Dudgeon, 1998). Despite the extensive list of health benefits associated with physical activity, more than half of adults do not meet the minimum weekly recommendations for physical activity (e.g., Breuer, 2005, CFLRI, 2005; King, Castro, Wilcox, Eyler, Sallis, & Brownson, 2000; U.S Dept Health and Human Services, 1996; World Health Organization, 1996). Physical inactivity poses considerable risk to the health of the population. In fact, the U.S. Centres for Disease Control and Prevention have estimated that physical inactivity (in combination with poor diet) is responsible for approximately 365,000 deaths (16 percent of all deaths) annually (Mokdad, Marks, Stroup, & Gerberding, 2005). Physical activity, however, is considered a modifiable risk factor and has therefore received considerable attention from health practitioners and researchers as an avenue for intervention and a means to influence the health of the population.

Self-efficacy and exercise

One variable that has been found to be a robust predictor of health behaviour, including physical activity, is self-efficacy (SE; Bandura, 1986; 1997). A substantial body of research has demonstrated a positive link between SE and exercise behaviour, particularly when individuals are faced with challenges (Bandura, 1986, 1997, 2004; Dishman, Motl, Sallis, Dunn, Birnbaum, Welk et al., 2005; McAuley, Jerome, Elavsky, Marquez, & Ramsey, 2003; McAuley, Elavsky, Motl, Knopak, Hu, & Marquez, 2005). SE refers to an individual's confidence in his or her ability to perform the behaviours required to obtain a desired outcome (Bandura, 1986, 1997). Bandura (1997) argues that it is not only an individual's perceived efficacy to engage in specific skills which is important, but also the efficacy to perform these skills under challenging circumstances (p. 43). That is, the mere ability to perform a specific behaviour does not mean that one has the confidence to perform it under challenging situations. For example, an exerciser may judge herself as able to jog at a moderate pace for 30 minutes but have little confidence that she can complete this task when it is raining outside or she is feeling tired. SE reflects one's confidence for managing the skills required to produce even relatively routine behaviours over and over again when the specific circumstances of the behaviour are ever changing. It has been demonstrated that SE is a predictor of long term adherence to exercise among older adults and that SE can be manipulated in this population (McAuley et al., 2003; McAuley, Morris, Motl, Konopack, & Elavsky, 2007).

Maddux (1995) proposed two kinds of SE; task (i.e, SE to perform the elemental aspects of an activity) and coping (i.e., SE to perform a given task under challenging circumstances). Subsequently, with respect to exercise, a three factor model was proposed, including task SE, coping SE (i.e., related to overcoming barriers to exercise), and scheduling SE (i.e., related to coordinating one's activities to include regular exercise) (Rodgers & Sullivan, 2001). To date, the three factor model of exercise SE has received considerable support (Rodgers & Sullivan, 2001; Rodgers, Hall, Blanchard, McAuley, & Munroe, 2002; Rodgers et al., 2008; Rodgers, Murray, Courneya, Bell, & Harber, 2009). Rodgers and Sullivan (2001) found that non-exercisers reported high task SE, low coping SE, and low scheduling SE while avid exercisers reported high levels of all three types of SE. Furthermore, when exercisers were categorized into four groups according to their exercise frequency, Rodgers and Sullivan found that coping and scheduling SE better discriminated between the 4 groups than task SE indicating that these two types have differential influences. Furthermore, Rodgers et al. (2002) examined the influence of task and scheduling SE on regular exercisers and found that task SE positively influenced intentions to exercise while scheduling SE had an effect on behaviour. These findings demonstrated that task and scheduling SE are unique and represent different sets of skills.

Luszczynska, Schwarzer and their colleagues have also proposed a multidimensional conceptualization of SE which is phase specific conceptualization of the influence of SE (Luszczynska & Schwarzer, 2003; Luszczynska & Schwarzer, 2005; Luszczynska, Mazurkiewicz, Ziegelmann, & Schwarzer, 2007; Schwarzer, Luszczynska, Ziegelmann, Scholz, & Lippke, 2008). In this conceptualization, different skill sets are proposed to be more relevant at different phases of behaviour adoption. Schwarzer and Renner (2000) have described "action SE" which is involved in a pre-intentional phase of behaviour change and "maintenance SE" which is involved in post-intentional processes. The types of SE described in this conceptualization are similar to task and coping SE respectively. Further, Scholz, Sniehotta, and Schwarzer (2005) have described recovery SE, which is related to longer term maintenance and recovery from lapses. The conceptualization of SE put forth by Schwarzer and colleagues is based on distinct phases of exercise adoption in which different types of SE are present during each phase. In contrast, the conceptualization put forth by Rodgers et al. (2008) stipulates that the different types of SE are present to some degree at all times and the relative importance of each type of SE is contingent on the on the phase of change.

Rodgers et al. (2008) have provided psychometric support for the Multidimensional Self-Efficacy for Exercise Scale (MSEES). Using two samples of students, Rodgers et al. conducted an exploratory factor analysis followed by a confirmatory factor analysis and found support for three behavioural sub-domains of SE; task, coping, and scheduling. Using a third sample, Rodgers et al. provided discriminant validity evidence by demonstrating that theoretically consistent distinctions could be made between exercisers and nonexercisers using a multidimensional conceptualization of SE.

Despite the strong psychometric support for multiple dimensions of SE, there is limited experimental support that the three dimensions of SE can be influenced independently. Some preliminary evidence was provided by Rodgers et al. (2008) who examined changes in task, coping, and scheduling SE in a sample of 58 women involved in a 12-week strength training program. The results of this study showed that coping and scheduling SE changed over time, however the changes occurred at different rates. Specifically, both coping and scheduling SE increased over the first six weeks, while only coping SE continued to increase over the next six weeks suggesting that changes in the SE domains is relatively independent.

In a study conducted by Rodgers et al. (2009) the three types of SE were found to be behaviour specific. Individuals were enrolled in a 24-week exercise program and were randomized to: a walking program, traditional exercise program, or lifestyle maintenance control condition. The results revealed that for each type of self-efficacy, quadratic patterns of change were observed for the specific type of behaviour engaged in. These findings support the idea that SE is behaviour specific. It has yet to be determined, however, whether domain-specific interventions can differentially influence task, coping, and scheduling SE.

Duncan et al., (2010) examined the SE of 1116 male and female regular exercisers and found that the three types of SE are differentially related to different characteristics of exercise behaviour. Specifically, scheduling SE was the strongest predictor of exercise frequency and METS for males and females, followed by coping SE. Task SE did not contribute to the prediction of SE or METS for either gender. The strongest predictor of exercise duration was scheduling SE for both males and females. For males, both coping and task SE contributed to the prediction of duration, and for females, task SE added to the prediction. Finally, Duncan et al. found that number of years of regular exercise was predicted by coping SE for males and scheduling SE for females. This study demonstrated that task, coping, and scheduling SE play distinct roles in the prediction of various characteristics of exercise behaviour. Taken together with research conducted by Rodgers and colleagues (2008; 2009), this study provides a strong evidence that interventions targeting specific types of SE could have differential effects on exercise behaviour.

Mental imagery and exercise

Imagery, or mental practice, has been identified as an effective means for changing an individual's behaviours, thoughts and beliefs. In sport for example, athletes use imagery to learn and perfect new skills and strategies, stay motivated towards a goal, increase their self-confidence, and control arousal and anxiety levels (Hall, 2001; Martin, Moritz, & Hall, 1999). It is hypothesized that mental imagery is an important vehicle for information processing and that vivid mental images can closely represent an object, emotion, or psychological state and consequently link closely with perception (Farah, 1989). Research has demonstrated that visual images are most common, while images using other senses (i.e., kinaesthetic, auditory, and gustatory images) are less common (Kosslyn, 1994). Using multiple sensory modalities to create mental images has been found to be more effective in some situations (Hall, 2001).

Hall (1995) proposed that imagery may be an important determinant of exercise behaviour and cognitions. Subsequent research has confirmed that regular exercisers frequently use imagery and by employing imagery exercisers can learn exercise tasks, become energized, set appearance related goals, and cope with exercise barriers (Gammage, Hall, & Rodgers, 2000; Giacobbi, Hausenblas, Fallon, & Hall, 2003; Hausenblas, Hall, Rodgers, & Munroe, 1999). Additional research has demonstrated that exercise imagery is linked to greater exercise intentions (Rodgers et al., 2002), as well as increased task and scheduling SE (Wesch, Milne, Burke, & Hall, 2006). Moreover, Wilson, Rodgers, Hall, and Gammage (2003) examined exercise imagery in the context of self-determination theory and found that two functions of imagery, appearance and technique, were related to more self-determined exercise regulations

While there is clear evidence supporting the relationships between imagery, behaviour, and cognitions in an exercise context, most of the research to date has not had a strong theoretical basis. Furthermore, the limited research that has been driven by theory (e.g., Wilson et al., 2003) has been correlational and cross-sectional in nature.

One framework from which theoretically driven imagery interventions could be designed is Social Cognitive Theory (SCT; Bandura, 1986). SCT identifies (in order of their degree of influence) past performance success, vicarious experiences, social persuasion, and physiological or affective states as the four primary sources of self-efficacy. According to SCT, mental imagery would fall under the umbrella of vicarious experiences and could have a relatively powerful influence on SE. Correlational evidence has identified a relationship between imagery and SE (e.g., Wesch et al., 2006), however it is not known if the different types of SE can be independently influenced and whether or not this can be done using an imagery intervention. Therefore, the purpose of the present study was to determine if three types of SE (i.e., task, coping, scheduling) could be differentially influenced using guided imagery interventions in an experimental design controlling for overt mastery experiences. Since previous research has found that task, coping, and scheduling change at different rates (Rodgers et al., 2008), it was hypothesized that the three different types of SE could be differentially influenced and that guided imagery sessions oriented toward one specific type of SE would influence that type of SE and not the other two types. The effect of the imagery interventions on SE can be isolated from the effects of overt exercise experiences because these were controlled to be the same in all experimental groups.

Methods

Participants

The participants (*N*=206) were healthy females between the ages of 18 and 45 (*M*=31.47, *SD*=9.25) recruited from on campus and in the community surrounding a large Canadian University. In order to participate in the study, participants were required to be non-exercisers, or infrequent exercisers (i.e., exercised less than once per week for a period of at least six months prior to study recruitment) who intended to become more active. The mean BMI of the participants was 27.71 (*SD*=6.23) indicating that on average, the participants were slightly overweight.

It should be noted that there was a large dropout rate among participants in this study. At the six-week assessment, only 95 participants remained. An additional 34 participants dropped out leaving 61 participants to complete the study. A Chi-square analysis was conducted in order to determine differences in adherence across the four study groups and the results confirmed that there were no significant differences in dropout rates between the four groups. It was important to include only participants who adhered to the exercise prescriptions, however, in order to ensure that they had equivalent overt experiences with the exercise.

A series of t-tests were conducted in order to determine if differences existed between the adherers and the dropouts on the self-efficacy variables at baseline. The results revealed that no differences existed between the participants who adhered to the study protocol and those who dropped out in terms of baseline task, coping, or scheduling self-efficacy.

Measures

At baseline, participants were asked to complete a demographic questionnaire which assessed age, exercise frequency, race, income, education, occupation, marital status, and number of children. In addition, participant weight and height were measured by the researcher at the baseline and final assessments.

Multi-Dimensional Self-Efficacy for Exercise Scale (MSES; Rodgers et al., 2008). The MSES includes a total of 9 items which measure task SE (*three items*), coping SE (*three items*) and scheduling SE (*three items*). Following the stem "How confident are you that you can..." each item is measured on a 100% confidence scale ranging from 0="no confidence" to 100="completely confident." The MSES has been found to possess adequate validity and reliablility (Rodgers et al., 2008).

Exercise intensity and duration were assessed objectively using Polar RS400 Running Computer™ heart rate monitors (HRM). The HRM provided the researcher with minute-by-minute heart rate data as well as workout duration. Individual heart rate data was recorded throughout each workout and downloaded to a software program for analysis. Workout duration was also assessed by self-report at the end of each exercise session. Finally, workout frequency was assessed using attendance records kept by the program monitors.

Procedure

Prior to participant recruitment the research protocol was approved by the research ethics board at the host institution.

Recruitment. Participants were recruited on campus at a large Canadian university as well as from the local community through newspaper advertisements, posters, and word of mouth. Interested potential volunteers contacted the investigators and were provided with more information via telephone or email. Participants were briefed on the study protocol then screened for eligibility.

Initial Assessment. Eligible and willing participants arranged an initial meeting with the researcher during which the study was explained in detail and informed consent was obtained. During the initial meeting, participants also completed baseline questionnaires measuring demographics and exercise SE.

During the initial meeting participants underwent a baseline sub-maximal aerobic fitness test on a cycle ergometer. The fitness test was conducted by a certified kinesiologist or a trained masters-level researcher in accordance with the guidelines outlined by the American College of Sports Medicine (ACSM, 2000) and it took approximately 10-15 minutes to complete.

The initial assessment also involved an interactive lab tour in which the participants were familiarized with the exercise facility. The participants received a demonstration regarding the appropriate technique to be maintained on the various exercise machines (i.e., treadmills, rowing machines, stair climbers, and stationary bikes). Participants were then given the opportunity to try each of the machines to ensure that they were comfortable on the equipment.

Exercise Program. All participants were prescribed a 12-week individualized, cardiovascular exercise program which was created based on the results of each individual's sub-maximal fitness test and her resting heart rate value. The participants were asked to exercise three times per week for 30- 45 minutes and to maintain a heart rate within an assigned, pre-determined range. The target heart rate range increased every three weeks beginning with a target heart rate between 50 and 60 percent of heart rate reserve (age predicted maximum heart rate - resting heart rate) and climbing to a range of 60 to 70 percent of heart rate reserve in the last three weeks of the program. The prescription also involved a progressive increase in workout duration which began at thirty minutes and increased to 45 minutes at the end of 12 weeks. The participants were asked to complete all of their exercise sessions in the study's exercise facility. The participants were also informed that if they wished to do so, they could exercise more than three times per week, however they were asked to complete these sessions at the study facility. Compliance with the program was monitored by attendance sheets located inside the exercise facility as well as minute-by-minute heart rate and exercise duration data collected by heart rate monitors worn during each exercise session.

Imagery Intervention. The participants were randomly assigned into one of three experimental groups: task SE, coping SE, or scheduling SE imagery groups or to the control group. Participants in the imagery groups received three guided imagery sessions over the course of one week, before they began the exercise program. The researcher administered the guided imagery in a quiet room by reading an imagery script that focused on enhancing the type of exercise SE designated by the group assignment. The participants were instructed to close their eyes, relax, and try to create the most vivid images possible, using as many of their senses as possible. Each imagery script reading took approximately five minutes. After each reading, the participants were given a copy of the script and instructed to practice their exercise imagery on their own, four times per week (once per day on the days that they did not exercise).

The task imagery scripts involved statements related to properly performing the exercise movements and accurately following the instructions given by the researchers (i.e., stay in the designated heart rate range for a minimum of thirty minutes). The task imagery scripts included statements such as; "Think about keeping the core of your body supported and upright", and "Think about your heart beat. Imagine what it feels like to be exercising in a moderate heart rate range". Because the exercise instructions were unique to each piece of equipment in the study facility and the participants were able to choose the equipment they would use, four separate task imagery scripts were drafted, one for each exercise machine. In the first week the participants listened to the script for the treadmill and the bike. At the third imagery script reading the participant was asked whether they thought they would use the stepper or the rower more frequently and the third imagery script was selected based on her response. When the participants returned for a 'booster' imagery session (during the six-week assessment) they selected the imagery script they would hear based on the machine they used most frequently.

The imagery scripts for the coping group reflected the ability to adhere to exercise in the face of challenges. The coping imagery script described statements that might challenge the participant to engage in exercise (e.g., feeling low in energy or experiencing muscle stiffness due to a previous workout). The participants were then led to imagine overcoming those challenges (e.g., beginning to feel invigorated and rejuvenated by the exercise or following the workout). Participants in the coping group listened to the same imagery script at each reading.

The imagery script for the scheduling group described the process of scheduling exercise into a day or week. This script also addressed the need to re-schedule a workout if a planned exercise session was missed. The scheduling script involved statements such as "Think about when, during your day you will exercise, and how you will coordinate this with your other daily activities". One imagery script was written for the scheduling condition and the participants read the same script each time they met with the researcher.

The content of the imagery scripts was created by the lead author and was heavily guided by the conceptualizations of task, coping, and self-efficacy as described by Rodger and Sullivan (2001) and Rodgers et al. (2008). The content validity of the imagery scripts was verified by a researcher who has used the multidimensional conceptualization of self-efficacy extensively in her research and by an expert in the field of exercise imagery. Both expert reviewers suggested minor changes to the imagery scripts which were incorporated into the final version of the scripts.

Participants in the attention control condition met with the researcher three times before they began the exercise program and were given information regarding healthy nutrition. Each nutrition session lasted approximately five minutes. Following each session, the participants were given a handout detailing the nutrition information they had received during the session.

Mid-point assessment and intervention. At the mid-point of the exercise program (i.e., 6 weeks), the participants completed the MSES. At the mid-point meeting an imagery 'booster' session was also provided. Participants in the imagery groups received one final guided imagery session targeting the designated type of SE and were reminded to continue practicing imagery on their own. Participants in the control group met with the researcher for one additional nutrition information session.

Final Assessment. Upon completion of the 12-week exercise program, the participants were asked to attend a final assessment in which they completed the MSES.

They also completed a debriefing questionnaire which served as a manipulation check for the imagery intervention and allowed them to provide personal feedback regarding their participation in the study. The final assessment also involved a sub-maximal fitness test using the same protocol employed at baseline.

Results

A series of one way ANOVAs were conducted to determine if there were any differences between the study groups on various indicators of weekly adherence including: frequency, self-reported duration, objectively measured duration, mean exercise heart rate, and number of minutes spent in the prescribed heart rate zone. The analyses revealed that there were no differences between groups on any adherence indicators at any point in the 12 week exercise program ($p>.05$) supporting the assumption that mastery experience was equivalent for all groups (and therefore successfully controlled), allowing for the effect of the imagery interventions on SE to be isolated from the mastery experiences which can be assumed to be constant.

To test the influence of the various imagery interventions on the types of SE over time, two doubly multivariate ANOVAs were conducted, one for the first time period, from baseline to 6 weeks, and the other for the second time period, from 6 weeks to 12 weeks (end of intervention). The analysis specifically assessed the influence of four groups (task imagery, coping imagery, scheduling imagery, control) on the types of SE (task, coping, scheduling) over time (2 times in each analysis) yielding a 4 (group) x 3 (type of SE) x 2 (time) with repeated measures on both type of SE and time following the assumption that the types of SE and the time-based assessments are not independent of each other. The scores on the MSES subscales served as the dependent variables.

The first analysis (baseline to 6 weeks) revealed the following significant multivariate effects (all for Pillai's Trace): a main effect for time, $F(1,91)=26.14$, $p<.0001$, $\text{Eta}^2=.223$; a main effect for SE, $F(2,90)=103.41$, $p<.0001$, $\text{Eta}^2=.697$; a time x SE interaction, $F(2,90)=10.49$, $p<.0001$, $\text{Eta}^2=.189$, and a time x SE x Group interaction, $F(6,182)=2.23$, $p<.04$, $\text{Eta}^2=.069$. The means and standard deviations (*SD*s) for this analysis are in Table 1.

The three way interaction is the analysis of principle interest, because it shows that the types of SE change differently over time in response to the different imagery interventions. This interaction can be understood by considering Figures 1, 2, and 3. Figure 1 shows that task SE increased significantly more for the group that received the task SE imagery intervention, although, as expected, we do see a generalized increase in Task SE over the first 6 weeks of the intervention for all the groups. Similarly, Figure 2 shows us that coping SE for exercise changed most among those people who received the coping SE imagery intervention. Also, as expected, everyone's coping SE for exercise increased over time with overt experience. Finally, Figure 3 shows us that scheduling SE for exercise changed most rapidly among those people who received the scheduling SE imagery intervention.

The second analysis (week 6 to week 12) revealed that only the main effect for SE type, $F(2, 56)=41.39$, $p<.0001$, $\text{Eta}^2=.596$, remained significant, reflecting a general flattening out of the curves for the types of SE in all groups. These results suggest that the main changes observed within a 12 week intervention take place within the first six weeks. The means and standard deviations for this analysis are in Table 2.

Discussion

Social Cognitive Theory suggests that overt mastery experience and vicarious experience are the two strongest sources of SE information. Previous research has shown that SE for exercise increases as a result of overt exercise experience (e.g., Rodgers et al., 2008). As a result, in the current study we would expect an increase in all three types of SE for exercise by the study participants as a direct result of participation in the exercise program. In fact, the current results show us that overt mastery experiences have a strong influence on SE, as all types of SE increased from baseline to 6 weeks, regardless of their study group. However, the main purpose of the present study was to determine if task, coping, and scheduling SE could be differentially influenced using guided imagery interventions in an experimental design that controlled for mastery experiences (because all participants had similar mastery experiences). More specifically, it was hypothesized that the three different types of SE could be differentially influenced and that guided imagery sessions focused on one specific type of SE would influence that type of SE more than the other types. The results showed that each type of SE was augmented by the corresponding imagery to a greater extent than the other types of SE by the interventions as expected. Furthermore, these results suggest that the influence of multiple sources of SE information is not redundant. Future research is needed to replicate this effect, but clearly at least two sources of SE information (overt mastery and imagery) have a positive effect on task, coping and scheduling SE.

Overall, the results of the current study show us that task, scheduling and coping SE for exercise are independent from each other. Specifically, the results demonstrate that exercise participants report significantly different levels of each type of SE at all time points, suggesting that the SE types are both conceptually and practically distinguishable.

Most importantly, the results also show that targeting each type of SE through intervention has separable effects that are primarily restricted to the targeted type. It should be noted, however, that task SE seems to be either (a) related to both the other types and, or (b) most quickly affected by overt experience. We would endorse both these arguments. First, it has been consistently argued and empirically demonstrated that the three types of SE are correlated to each other (e.g., Rodgers et al., 2008). This might be particularly true of task SE for exercise and the other two types, coping and scheduling, which both assume a certain degree of task confidence in addition to being able to perform the task in spite of varying obstacles. It is consistent with the original conceptualization of the MSES that the types of SE should be correlated (Rodgers et al., 2008). Second, Bandura (1997) has argued, and these data support, that the strongest source of SE is overt experience. Furthermore, the most overt experience gained in only six weeks of exercise is task experience; actually performing the exercises. We have argued previously (Rodgers et al., 2002; 2008) that it takes longer to accrue sufficient experience with overcoming scheduling barriers or other types of barriers to gain the same amount of confidence for performing exercise challenged by the barriers as for performing the exercise in the absence of barriers. This idea is consistent with the work of Schwarzer and Renner (2000) who contend that action (similar to task SE) and maintenance (similar to coping SE) self-efficacy have differential influences over time during behaviour adoption. Nonetheless, in the present study some overt experience is being gained for all three types of SE for exercise over and above the imagery interventions designed to augment only one type of SE. Therefore, the three way interactions observed here provide very strong evidence for some basic tenets of SE theory, as well as for the conceptual and operational independence of task, coping and scheduling SE for exercise as assessed by the MSES.

The power of the imagery interventions should not be overlooked. In addition to over behavioural experience, the relatively small intervention (20 total minutes of guided imagery) produced a significant change in the type of SE targeted suggesting imagery is an important potential vehicle for changing exercise-related cognitions.

One limitation to the study involves the timing of the baseline assessment of SE. Baseline questionnaires were administered during the initial meeting with the participant, before the fitness test occurred, the exercise program was prescribed, and (most importantly) the imagery intervention was administered. The first post-imagery SE assessment took place at time 2, six weeks following the delivery of the imagery intervention. Since the results of the current study indicate that the greatest changes in self-efficacy occurred within the first six weeks of exercise it would be ideal to have a post-imagery, pre-exercise assessment of self-efficacy. Based on the data, it is not possible to determine if the impact of the imagery intervention was the strongest directly after the intervention was delivered or whether the effects of the imagery were strengthened as the participants achieved overt experience in the exercise program. Future studies should include a more isolated assessment of the impact of an imagery intervention on the target variable.

Despite the limitations, two main conclusions can be drawn from the current study. First, from both conceptual and operational perspectives, task, coping, and scheduling SE for exercise seem to be independent from one another. Second, the imagery intervention was successful and these results point to the utility of imagery interventions to influence exercise-related cognitions. More research is needed in order to determine whether imagery can be used to influence actual behaviour and the imagery dose that would be required to do so.

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Footnote

[1] A version of this chapter has been submitted for publication

Table 1

Descriptive data for first analysis from time 1 to time 2

		Group				
SE Type	Time	Task Mean (*SD*)	Coping Mean (*SD*)	Scheduling Mean (*SD*)	Control Mean (*SD*)	α
Task	1	76.15 (17.01)	72.87 (18.38)	75.51 (21.97)	79.20 (14.85)	.85
	2	85.00 (11.52)	77.96 (15.10)	81.03 (18.06)	82.73 (11.00)	.86
Coping	1	48.33 (25.04)	47.13 (18.42)	48.91 (23.19)	49.87 (18.55)	.78
	2	64.10 (18.41)	67.87 (15.49)	55.70 (23.50)	58.93 (19.48)	.85
Scheduling	1	71.86 (27.20)	70.28 (20.80)	69.74 (20.29)	71.67 (15.55)	.87
	2	77.44 (16.09)	73.13 (20.74)	78.85 (16.08)	72.93 (13.55)	.86

Table 2

Descriptive data for first analysis from time 2 to time 3

		Group				
SE Type	Time	Task Mean (*SD*)	Coping Mean (*SD*)	Scheduling Mean (*SD*)	Control Mean (*SD*)	α
Task	2	83.70 (12.88)	78.21 (17.31)	81.77 (14.15)	83.97 (13.08)	.86
	3	83.70 (17.78)	83.59 (12.29)	85.10 (11.61)	83.46 (10.98)	.94
Coping	2	65.00 (18.41)	70.26 (15.42)	56.96 (21.96)	57.70 (23.43)	.85
	3	64.72 (25.02)	73.08 (18.38)	59.02 (26.33)	61.29 (23.04)	.93
scheduling	2	77.59 (15.20)	77.41 (18.21)	80.00 (14.43)	71.28 (17.61)	.86
	3	80.19 (18.45)	81.10 (18.62)	79.31 (19.12)	76.28 (14.40)	.94

Figure 1. Change in task SE for exercise for four groups from baseline to 6 weeks.

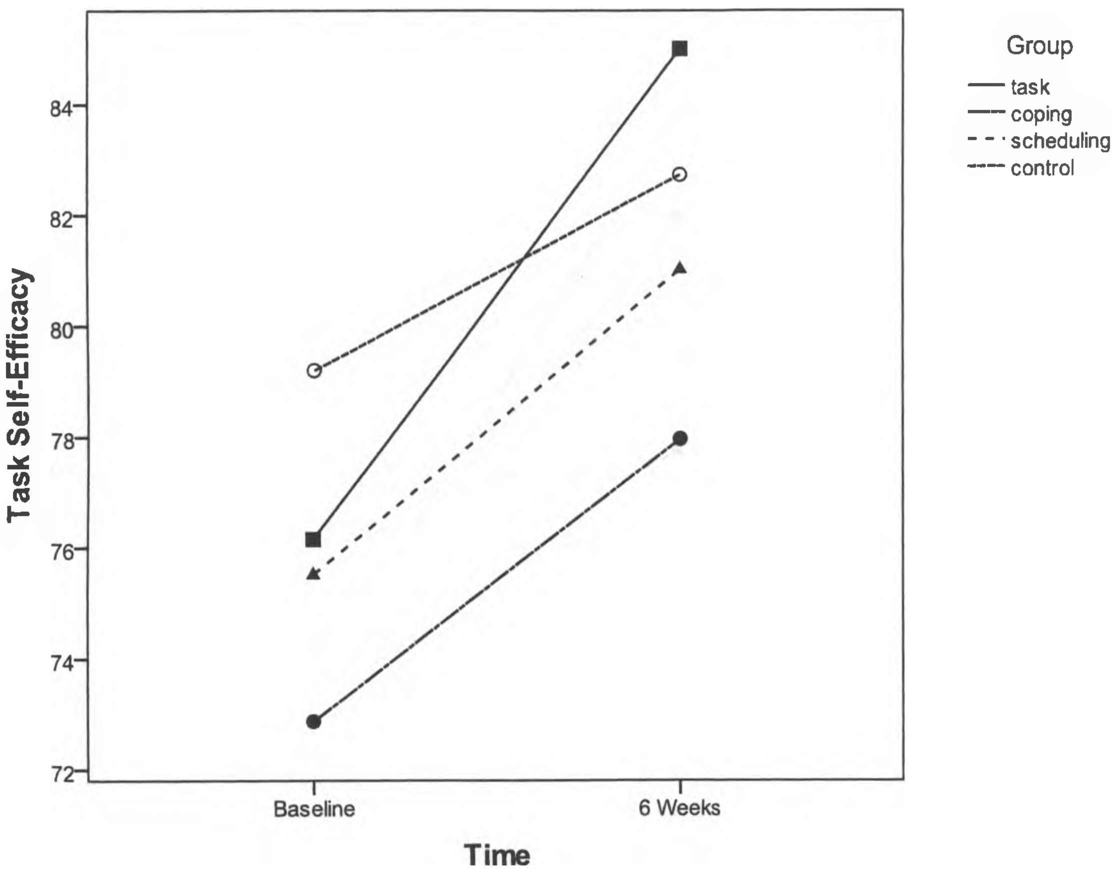


Figure 2. Change in coping SE for exercise for four groups from baseline to 6 weeks.

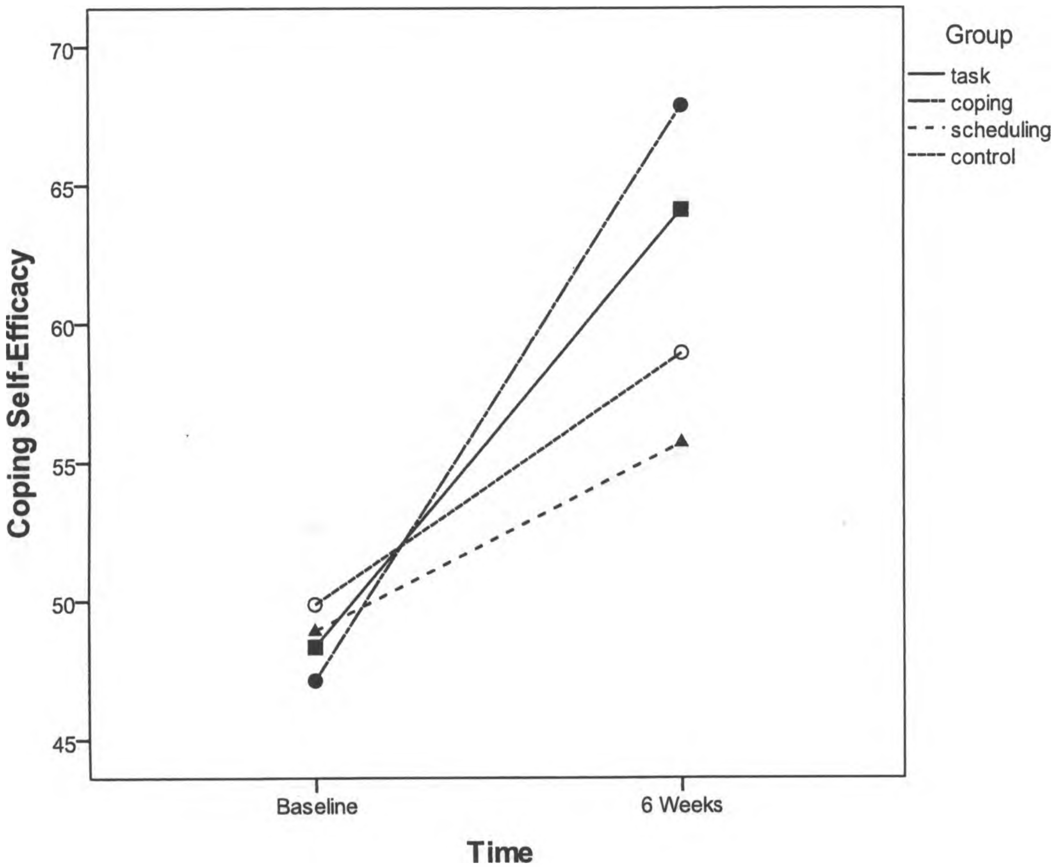
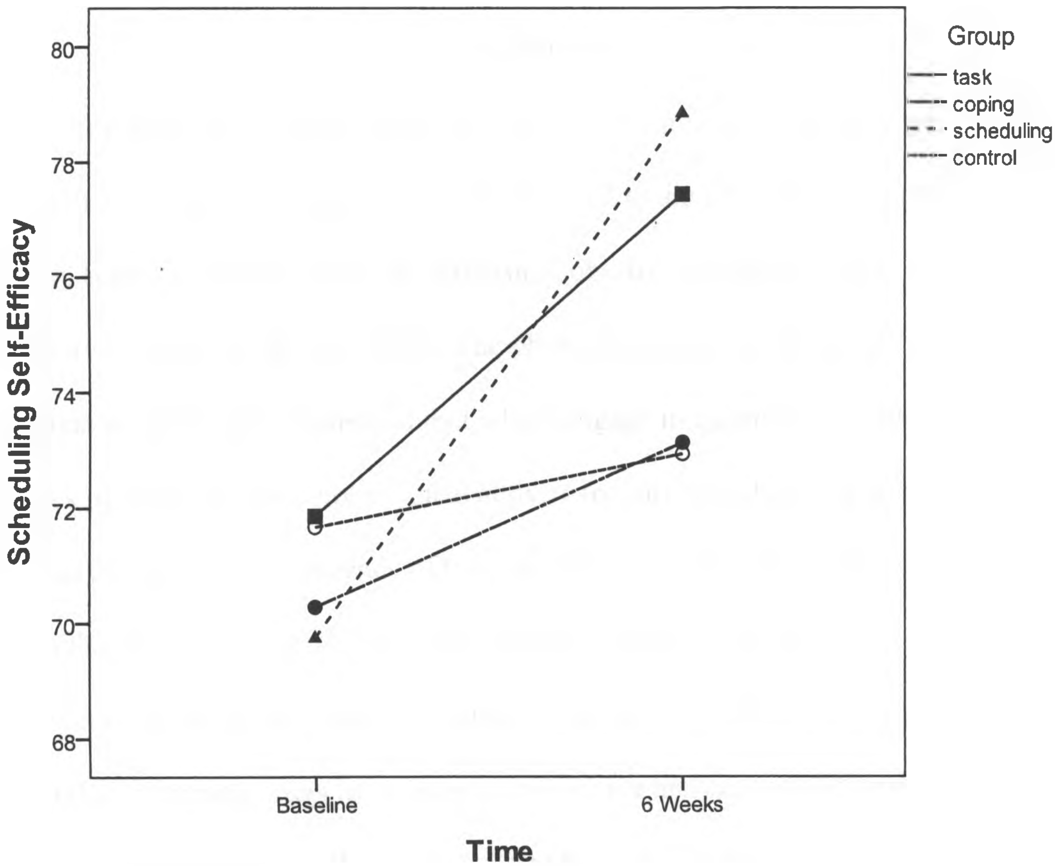


Figure 3. Change in scheduling SE for exercise for four groups from baseline to 6 weeks.



STUDY 3

EXERCISE MOTIVATION: A CROSS-SECTIONAL ANALYSIS EXAMINING ITS RELATIONSHIPS WITH FREQUENCY, INTENSITY, AND DURATION OF EXERCISE[1]

Engagement in regular physical activity is an important part of a healthy lifestyle. Research has shown that regular exercise is linked to the prevention of cardio-vascular disease, type 2 diabetes, cancer, hypertension, obesity, osteoporosis, and depression (Warburton, Nicol, & Bredin, 2006). The physical activity guidelines set forth by the Canadian government recommend that adults engage in a cumulative total of sixty minutes of moderate intensity physical activity (occurring in bouts of at least 10 minutes) every day (Public Health Agency of Canada, 2000). In addition to this, some research has shown that vigorous exercise can lead to health benefits above and beyond those offered by moderate intensity exercise. For example, the use of antidiabetic, antihypertenstion, and LDL-C lowering drugs have been found to have an inverse relationship with vigorous physical activity (Williams & Franklin, 2007). Furthermore, in a study examining the relationships between physical activity and fatness in adolescents, it was found that lower percent body fat was related to vigorous physical activity but not to moderate intensity physical activity (Gutin, Yin, Humphries, & Barbeau, 2005). It appears that in order to achieve the health benefits associated with physical activity it is important to exercise regularly and at an appropriate intensity. Despite the vast amount of research that has demonstrated the link between physical activity and health, 63% of Canadians are not sufficiently active to obtain these health benefits (PHAC, 2000). One factor that is thought to contribute to an individual's physical activity levels is his or her motivation to exercise. In fact, various types of motivation have been found to influence effort expended during exercise sessions as well as intentions to continue exercising (Wilson, Rodgers, Fraser, & Murray, 2004).

Self-Determination Theory (SDT; Deci & Ryan, 1985) has been proposed as one way of looking at motivation. SDT is a general theory which has frequently been applied in the exercise domain. The SDT framework posits that human motivation lies along a continuum which represents varying degrees of autonomy. Autonomy refers to behaviours being self-determined, or freely initiated by the individual (Deci & Ryan, 1985). The self-determination continuum is comprised of both intrinsic and extrinsic components. Intrinsic motivation occupies the most self-determined end of the continuum and involves motivation derived from the sheer pleasure and satisfaction of engaging in the behaviour itself (Deci & Ryan, 1985). An exerciser who is intrinsically motivated might swim, for example, because they enjoy the feeling of their body moving through the water. Four distinct behavioural regulations comprise the extrinsic part of the motivational continuum. These four regulations successively decrease in their degree of self-determination from autonomous regulations to controlling regulations. Integrated and identified regulations represent the more autonomous forms of extrinsic motivation. Integrated regulation is represented by an individual's belief that a behaviour is an important part of his or her identity and is consistent with his or her personal values (Ryan & Deci, 2000). An individual who demonstrates integration might go running because they believe they are 'a runner' and therefore running is consistent with their sense of identity. Identified regulation refers to being motivated to perform a behaviour because it is personally significant and results in outcomes which are valued by the individual (Deci & Ryan, 1985; Ryan & Deci, 2000). For example, individuals might engage in resistance training because they know that weight bearing activities are important for bone health. Controlling regulations (introjected and external) occupy the less self-determined end of the motivational continuum. Introjected regulation represents the desire to obtain intrapersonal rewards (e.g., pride) or to avoid self-inflicted punishments (e.g., guilt or shame) (Ryan & Deci, 2000) while external regulation refers to the desire to obtain external rewards or avoid punishments (Ryan & Deci, 2000). An individual who exercises for external reasons might do so to appease their spouse or their physician. It is also possible that an individual will be amotivated. That is, they will engage in a behaviour without feeling any motivation, or they will exhibit a complete lack of intention to perform a behaviour. An individual's relative location along the self-determination continuum is determined by the degree to which he or she has achieved satisfaction of the basic psychological needs for competence, autonomy, and relatedness (Ryan, 1995).

One important contention of SDT is that the external regulations and amotivation are less adaptive in nature while intrinsic motivation results in positive motivational consequences. Research has supported this contention with amotivation being linked to behavioural disengagement and negative psychological conditions (Ryan & Deci, 2000). Furthermore, intrinsic motivation is associated with persistence at a task as well as psychological health and well-being (Deci & Ryan, 1985). In an exercise context, research has examined individuals at various stages of exercise adoption and found that individuals with tendencies toward more regular exercise are more self-determined in their motivation (Mullan & Markland, 1997).

In spite of these findings, it has been suggested that some people may persist at sport and exercise despite being extrinsically motivated (Frederick & Ryan, 1993). This suggestion can be highlighted by research examining the relationships between obligatory exercise and motivation. In a study involving regular exercisers it was found that individuals who are preoccupied with exercise, or who exercise at greater frequency, tend to score higher on identified regulation (Duncan, Hall, Rodgers, Wilson, 2010). Furthermore, individuals who experience negative emotional consequences (i.e., anger, depression) when they miss an exercise session tend to score highly on introjected regulation (Duncan et al., 2010). In terms of exercise intensity, for individuals who show symptoms of exercise dependence, introjected regulation approached significance as a positive predictor of strenuous exercise behaviour and identified regulation was found to be a positive predictor of strenuous exercise (Edmunds, Ntoumanis, Duda, 2006).

Using SDT as a context for examining the motivation of 598 male and female university students engaged in a variety of exercise classes (e.g., weight training, aerobics, swimming), it was found that students who were classified as 'more frequent exercisers' showed higher levels of intrinsic motivation and the autonomous forms of extrinsic regulation compared to 'less frequent exercisers' (Li, 1999). A gender analysis revealed that females reported higher levels of intrinsic motivation and autonomous regulations while exercise behaviour among males was more externally regulated and amotivated.

Further research examined the relationships between exercise regulations and various motivational consequences (i.e., behavioural intention, effort and importance associated with exercise participation, and current exercise behaviour) among university students (Wilson et al., 2004). Results revealed that identified regulation was the strongest predictor of each of the three motivational consequences in both males and females. Intrinsic regulation was also found to predict effort and importance for males and females, as well as behavioural intention for females only. These findings were consistent with previous research and with SDT. Interestingly, it was found that introjected regulation was a positive predictor of all three motivational consequences for females only. This finding suggested that females may experience a sense of pride associated with exercise or some degree of guilt or shame if they do not exercise.

Overall, it appears that exercise-related motivation varies according to the amount of exercise an individual undertakes. Previous research has considered exercise behaviour in several different ways, from intention to exercise and self-reported exercise frequency (Mullan & Markland, 1997) to a measure including exercise intensity (Wilson et al., 2004) and indicates that different types of behaviour (e.g., exercise frequency and intensity) may be differentially regulated. Since SDT suggests that the regulations along the continuum are distinct, it is possible that they can be individually manipulated. If key motivational forces can be identified in regular exercisers and specific motivational deficits can be identified in less frequent exercisers, perhaps it is possible to target the most relevant types of motivation in order to increase exercise behaviour among those who are insufficiently active. If this is the case, understanding the unique role that each regulation plays in exercise behaviour has important practical implications for exercise interventions.

One main limitation to research regarding motivation to exercise has been that the three basic measures of exercise behaviour, frequency, intensity and duration have not been investigated within a single study. Another limitation is the lack of a measure of integrated regulation. Many of the studies examining exercise motivation have used the Behavioural Regulation in Exercise Questionnaire (BREQ; Mullan, Markland, & Ingledew, 1997) which does not measure integration. More recently, a measure of integrated regulation which is complementary to the BREQ has been developed (Wilson, Rodgers, Loitz, & Scime, 2006). The inclusion of an integrated subscale allows for the full spectrum of motives to be measured which is important in order to gain a complete understanding of how individuals are motivated to engage in exercise. Therefore, the purpose of this study was to examine the relationships between three exercise behaviours (frequency, intensity, and duration) and the various behavioural regulations according to the SDT framework, including integrated regulation. Based on the contention of SDT that free-choice behaviours are most closely related to more self-determined motives, it was hypothesized that all three exercise behaviours would be most closely related to autonomous regulations and intrinsic motivation.

Methods

Participants

Participants (N=1054) were male (n=460) and female (n=594) volunteer (M_{age}= 24.15, SD=9.61) regular exercisers. For the purposes of this study, 'regular exercise' was defined as consistently engaging in at least two exercise sessions (of any kind) each week for the past six months. The sample was largely composed of students with 75% of participants reporting 'student' as their primary occupation. Self-report data revealed the sample was quite active ($M_{frequency}$= 4.07 sessions per week, SD= 1.77; $M_{duration}$= 67.31 minutes per session, SD= 28.23; and $M_{intensity}$= 69.71 weekly METS, SD= 39.65).

Participants listed the exercise activities in which they typically participate. The most commonly cited exercise activities were running (62.6%), weight training (61.2%), playing sports (58.7%), walking (48.5%), and exercising on cardio equipment (e.g., treadmills, stationary bikes, elliptical trainers; 46.8%).

Measures

Exercise behaviour was assessed using a self-report measure in which participants indicated the number of times they exercise in a typical week, the average duration of each session, and the type of exercises they engage in.

The Leisure Time Exercise Questionnaire (LTEQ; Godin & Shephard, 1985) was used to assess participants self-reported exercise intensity. Participants indicated the frequency of mild, moderate, and strenuous activity they engage in for at least 15 minutes during a typical week. A composite exercise behaviour score was then calculated using the weighted sum of each exercise intensity according to the following formula: (mild x 3) + (moderate x 5) + (strenuous x 9). The result was a weekly MET (units of metabolic equivalence) value. The LTEQ has been found to be valid and reliable when compared to objective measures of physical activity (Jacobs, Ainsworth, Hartman, & Leon, 1993).

The Behavioural Regulation in Exercise Questionnaire- version 2 (BREQ-2; Markland & Tobin, 2004) is a 19-item self-report measure which was adapted from the original BREQ (Mullan et al., 1997) and assesses exercise regulations according to the SDT framework. The BREQ-2 includes 5 subscales assessing intrinsic (e.g., "I enjoy my exercise sessions;" n=4), identified (e.g., "It's important to me to exercise regularly;" n=4), introjected (e.g., "I feel guilty when I don't exercise;" n=3), and external (e.g., "I feel under pressure from my family/ friends to exercise;" n=4) regulations as well as amotiviation (e.g., “I don’t see why I should have to exercise;” *n*=4). Each item is rated on a 5-point scale ranging from 0= “not true for me” to 4= “very true for me.” Recently, the BREQ-2 has been extended to include four additional items assessing integrated regulation (e.g., “I exercise because it is consistent with my values;” *n*=4) (Wilson et al., 2006). The integrated subscale was included in the current study. A reliability analysis revealed internal consistency values ranging from .76 to .90 for the various regulations for males and females, with the exception of amotivation for males being .54 (see Table 1 for specific values).

Procedure

All study procedures were approved by a university research ethics board. Participants were approached by the researcher prior to or following their workouts in their regular gym setting. Once informed consent was obtained, the participants completed the BREQ-2R, LTEQ, and demographic information.

Results

Preliminary Data Screening

The data was screened in order to detect missing values and outliers as well as to test for conformity with the assumptions of multiple regression (normality, linearity, and homoscedasticity). The analysis revealed no missing values and no cases of extreme responses (values > 4 standard deviation units from the mean on any measure). An examination of the distribution properties and histograms of each variable indicated that the amotivation variable deviated substantially from normality and warranted transformation. A logarithmic transformation with the addition of a constant to each value was conducted in order to normalize the amotivation variable (Tabachnik & Fidell, 2001). All subsequent analyses were conducted using the transformed amotivation variable. No violations to the assumptions of linearity or homoscedasticity were observable through an examination of scatterplots of the residuals indicating that the data was suitable to undergo regression analyses.

Descriptive Statistics, T-tests, and Bivariate Correlations

Descriptive statistics for both males (n=460) and females (n=594) are presented in Table 1. The data confirmed that the males and females were all highly active, reporting mean exercise frequency scores of 4.20 (SD=1.84) and 3.97 (SD=1.70) workouts per week respectively. Furthermore, mean scores for the exercise intensity variable (weekly METS) were slightly higher than values reported in previous research (Hayes, Crocker, Kowalski, 1999; Wilson et al., 2004).

Mean scores for the subscales of the BREQ revealed an expected pattern in which individuals reported participating in exercise for more autonomous reasons compared to more controlling reasons (Wilson et al, 2004; Wilson, Rodgers, & Fraser, 2001). Specifically, for both genders, identified was the most strongly endorsed regulation followed by intrinsic, integrated, introjected, external, and amotivation respectively.

T-tests revealed that males and females differed significantly (p<.017 to control for type 1 error) in terms of the typical duration of exercise sessions (t(931.79)=2.72, p=.007). In this case, males reported exercising for longer durations than females (Table 1). No significant difference was observed between males and females number of exercise sessions per week (frequency; t(1052)=2.07, p=.039) or for exercise intensity (t(1052)=-.78, p=.436).

Correlations were conducted between each of the variables of the BREQ and the three exercise behaviours (frequency, intensity, and duration; Table 2 and Table 3). The analyses revealed a theoretically consistent pattern of relationships in which adjacent subscales from the BREQ were more strongly and positively correlated with subscales theorized to be more proximal along the motivation continuum. This finding is consistent with previous research (Wilson et al., 2004) and supports the concept of a motivational continuum as proposed by SDT (Deci & Ryan, 1985; Ryan, 1995; Ryan & Deci, 2000).

Strong correlations were found between the identified and integrated subscales for both males (r=.74, p=.0001) and females (r=.78, p=.0001). Some researchers have indicated that bivariate correlations >.70 between variables may suggest collinearity (Tabachnik & Fidell, 2001). An examination of the collinearity diagnostics revealed that when the condition index was high (>10), no two variables had variance proportions exceeding the recommended threshold (.50) (Pedhazur, 1997) and therefore it was determined that the subscales were not collinear.

In line with self-determination theory, all three exercise behaviours were more strongly correlated with intrinsic motivation and the more autonomous forms of extrinsic motivation for males and females. For males, exercise frequency and intensity were most strongly related to identified regulation, while duration of exercise was most strongly related to integrated regulation. Similar to males, for females, identified regulation had the strongest relationship with exercise intensity and integrated regulation was most strongly related to frequency. For females, however, integrated regulation was also most strongly related to duration of exercise.

Simultaneous Multiple Regression Analyses

Regression analyses were conducted to examine the relationships between exercise regulations and the three exercise behaviours. Based on the results of the *t*-tests revealing a significant difference between males and females for one of the dependent variables (i.e., duration of exercise), and previous research which has conducted regression analyses separately by gender (Wilson et al., 2004), the current analyses involved separate regression analyses for males and females.

Results of the analyses revealed that integrated and identified regulations were significant predictors of exercise frequency for both males and females (Table 4). In terms of duration of exercise, integrated regulation was found to be a significant and positive predictor for males and females (Table 5). Finally, introjected regulation was found to be a positive predictor of exercise intensity for females only, while none of the behavioural regulations were a unique predictor of intensity among men (Table 6).

Discussion

The purpose of this study was to examine the relationships between three exercise behaviours (frequency, intensity, and duration) and various behavioural regulations. The findings are consistent with our original hypothesis and with the contention of SDT that free choice behaviours can be predicted by more autonomous motives.

Previous research examining the relationship between behavioural regulations and various motivational consequences (i.e., behavioural intention, effort and importance, and exercise behaviour) found that more autonomous regulations predicted behavioural intention however integrated regulation was not assessed (Wilson et al., 2004). These findings highlight the importance of including a measure of integrated regulation when assessing exercise motivation.

In the current investigation, integrated regulation was the strongest (and the only significant) predictor of exercise duration for males and females. This finding suggests that individuals are more likely to engage in longer bouts of physical activity if they feel that exercising is consistent with their identity. If free choice behaviours, such as exercise, are associated with autonomous motivation in general, why did integrated regulation emerge as the only significant predictor of exercise duration? Perhaps it is the nature of the exercise behaviour under investigation. Without a doubt, individuals who are characterized as regular exercisers are aware of the many physiological and psychological benefits that are associated with regular exercise. As a result, it is not surprising that regular exercisers have aligned their values and goals with regular exercise. It also seems logical that individuals who value the benefits associated with regular exercise have incorporated that behaviour into their sense of identity. With exercise frequency, more is generally thought of as better, but with exercise duration, longer is not necessarily better. The duration of exercise depends on the goals of the exercise program and the intensity of the exercise and it can range from a few minutes to a few hours (Heyward, 2006). As a result, individuals may not build their exercise-related values and goals based on a 'longer is better' conception. It is possible however that longer bouts of exercise play a stronger role in confirming ones exercise identity compared to shorter bouts of exercise, in part, as a function of the amount of time the individual invests each week in exercise participation.

The results of the current study revealed the importance of integrated regulation in the prediction of regular physical activity. Integration involves identifying that engaging in a behaviour is an important part of one's identity, is proposed to be the most autonomous of the external regulations, and tends to be associated with behavioural persistence and more adaptive psychological outcomes (Deci & Ryan, 2008). The current analyses revealed that, in the motivational profile of a regular exerciser, the creation of an identity surrounding exercise, that is, believing that being 'an exerciser' is an important part of 'who I am' is crucial. In light of this, exercise practitioners should work to develop programs which seek to integrate exercise into an individual's personal value system and help to influence people to include the word 'exerciser' as a self-descriptor. For individuals who are moderately active, it may be possible to influence integrated regulation through a goal setting intervention in which goal setting could be used as a conduit for enhancing exercise-related identity. For example, the exerciser could be encouraged to establish exercise-related goals and use self-monitoring to track their progress toward these goals. In turn, this self-monitoring could be used as a means to substantiate the individual's exercise identity.

Interestingly, introjected regulation was the only significant predictor of exercise intensity, and this was the case for females only. Exercise intensity was not predicted by the autonomous regulations or intrinsic motivation. This finding is consistent with previous findings that introjected regulation predicted exercise behaviour and the effort and importance associated with exercise for females (Wilson et al., 2004) and suggests that intense exercise is driven by a sense of obligation, rather than more adaptive and personally significant motives. Research examining the motivating forces behind exercise dependence has found a similar link. For example, it has been found that introjected regulation was the strongest predictor of exercise dependence (Hamer, Karageorghis, & Vlachopoulos, 2002). In addition, researchers examined individuals who exhibited symptoms of exercise dependence and found that introjected regulation approached significance as a positive predictor of exercise intensity (Edmunds et al., 2006).

It is not surprising that a sense of obligation drives exercise intensity for women. This may even be the case for women who are not exercise dependent. One study found that college-aged women believe that intense physical activity expends more energy than longer sessions of lower intensity physical activity (such as household chores) although this is not necessarily the case (Slotterback, Leeman, & Oakes, 2006). This study also found that college-aged women focused on the rate of caloric expenditure as an indication of an effective activity. Further research found that throughout an acute exercise session, women experienced a significant decrease in positive affect between the first minute of exercise and the minute before they reached their ventilatory threshold (Welsh, Hulley, Ferguson, & Beauchamp, 2007). Together, these findings demonstrate that while women feel the need to exercise intensely, they do not tend to enjoy this type of activity. The problem that arises with this is that people who experience more controlling types of behavioural regulation tend not to persist at an activity for extended periods of time (Williams, Freedman, & Deci, 1998; Williams, Gagné, Ryan, & Deci, 2002). While women recognize the importance of more intense exercise, they are not exhibiting motivation that will lead them to persist at higher intensity exercise. Exercise programs and interventions that are autonomy enhancing may prove to be effective in increasing the frequency with which women engage in intense exercise.

While this study did provide some insight into the link between motivation and exercise behaviour, the results must be interpreted with some degree of caution as all of the exercise behaviour measures were taken by self-report. Specifically, it is difficult to accurately assess exercise intensity using self-report measures (Wareham & Rennie, 1998). Future research would do well to examine the link between motivation and objectively measured exercise behaviour. Further, the current sample was composed primarily of undergraduate students. While this sample did allow for the depiction of the motivational profile of a regular exerciser, it may be specific to the sample under investigation. For example, the motivational drive and exercise-related identity of a middle-aged male is likely to be strikingly different from that of a university-aged female. Over the lifespan, the role that exercise plays in an individual's life is likely to change. In the current investigation it was noted that males and females differed in terms of the role that introjected regulation played in motivating regular exercise behaviour. Perhaps this difference would be attenuated (or enhanced) for males and females in different age groups. While general motivational patterns are likely to remain constant (e.g., exercisers experiencing primarily autonomous motives), it may be more realistic to examine motivational profiles that are specific to different demographic groups.

There are two important strengths associated with this study. First, we were able to measure the entire spectrum of motives proposed by SDT (Deci & Ryan, 1985). This allowed us to identify the most important motivational forces behind various characteristics of exercise behaviour. Second, we examined the motivation behind three different characteristics of exercise in the same study. This allowed us to gain some understanding about how motivation affects decisions to engage in exercise of varying frequency, intensity, and duration. It may be possible to influence persistence among exercise initiates using interventions that target their motivational profile and influence their development toward a profile more similar to that of a regular exerciser. Overall, the current investigation provides an important first step in determining the motivational profile of a regular exerciser which will provide a necessary point of reference with which to develop such interventions.

The results of the present study revealed that various characteristics of exercise are differentially regulated. Furthermore, in the motivational profile of a regular exerciser, identified and integrated regulations are important contributors to exercise frequency while integrated regulation plays an important role in determining exercise duration. The influence that integration has on exercise behaviour indicates that an individual's exercise-related identity can be influential in determining their exercise behaviour. This finding points to the importance of measuring integrated regulation in an exercise context and the need for practitioners to develop programs that aim to enhance exercise-related identity in order to increase exercise participation among individuals.

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Footnote

[1] A version of this chapter has been published in the International Journal for Behavioural Nutrition and Physical Activity.

Table 1

Descriptive statistics for age, frequency, duration, intensity and BREQ subscales

Variables	Females (*n*=594)			Males (*n*=460)		
	M	*SD*	*α*	*M*	*SD*	
Age	24.15	9.81		24.15	9.35	
Frequency (times/week)	3.97	1.70		4.20	1.84	
Duration (mins)	65.21	26.80		70.02	29.78	
Intensity (LTEQ- METS)	70.55	38.42		68.63	41.19	
Intrinsic motivation	3.06	0.75	.87	3.07	0.82	.88
Integrated regulation	2.70	1.02	.90	2.76	1.00	.89
Identified regulation	3.22	0.68	.76	3.16	0.74	.79
Introjected regulation	1.97	1.08	.80	1.72	1.15	.82
External regulation	0.82	0.84	.84	0.84	0.87	.85
Amotivation	0.13	0.31	.54	0.20	0.47	.79

Note. *M*= Mean; SD = standard deviation; BREQ = Behavioural Regulation in Exercise Questionnaire; LTEQ= Leisure Time Exercise Questionnaire; BREQ scale, 0 = "not true for me" to 4 = "very true for me.

Table 2

Bivariate Correlations between BREQ, exercise frequency, duration, intensity for males

Variable	1	2	3	4	5	6	7	8	9
1. Frequency	-								
2. Duration	.26*	-							
3. Intensity	.45*	.19*	-						
4. Intrinsic	.30*	.24*	.20*	-					
5. Integrated	.41**	.30**	.21**	.65**	-				
6. Identified	.42**	.29**	.22**	.65**	.78**	-			
7. Introjected	.25*	.23*	.17*	.32*	.50**	.53**	-		
8. External	.03	.03	.07	-.08	.09	.05	.35*	-	
9. Amotivation	-.20*	-.06	-.14	-.33*	-.35**	-.44**	-.13*	.25*	-

*$p<.01$.

** $p<.001$.

Table 3

Bivariate Correlations between BREQ, exercise frequency, duration, intensity for females

Variable	1	2	3	4	5	6	7	8	9
1. Frequency	-								
2. Duration	.31*	-							
3. Intensity	.43*	.22*	-						
4. Intrinsic	.34*	.18*	.25*	-					
5. Integrated	.41**	.30**	.21**	.65**	-				
6. Identified	.42**	.29**	.22**	.65**	.78**	-			
7. Introjected	.24*	.12*	.20*	.21*	.50**	.53**	-		
8. External	-.09	-.06	-.01	-.16*	.09	.05	.27*	-	
9. Amotivation	-.14*	-.12*	-.16*	-.28*	-.35**	-.44**	-.10*	.25*	-

*p<.01.

** p<.001.

Table 4

Multiple regression analysis predicting exercise frequency from exercise regulations

Variable	*F*	*df*	R^{2adj}	B	SE B	β	*t*
Males	18.25***	6, 453	.18				
Intrinsic motivation				-.02	.13	-.01	-.16
Integrated regulation				.38	.13	.20	2.82**
Identified regulation				.62	.19	.25	3.23**
Introjected regulation				.04	.09	.02	.42
External regulation				-.01	.10	-.01	-.13
Amotivation				-.22	.75	-.02	-.30
Females	38.50***	6, 587	.28				
Intrinsic motivation				-.03	.11	-.02	-.30
Integrated regulation				.65	.09	.39	7.20***
Identified regulation				.38	.15	.15	2.51**
Introjected regulation				.09	.07	.06	1.35
External regulation				-.15	.08	-.07	-1.92
Amotivation				.17	.71	.01	.23

*$p < .05$.

** $p < .01$.

*** $p < .001$.

Table 5

Multiple regression analysis predicting exercise duration from exercise regulations

Variable	*F*	*df*	R^{2adj}	B	SE B	β	*t*
Males	9.48***	6, 453	.10				
Intrinsic motivation				2.11	2.26	.06	.93
Integrated regulation				4.80	2.26	.16	2.13*
Identified regulation				4.69	3.26	.12	1.44
Introjected regulation				2.44	1.49	.09	1.64
External regulation				-1.30	1.73	-.04	-.75
Amotivation				22.24	12.75	.09	1.74
Females	6.61***	6, 587	.05				
Intrinsic motivation				2.80	2.01	.08	1.39
Integrated regulation				4.98	1.61	.19	3.09**
Identified regulation				-2.84	2.74	-.07	-1.04
Introjected regulation				1.77	1.18	.07	1.50
External regulation				-1.58	1.40	-.05	-1.13
Amotivation				-18.29	12.68	-.06	-1.44

*$p < .05$.

** $p < .01$.

*** $p < .001$

Table 6

Multiple regression analysis predicting exercise intensity from exercise regulations

Variable	*F*	*df*	R^{2adj}	B	SE B	*β*	*t*
Males	5.28***	6, 453	.05				
Intrinsic motivation				4.54	3.12	.09	1.42
Integrated regulation				1.51	3.20	.04	.47
Identified regulation				3.68	4.63	.07	.79
Introjected regulation				1.85	2.11	.05	.88
External regulation				3.33	2.45	.07	1.36
Amotivation				-28.20	18.09	-.08	-1.56
Females	11.22***	6, 587	.09				
Intrinsic motivation				5.47	2.82	.11	1.94
Integrated regulation				3.02	2.26	.08	1.34
Identified regulation				4.42	3.84	.08	1.15
Introjected regulation				3.85	1.66	.11	2.32*
External regulation				.40	1.97	.01	.20
Amotivation				-32.11	17.78	-.08	-1.81

*$p < .05$.

** $p <.01$.

*** $p <.001$

STUDY 4

THE USE OF A MENTAL IMAGERY INTERVENTION TO ENHANCE INTEGRATED REGULATION AMONG A SAMPLE OF FEMALE EXERCISE INITIATES[1]

Understanding how different types of motivation contribute to exercise behaviour is an important first step in identifying ways to increase exercise among individuals (Deci & Ryan, 2008). Self-Determination Theory (SDT; Deci & Ryan, 1985) is a general theory of motivation that provides a good framework from which to understand exercise behaviour. One mini-theory within SDT, Organismic Integration Theory, proposes that motivation can be intrinsic or extrinsic and lies along a continuum representing successive levels of autonomy. Intrinsic motivation is freely initiated by the individual. Individuals who are intrinsically motivated derive pleasure and satisfaction from the behaviour itself, not from some separable consequence. An exerciser would be intrinsically motivated, for example, if they went out for a jog just because they enjoy the feeling of being physically active in this way. Compared to intrinsic motives, extrinsic motives are less self-determined and are not freely initiated by the individual. SDT describes four types of extrinsic motives, two of which are considered to be controlling and two which are thought to be more autonomous (or, self-determined).

The least autonomous type of extrinsic motive is external regulation in which behaviour is motivated by a sense of external pressure. For example, an individual may exercise because their physician or their spouse insists that they do so. Introjected regulation represents motivation which is slightly more internalized than external regulation, however is still considered controlling. Introjection is characterized by an internal sense of pressure. For example, an individual may exercise because they know they will feel guilty or ashamed if they do not. The more autonomous types of extrinsic motivation are identified and integrated regulations which represent motives related to values and goals or a sense of personal importance and identity, respectively. Identified regulation may involve exercising because it is consistent with one's health goals such as losing weight or improving cardiovascular fitness. Integrated regulation involves exercising because one believes that being 'an exerciser' is an important part of who they are. SDT also describes amotivation in which individuals engage in a behaviour despite a complete lack of motivation to do so.

Exercise Motivation

SDT proposes that individuals will engage in a behaviour and obtain the most psychological benefit from doing so if the behaviour is intrinsically motivated. In an exercise context, research consistently shows that intrinsic motivation is an important determinant of persistence (e.g., Li, 1999; Mullan & Markland, 1997; Wilson & Rodgers, 2004). Frederick and Ryan (1993) however, noted that individuals often engage in regular sports and exercise despite being extrinsically motivated. In fact, exercise motivation research supports this observation. For example, Wilson, Rodgers, Fraser, and Murray (2004) examined the motivation of a large sample of university-aged regular exercisers and found that identified regulation was the most important predictor of current exercise behaviour, intentions to continue exercising in the next 4 months, and effort and importance associated with exercise.

Compared to regular exercisers however, exercise initiates report less self-determined regulations for exercise involvement (Daley & Duda, 2006; Li, 1999; Mullan

& Markland, 1997). Recently, Hall, Rodgers, Wilson, and Norman (2010) examined the motivation of regular exercisers, non-exercisers who intended to begin exercising, and non-exercisers who did not intend to begin exercising. Consistent with previous research, the regular exercisers reported the most self-determined motives while non-intenders reported the least self-determined motives. Importantly, the patterns of motivation reported by each group were not consistent. This suggests that the various behavioural regulations may develop independently and may also have independent influences on behaviour.

Research has demonstrated that exercise initiates will show an increase in autonomous regulations as they participate and adhere to a structured exercise program (Rodgers, Hall, Duncan, Pearson, & Milne, 2010). In a review of four longitudinal exercise studies, Rodgers et al. (2010) found that exercise initiates experience an increase in identified regulation and intrinsic motivation within the first 8 weeks of participation. Interestingly, the values for these types of motivation do not seem to reach levels reported by regular exercisers, even after six months of exercise participation. Rodgers et al. suggested that future interventions should aim to enhance the development of these types of motivation in an effort to increase the probability of long-term adherence among exercise initiates.

One major limitation to the SDT research in the exercise domain is the shortage of research including a measure of integrated regulation. One of the main reasons that integrated regulation has been left out of this body of research is that the Behavioural Regulation in Exercise Questionnaire (BREQ; Mullan, Markland, & Ingledew, 1997) and the subsequent Behavioural Regulation in Exercise Questionnaire- Version 2 (BREQ-2;

Markland & Tobin, 2004) are commonly employed to measure exercise motivation but do not include a measure of integration. Despite the exclusion of integrated regulation in a great deal of the exercise motivation literature, there is evidence that integration is an important type of motivation for athletes (Mallett & Hanrahan, 2004) and is linked to health behaviours such as healthy nutrition (Pelletier, Dion, Slovinec-D'Angelo, & Reid, 2004). This evidence points to the need to consider integrated regulation in studies examining other health behaviours such as exercise and physical activity.

Wilson et al. (2006) developed a 4-item integration subscale for exercise which seems to hold up quite well from a psychometric perspective. The addition of an integrated subscale has allowed researchers to begin examining the role of integrated regulation in exercise cognition and behaviour and has yielded some promising data. For example, Duncan, Hall, Wilson, and O (2010) used the BREQ-2 with the additional integrated subscale to assess the motivation of 1054 regular exercisers and found that integrated regulation was among the most strongly endorsed behavioural regulations (in addition to identified regulation and intrinsic motivation). Integrated and identified regulations were significant predictors of exercise frequency and integrated regulation alone was a significant and positive predictor of exercise duration. These findings highlight the importance of considering integrated regulation when examining the motivation of exercisers.

Previous studies (e.g., Rodgers et al., 2010) determined that as exercise initiates undergo an exercise program they begin to endorse more autonomous motives for exercise, however these studies did not include a measure of integrated regulation. Duncan, Hall, Rodgers, and Wilson (2009) sought to examine the changes in all of the behavioural regulations in a sample of 57 female exercise initiates over the course of a 12-week exercise program. As predicted, the results revealed that the initiates experienced an increase in the autonomous regulations, including integration. However, while integration did increase, after 12 weeks the level of integration reported by the participants did not reach levels reported previously for regular exercisers. This suggested that integrated regulation may be an effective target for interventions.

Exercise Imagery

Hall (1995) proposed that mental imagery may be an important determinant of exercise cognitions and behaviour. Subsequent research has confirmed that regular exercisers frequently use imagery and by employing imagery exercisers can learn exercise tasks, become energized, set appearance related goals, and cope with exercise barriers (Gammage, Hall, & Rodgers, 2000; Giacobbi, Hausenblas, Fallon, & Hall, 2003; Hausenblas, Hall, Rodgers, & Munroe, 1999). Wilson, Rodgers, Hall, and Gammage (2003) examined exercise imagery in the context of self-determination theory and found that two functions of imagery, appearance and technique, were related to more self-determined exercise regulations. While there is clear evidence supporting the relationships between imagery, behaviour, and cognitions in an exercise context, most of the research to date has not had a strong theoretical basis and the limited research that has been driven by theory (e.g., Wilson et al., 2003) has been correlational and cross-sectional in nature.

Recently, Duncan, Rodgers, et al. (2010) demonstrated that task, coping, and scheduling self-efficacy of female exercise initiates enrolled in a 12-week cardiovascular exercise program could be differentially influenced using targeted imagery interventions.

This finding further supported the potential utility of using imagery interventions to enhance cognitive variables in an exercise context. Based on the success of this intervention, it stands to reason that we may be able to experimentally manipulate other psychological variables related to exercise. Previous research has suggested that exercise initiates may be more likely achieve long term adherence to an exercise program if they undergo an intervention aimed at the development of integrated regulation (Duncan et al., 2009). Perhaps it is possible to use guided imagery to do so.

The purpose of this study was to examine the effects of a mental imagery intervention designed to enhance integrated regulation among female exercise initiates. It was hypothesized that women who received the imagery intervention would experience greater increases in integrated regulation compared to participants in a control condition.

Methods

Participants

The participants were female exercise initiates (N= 102) between the ages of 22 and 50 (M_{age}=30.47, SD=9.00). Participants were eligible to participate in the study if they exercised less than once per week for a period of at least six months prior to study enrollment, did not possess any contraindications to exercise, and were able to commit to the study protocol (i.e., regular visits to the study facility). The mean BMI of the participants was 25.92 (SD=4.96) indicating that overall, the participants were slightly overweight.

It should be noted that there was a large dropout rate among participants in this study. At the final assessment, only 55 participants remained, representing 54% of the original sample. A Chi-square analysis was conducted in order to detect differences in adherence across the two study groups and the results confirmed that there were no significant differences in dropout rates between the intervention and control groups.

Measures

Participants completed a demographic questionnaire at baseline which assessed age, exercise frequency, race, income, education, occupation, marital status, and number of children. Weight and height were measured by the researcher at the baseline and final assessments.

The Behavioural Regulation in Exercise Questionnaire- version 2 (BREQ-2; Markland & Tobin, 2004) was used to assess exercise regulations according to the SDT framework. The BREQ is a 19-item self-report measure which was adapted from the original BREQ (Mullan et al., 1997). The BREQ-2 includes 5 subscales including; intrinsic motivation (e.g., "I enjoy my exercise sessions;" *n*=4), identified (e.g., "It's important to me to exercise regularly;" *n*=4), introjected (e.g., "I feel guilty when I don't exercise;" *n*=3), and external (e.g., "I feel under pressure from my family/ friends to exercise;" *n*=4) regulations as well as amotiviation (e.g., "I don't see why I should have to exercise;" *n*=4). Each item is rated on a 5-point scale ranging from 0= "not true for me" to 4= "very true for me." Previous research has supported the BREQ-2's factor structure, invariance across gender, and the ability of scores on the BREQ-2 subscales to discriminate between physically active and non-active groups (Markland & Tobin, 2004; Mullan & Markland, 1997; Mullan et al., 1997; Wilson, Rodgers, & Fraser, 2002).

In the current study an additional subscale was used to assess integrated regulation (BREQ-2R; Wilson et al., 2006). The 4 items which comprise this subscale were constructed in the format of the BREQ items (i.e., follow the question "why do you exercise" and use the same 5-point rating scale) and are easily administered along with this questionnaire. A reliability analysis revealed acceptable internal consistency values for each of the six BREQ-2R subscales (Table 1).

Exercise intensity and duration were assessed objectively using Polar RS400 Running Computer™ heart rate monitors (HRM) for all exercise sessions participants completed in the study facility. The HRM provided the researcher with minute-by-minute heart rate data as well as workout duration. Individual heart rate data was recorded throughout each workout and downloaded to a software program for analysis. Workout duration was also assessed by self-report at the end of each exercise session. Finally, workout frequency was assessed by attendance records kept by the program monitors.

Procedure

Recruitment. The research protocol was approved by the research ethics board at the host institution prior to study recruitment. Participants were recruited on campus and in the community surrounding a large Canadian university using posters, newspaper advertisements, and word of mouth. Interested potential volunteers contacted the researchers via telephone or email at which point they were briefed on the study protocol then screened for eligibility.

Initial Assessment. Participants who were interested and eligible arranged an initial meeting with the researcher. During the initial meeting the study protocol was explained in detail and informed consent was obtained. At this time participants also provided demographic information and a baseline measure of exercise motivation.
A sub-maximal aerobic fitness test was completed at the initial meeting. The fitness test was conducted on a treadmill by a certified kinesiologist or a trained masters-level

researcher in accordance with the guidelines outlined by the American College of Sports Medicine (ACSM, 2000).

Each participant was given an interactive lab tour in which they were oriented to the study facility and the exercise equipment. It was ensured that the participants learned the appropriate technique to be maintained on the various exercise machines (i.e., treadmills, rowing machines, stair climbers, and stationary bikes).

Exercise Program. A 12-week individualized, cardiovascular exercise program was prescribed to each participant. The program was established based on the results of each participant's sub-maximal fitness test and her resting heart rate value. The program involved three workouts per week lasting 30- 60 minutes. Participants were asked to maintain a heart rate within an assigned, pre-determined range. The target heart rate range increased every two weeks beginning with a target heart rate between 50 and 60 percent of heart rate reserve (age predicted maximum heart rate - resting heart rate) and climbing to a range of 60 to 70 percent of heart rate reserve in the last three weeks of the program. The prescription also involved a progressive increase in workout duration from thirty minutes at the start of the program to 60 minutes at the end of 8 weeks. The participants were asked to complete the majority of their exercise sessions in the study's exercise facility. In weeks 1 through 4, all three exercise sessions took place in the study facility. In weeks 5 and 6 the participants were given the option to exercise in a preferred exercise location (i.e., home, local community centre or fitness facility) for one of the three exercise sessions. In weeks 7 and 8 the participants were given the option to exercise in their preferred location for two of their exercise sessions. Throughout the 8-week study the participants were given the option to conduct all three weekly exercise sessions at the study facility. The exercise schedule was arranged in this way to ensure that the participants learned the principles of a proper exercise program (i.e., appropriate frequency, intensity, and duration) in a safe environment early in the program. As the study progressed it was hoped that allowing the participants to exercise in their preferred setting would help them to establish an exercise related identity that was consistent with their natural environment and not isolated to our study facility.

Imagery Intervention. The participants were randomized into the imagery group or an attention control group. The imagery sessions were administered on a weekly basis, prior to the first exercise session of the week. The participants met with the researchers individually in a quiet room and were encouraged to relax. The participants were reminded that the most effective imagery involves all of the senses and they were instructed to follow the script closely and to create the most realistic images possible. The scripts were audio recorded and played for each participant on an individual basis.

The imagery scripts involved statements related to integrated regulation and were designed to help the participants begin to believe that exercise is consistent with their identity. The scripts included statements such as; "Imagine yourself in the lab, feeling like you belong", "You feel like you are in control of your body", and "This is what it feels like to be an exerciser". Following each imagery session, the participants were reminded that they could use imagery on their own to create similar situations that are relevant to their own life.

The content of the imagery scripts was created by the lead author based on Deci and Ryan's (1985) conceptualization of integrated regulation and on the work of other authors who have examined integrated regulation in a variety of contexts (e.g., sports and music). The content of the imagery scripts was verified by a researcher with expertise in self-determination theory who has published work examining integrated regulation in an exercise context as well as an exercise imagery expert. Both reviewers suggested small changes to the scripts which were incorporated in the final version and used during in the intervention.

Participants in the attention control condition met with the researcher and were given information regarding the benefits of exercise. The information sessions were delivered on the same weekly schedule as the imagery intervention and involved topics such as exercise and the prevention of cancer, type II diabetes, depressions, and heart disease. Each information session lasted approximately five minutes and was delivered to the participants on an individual basis via audio recording.

Mid-point and final assessments. At the mid-point of the exercise program (i.e., 4 weeks), the participants completed the BREQ-2R. Upon completion of the 8-week exercise program, the participants attended a final assessment in which they completed the BREQ-2R. They also completed a follow-up questionnaire which served as a manipulation check for the imagery intervention and allowed them to provide personal feedback regarding their participation in the study. The final assessment also involved a sub-maximal fitness test using the same protocol employed at baseline.

Results

A 2 (group) x 3 (time: baseline, week 4, week 8) ANOVA with repeated measures on the second factor was conducted in order to examine the changes in integrated regulation for the imagery and control groups across time. The analysis revealed a main effect for time $F(2,54)=50.45$, $p<.0001$, $\text{Eta}^2=.651$, and a time x group interaction,

$F(2,54)=7.51$, $p<.001$, $Eta^2=.218$ (see Figure 1). The means and standard deviations for this analysis are presented in Table 1. The time x group interaction is of primary interest because it demonstrates that the imagery group experienced an increase in integrated regulation greater than that of the control group indicating that the imagery intervention was effective. Figure 1 shows that participants in the imagery group experienced a steady increase in integration from baseline through four weeks to eight weeks. The control participants also experienced an increase in integrated regulation from baseline to four weeks and then a less pronounced increase from four to eight weeks. The magnitude with which integration increased among control participants during both phases was lower than that experienced by the imagery.

A second analysis employing the same ANOVA and post hoc tests examined the changes in intrinsic motivation for the imagery and control groups over time, and also revealed a main effect for time $F(2,54)=12.00$, $p<.001$, $Eta^2=.324$, and a time x group interaction $F(2,54)=3.22$, $p<.05$, $Eta^2=.114$ (see Figure 2). The means and standard deviations for this analysis are presented in Table 1. The interaction depicted in Figure 2 is of primary interest as it shows the changes in intrinsic motivation for the imagery and control groups across time. For the imagery group it can be seen that participants experienced a somewhat steady increase in intrinsic motivation from baseline to eight weeks. Control participants on the other hand did not demonstrate an increase in intrinsic motivation between baseline and four weeks, however intrinsic motivation significantly increased during the second half of the study ($p < .05$). At the eight week time point, intrinsic motivation among imagery participants was significantly higher than intrinsic motivation among control participants ($p < .05$).

Finally, a third analysis examined the changes in identified regulation for the imagery and control groups over time and revealed a main effect for time only $F(2,54)=25.37$, $p<.001$, $Eta^2=.499$ (see Figure 3). The lack of an interaction effect indicated that there was no difference in the changes in identified regulation over time between imagery and control participants. The means and standard deviations for this analysis are in Table 1.

A series of t-tests were conducted in order to examine if differences existed between adherers and dropout on any of the motivation variables at baseline. Individuals who adhered until the 8 week (final) assessment were compared with individuals who did not. There were no differences in motivation at baseline or 4 weeks for adherers and dropouts ($p > .05$). An additional series of t-tests examined the differences in motivation between individuals who adhered until the 4 week assessment (but dropped out before 8 weeks) and those who dropped out before 4 weeks. No differences in motivation were observed for these two groups at baseline ($p > .05$).

Discussion

While overt experience in an exercise program has been found to increase integrated regulation among exercise initiates, it has also been noted that even after three months of exercising these individuals do not achieve the level of integrated regulation reported by regular exercisers (Duncan et al., 2010). The purpose of this study was to determine if an imagery intervention targeting integrated regulation could be useful in helping exercise initiates achieve a motivational profile which is more like a regular exerciser. The current findings demonstrate that such an intervention is useful in increasing integrated regulation among a sample of female exercise initiates.

This finding has important implications for future exercise research based on SDT. Previous research has demonstrated that the behavioural regulations differentially influence various motivational consequences (Wilson et al., 2004) and various exercise behaviours (Duncan et al., 2010). The current research demonstrates that interventions can be targeted to influence specific behavioural regulations. Taken together, it appears that interventions could be tailored to influence a given regulation which would in turn produce predictable cognitive, motivational, or behavioural consequences.

On a conceptual level, integrated regulation seems to be closely aligned with identity. Exercise identity is a robust predictor of exercise-related cognitions and behaviour. Individuals who identify themselves as an exerciser tend to have greater self-efficacy for exercise (Strachan et al, 2005), greater intentions to exercise (Kendzierski, 1998), and they report more frequent exercise behaviour (Anderson, 2004; Anderson, Cychosz, & Franke, 1998; Kendzierski, 1988). In addition, individuals with a stronger exerciser schema are able to identify more solutions to cope with the barriers that might stand in the way of regular exercise (Kendzierski, 1988). A recent study demonstrated that exercise identity and integration are closely aligned when used to predict exercise behaviour (Duncan, Hall, & Cobourn, 2010). The advantage of measuring integration rather than identity is that it is imbedded within a more global theory of human motivation, and it allows this type of motivation to be considered alongside intrinsic motivation and other types of extrinsic motivation. Considering the close association between integration and identity, however, it seems likely that enhancing integrated regulation via an imagery intervention could also result in increased exercise identity.

The exercise program employed in this study was rigidly prescribed to all of the participants, regardless of group, and did not allow for variation in frequency, intensity, and duration. As a result, we were not able to investigate differences in exercise behaviour between individuals in the intervention and control groups. While this could be viewed as a limitation, controlling exercise behaviour permitted us to examine the effect of the imagery intervention on integrated regulation isolated from the effects of overt exercise experiences because these were controlled to be the same in the experimental and control groups. In order to examine changes in exercise behaviour resulting from an imagery intervention such as the one used in this research, future studies should allow for greater individual variability in behaviour by employing a less structured exercise program conducted in a more natural environment (rather than a research facility).

Interestingly, a spill-over effect was observed in that the imagery intervention also had a positive effect on the intrinsic motivation of the participants in the experimental group. That is, intrinsic motivation among imagery group participants was enhanced over and above the increases experienced by the control participants. This is not surprising considering that previous research has shown integrated regulation and intrinsic motivation to be closely linked and quite high among regular exercisers (Duncan, Hall, et al., 2010; Wilson et al., 2006). Despite the spill-over effect observed in this study, we believe that integrated regulation and intrinsic motivation are distinct. The imagery scripts do include statements that may have triggered some feelings of pleasure and satisfaction associated with exercise in addition to integration-related themes. Therefore, while our initial intention was not to enhance intrinsic motivation, it appears that a guided imagery intervention can also have a positive influence on this regulation. In order to confirm the distinctive nature of integration and intrinsic motivation, further research should investigate whether or not different imagery interventions can be used to differentially influence integrated and intrinsic motivation.

All study participants, regardless of experimental group, demonstrated a significant increase in identified regulation over time. This is consistent with previous research in which the identified regulation of exercise initiates increased as a result of exercise experience (Rodgers et al., 2010). Identified and integrated regulation are often highly correlated and some questionnaires assessing motivation have been unable to distinguish the two constructs (e.g., Vallerand, Pelletier, Blais, Briere, Senecal, & Valliers, 1992; Pelletier, Fortier, Vallerand, Tuson, Briere, & Blais, 1995). The current results support the distinction between these two regulations in the exercise domain and, more importantly, demonstrate that one can be experimentally manipulated without inducing changes in the other. Again, it would be interesting to determine if separate imagery interventions could differentially influence integrated and identified regulations.

One main limitation to the current research was the relatively small dose of imagery that was involved in the intervention. Each participant received one guided imagery session each week which lasted approximately five minutes. This resulted in a total of forty minutes of guided imagery over the course of two months. The participants were encouraged to practice imagery on their own however overall compliance with this aspect of the study was low. Increasing the dose of the imagery intervention may cause faster changes in integrated regulation.

Another limitation to this study involved the lack of a long-term follow-up of exercise motivation and behaviour. Since integrated regulation concerns an individual's sense of "who they are" it is likely to be a relatively stable construct. It is not known if the participants who received the imagery intervention were able to maintain the levels of integration that they achieved during the study period. Importantly, the increases in integration that occurred during the study were achieved at the same time that the participants were enrolled in a program of regular exercise, a situation in which perceptions of one's self were congruent with their current behaviour. It would be interesting to examine the changes in integrated regulation once the prescribed exercise program was complete. Presumably, integration would remain high among those individuals who maintained a program of regular exercise and would decline for those participants who failed to maintain regular exercise. Since the benefits of regular exercise are only obtained when the behaviour is maintained over the long term (Blair, LaMonte, & Nichaman, 2004) it is important to understand motivation on a long term basis.

This is one of the first studies to investigate the effectiveness of an imagery intervention in the exercise domain. Two main conclusions can be drawn from this study. First, imagery is an effective intervention strategy for enhancing integrated regulation among exercise initiates. Second, this study provides preliminary evidence that individual behavioural regulations can be enhanced using a targeted imagery intervention. Additional research is warranted in order to determine whether imagery can be used to influence actual behaviour and the imagery dose that would be required to do so.

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Footnote

[1] A version of this chapter has been submitted for publication

Table 1

Descriptive data for motivation variables at baseline, 4 weeks, and 8 weeks

		Group		
	Time	Intervention Mean (SD)	Control Mean (SD)	α
Integrated Regulation	1	1.49 (1.00)	1.34 (.98)	.89
	2	2.41 (.74)	2.17 (.83)	.87
	3	3.18 (.53)	2.15 (1.07)	.93
Intrinsic Motivation	1	2.08 (.89)	2.06 (1.04)	.91
	2	2.68 (.65)	2.29 (.78)	.89
	3	2.97 (.58)	2.32 (1.01)	.94
Identified Regulation	1	2.57 (.67)	2.56 (.71)	.71
	2	3.05 (.60)	3.00 (.50)	.76
	3	3.18 (.55)	2.99 (.59)	.78

Note. Motivation variables were measured on a 5-point scale ranging from 0="not true for me" to 4="very true for me".

Figure 1. Change in integrated regulation for imagery and control groups.

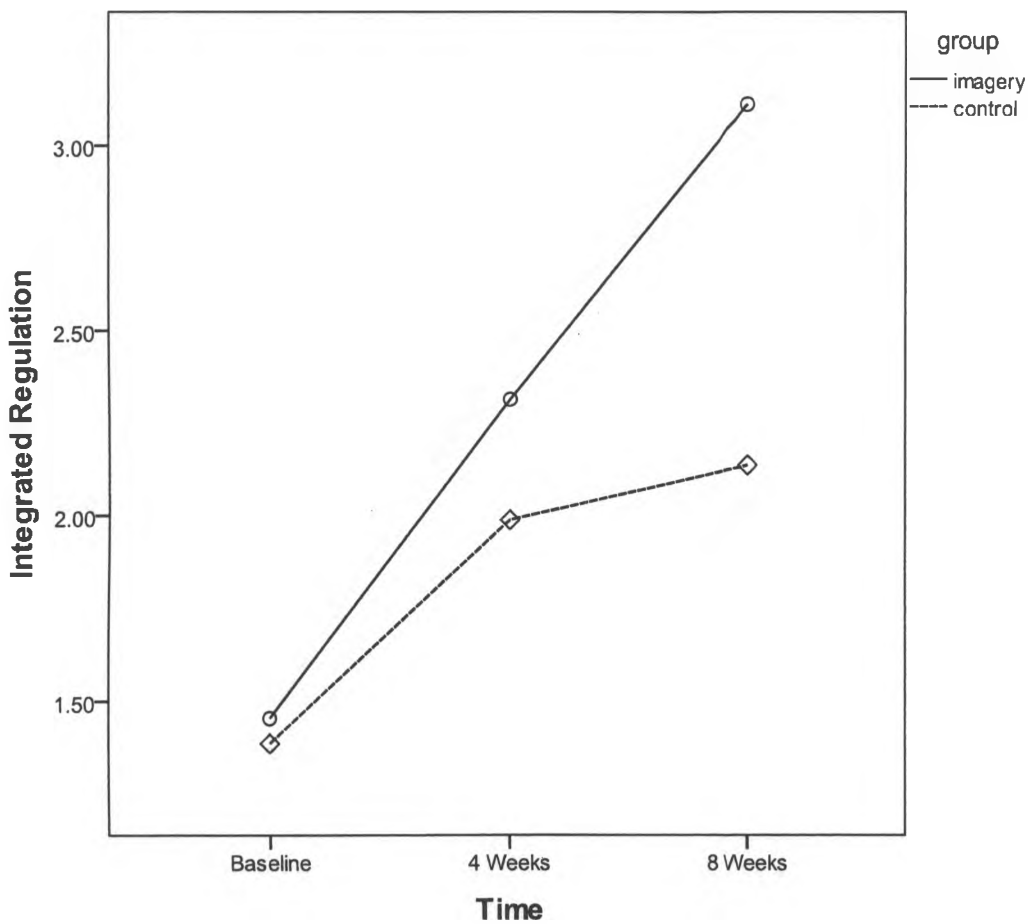


Figure 2. Change in intrinsic motivation for imagery and control groups.

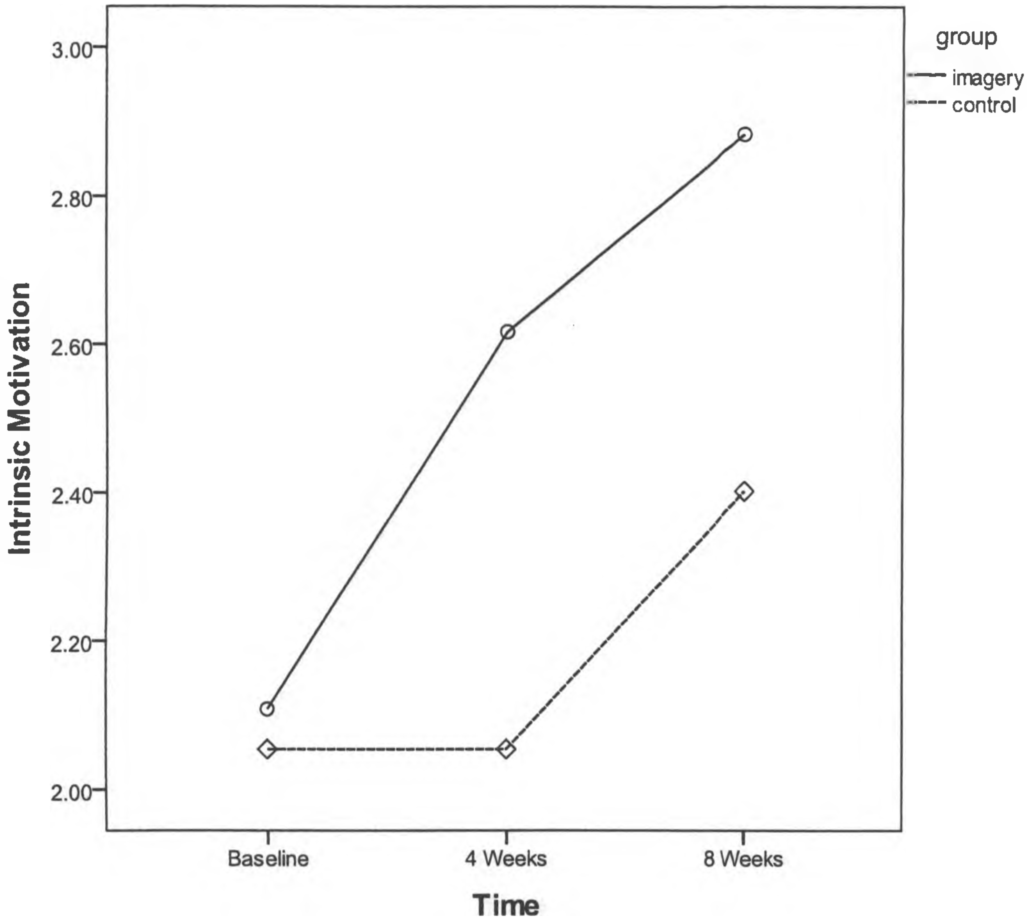
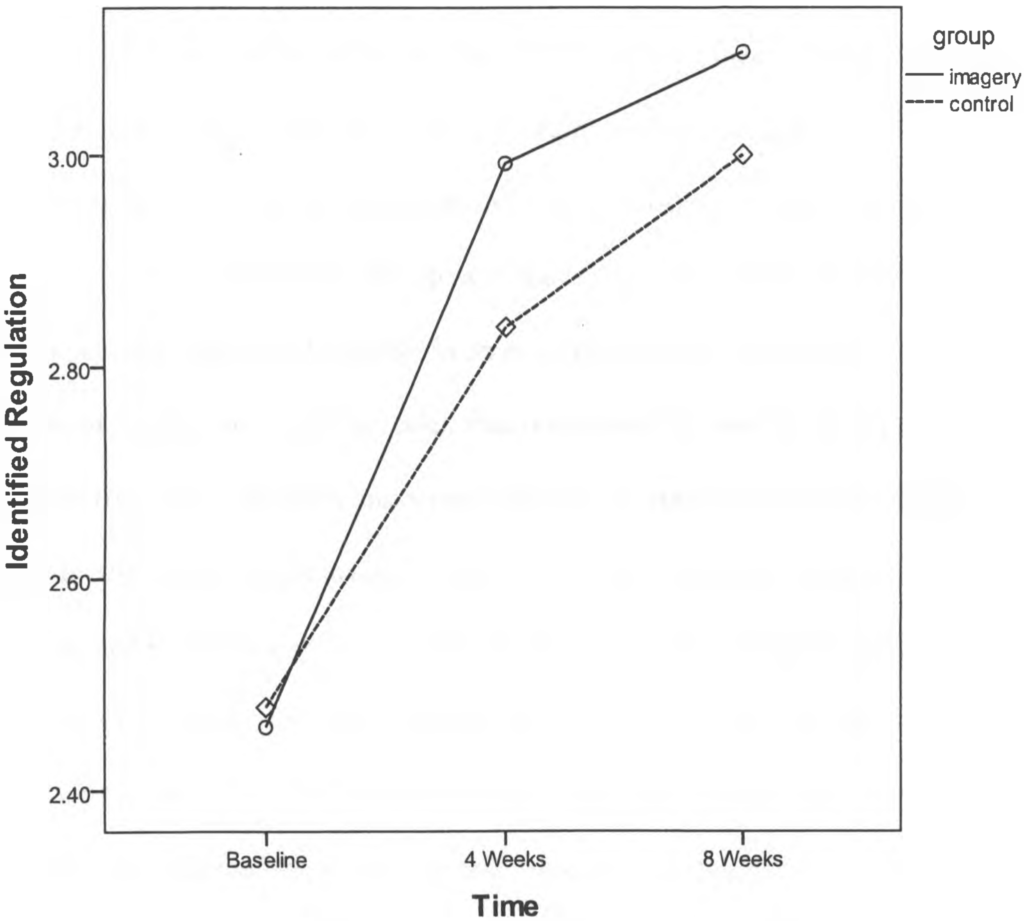


Figure 3. Change in identified regulation for imagery and control groups.



SUMMARY, IMPLICATIONS, AND FUTURE DIRECTIONS

The overall purpose of this dissertation was to examine some cognitive variables as they related to exercise and to test the effectiveness of mental imagery interventions for enhancing these cognitions during long-term exercise programs.

Study 1 involved an examination of the multi-dimensional conceptualization of SE for exercise. The primary objective of this study was to confirm the distinctive nature of task, coping, and scheduling SE in an exercise context. A cross-sectional analysis of a sample of regular exercisers revealed that scheduling SE was the strongest predictor of exercise frequency, duration and weekly METS for males and females. Coping SE added to the prediction of frequency and weekly METS for males and females, as well as duration and number of years of exercising for males only. Task SE added to the prediction of duration for males and females and was a unique predictor of number of years for females only. The findings revealed that task, coping, and scheduling SE for exercise can differentially predict various components of regular exercise supporting the contention that the three types of SE are distinct. In addition, it was determined that all three types of SE are important for both males and females however, the relative importance of each type might be gender specific. The results from Study 1 which demonstrated the distinct nature of task, coping, and scheduling SE supported the notion that the three types of SE could be differentially influenced and confirmed their suitability as targets for a guided imagery intervention.

The purpose of study 2 was to test the effectiveness of a mental imagery intervention within the context of SE theory. Specifically, Study 2 sought to determine if three types of SE could be differentially influenced using guided imagery interventions in an experimental design controlling for overt mastery experiences. The imagery interventions were successful in enhancing task, coping, and scheduling SE beyond the levels that occurred as a result of overt experience. The results of this study had important theoretical implications because they demonstrated that targeting each type of SE through intervention has separable effects that are primarily restricted to the targeted SE type. Overall, the results of Study 2 supported the contention that imagery interventions could be used to influence self-efficacy, one prominent psychological variable related to exercise.

Studies 3 and 4 employed SDT as the framework for testing the effectiveness of an imagery intervention. SDT is a useful approach because it describes specific types of motivation which are differentially related to various motivational consequences (e.g., Wilson, Rodgers, Fraser, & Murray, 2004) and behaviour (e.g., Li, 1999). The majority of the exercise-related SDT research, however, has not included a measure of integrated regulation. The purpose of Study 3 was to examine how motivation (including integrated regulation) contributes to various characteristics of exercise behaviour. The results of this study were theoretically consistent and revealed that three behavioural indices (frequency, intensity, and duration of exercise) were more highly correlated with autonomous regulations compared to controlling regulations. Regression analyses revealed that integrated and identified regulations predicted exercise frequency for males and females. Integrated regulation was found to be the only predictor of exercise duration across both genders. Finally, introjected regulation predicted exercise intensity for females only. These findings suggested that exercise regulations that vary in their degree of internalization can differentially predict characteristics of exercise behaviour. This had important implications for the current research because it supported the use of a mental imagery intervention to target one specific behavioural regulation.

Study 4 examined the effects of a mental imagery intervention designed to enhance integrated regulation. The results of Study 3 demonstrating the distinctive nature of the behavioural regulations in an exercise context, previous research suggesting that integrated regulation would serve as a good target for exercise interventions (Duncan, Hall, Rodgers, & Wilson, 2009), and the success of the imagery intervention employed in Study 2 provided a strong rationale for Study 4. The design of Study 4 was informed by the limitations that were identified in Study 2. Specifically, the schedule on which the imagery intervention was delivered in Study 4 reflected the need for more imagery sessions that extended further into the exercise program. The results of Study 4 provided further support for the effectiveness of imagery interventions in enhancing exercise-related cognitions. Specifically, participants in the imagery group experienced greater changes in integration compared to control participants.

Overall, the studies presented in this dissertation support the notion that imagery interventions employed throughout long-term exercise programs are an effective means for influencing exercise-related cognitions among female exercise initiates. There are some limitations to this research that should be acknowledged and that should help to inform future research. First, the imagery interventions presented here included female exercise initiates only. The results from Studies 1 and 3 indicate that SE and motivation variables play differential roles in the behaviour of males and females. In order to prevent confounding of the results, the present research focused on one gender only. Currently, the impact of imagery interventions on the SE and motivation of male exercise initiates is unknown. Study 1 revealed that all three types of SE are important for both males and females however, the relative importance of each type might be gender specific. In Study 1, task SE appeared to be more salient among female participants. Since task SE was a less common predictor of exercise behaviour among males, it is possible that males may not respond to a task imagery intervention in the same way that the female sample did in Study 2. More research is required in order to determine how males will respond to an imagery intervention and whether or not there are differences between males and females in this regard.

A second limitation to this study was the inability to extend the examination of the effects of the imagery intervention to the behavioural level. The underlying idea behind imagery interventions in an exercise context is that an imagery intervention should have a positive impact on some cognitive variable known to influence exercise behaviour and in turn exercise behavior will increase among individuals who receive the imagery intervention. In both studies 2 and 4, extensive objective measures of behaviour were taken. Participants wore heart rate monitors during every workout which measured minute by minute heart rate and workout duration. Exercise frequency was measured by attendance records kept by the researchers. All study participants underwent a sub-maximal cardiovascular fitness test at baseline and those participants who completed the study were tested again at the end of the exercise program. No differences were observed between participants in the imagery groups compared to the control groups on any behavior measures in Studies 2 or 4. The reason for this is not that the imagery intervention was ineffective but rather that the exercise prescription was too rigidly prescribed to allow for any variance in behavior between participants. Future research should allow for greater variance in exercise behaviour among the participants as they go through the exercise program.

Consistent with SE theory (e.g., Rodgers, Wilson, Hall, Fraser, & Murray, 2008; Rodgers, Murray, Courneya, Bell, & Harber, 2009) and SDT (Wilson et al., 2004), increases in SE and integrated regulation induced by the imagery should cause subsequent increases in behaviour. In addition, since Study 1 determined that different types of SE have differential influences on behaviour, perhaps participants in each imagery group would experience differential changes in their behaviour. For example, in Study 1 it was found that scheduling SE was the strongest predictor of exercise duration among regular exercisers. The main idea that guided this research would suggest that this effect is still present when the SE is induced by imagery. That is, the results of Study 1 suggest that participants in the scheduling imagery group in Study 2 might exercise for longer durations than participants in the other groups if allowed to self-select their workout duration. Once again, it is suggested that researchers who pursue this type of intervention identify ways to allow for greater variance in the exercise behaviour outcome variables.

The ultimate goal of this type of research is to identify ways of enabling long-term adherence to an exercise program. Public health guidelines regarding the amount of physical activity which should be maintained in order to obtain health benefits stipulate that regular exercise of physical activity must occur over the long term (Blair, LaMonte, & Nichaman, 2004). Therefore, it is important to understand the long-term impact of interventions such as the imagery interventions conducted in the present research. Future research should examine the impact of an imagery intervention with a follow-up assessment several months after the completion of the program to determine if the targeted variables remain high and whether or not increases in the target variables lead to an increase in long-term exercise behaviour.

It would be particularly interesting to examine the long-term effects of a study designed to enhance integrated regulation. Integration is a very complex variable. An individual whose exercise motivation is characterized by integrated regulation has achieved a state in which being an exerciser is part of "who they are"; that is, exercise is an important part of their identity. Integrated regulation also reflects congruence with other behaviours that are valued by an individual such as eating healthy and spending time with family. It would be interesting to examine the motivation of participants once they are removed from the study environment and must incorporate exercise into their normal routine.

Another interesting avenue for future research would be to examine the imagery dose that is required to elicit meaningful changes in exercise-related cognitions. The current dissertation presents strong evidence for the effectiveness of imagery interventions for influencing exercise-related cognitions. The imagery intervention administered in Study 2 was able evoke changes in task, coping, and scheduling SE with only three imagery sessions (lasting less than 15 minutes total). Could the effects of the intervention be enhanced with more frequent imagery sessions? Alternatively, could a less-intense intervention still have a meaningful effect? Understanding the imagery dose that is required to cause changes in exercise-related cognitions has important practical implications. For example, if a series of very short (i.e., 20 second) imagery sessions could be useful, perhaps aerobics instructors could guide participants through multiple short imagery sessions during a workout. If longer imagery sessions are required, a different method of administration would be required.

The studies presented in this dissertation are among the first to investigate the effectiveness of an imagery intervention in the exercise domain. This research confirmed that imagery interventions can be employed to enhance exercise-related cognitions. Specifically, it was demonstrated that imagery can be used to target and independently influence specific theoretical variables. The use of imagery interventions in exercise is a relatively new research domain and the success of these interventions signal its promise as an avenue for future investigation.

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APPENDIX A

QUESTIONNAIRE PACKAGES – STUDIES 1, 2, 3, & 4

Demographic Questionnaire – Study 1

Please be sure that you have not previously completed this questionnaire package.

1. Age: ______

2. Date of Birth (dd/mm/yyyy): ____________

3. Gender (circle one): Male Female

4. Occupation: ____________________

5. Marital status (check one):
   ______ Single/ Never married
   ______ Common law
   ______ Divorced/ Separated
   ______ Partner
   ______ Married
   ______ Widowed

6. Are you responsible for childcare? (circle one): Yes No

7. a) Number of times you exercise per week: ______

   b) If you exercise **one or more times per week**, how many years have you been doing this for? ____________

8. How long do you typically exercise for? (e.g., 30 minutes): _________________

9. Do you do exercise as training for a competitive sport? (circle one): Yes No

10. Please list the exercise activities you typically participate in (e.g., running, weights, etc): ____

Demographic Information – Study 2

Using Imagery Interventions to Increase Exercise Participation

ID Number: ____________________

Age: ________ Date of Birth: ____________________

Weight: _______ (lbs)

Height: _______ (cm)

Body Mass Index (BMI) ______________

Race: ________

Income: ______________ Do not wish to answer (check if appropriate): _

Education: ______________________________________

Occupation: _____________________________________

Marital Status: __________________________________

Do you have children? ________ Number: ______ Ages: ___________

For the next two questions, consider the following definition of exercise:

> **"Exercise is any leisure-time form of physical activity that is undertaken with the goal of improving strenth, fitness, flexibility, athletic skill, or overall health."**

How many times do you exercise each week? _________________________

When you do exercise, how long do you exercise for? __________________

Demographic Questionnaire – Study 3

Please be sure that you have not previously completed this questionnaire package.

Age: ______

Date of Birth (dd/mm/yyyy): _____________

Gender (circle one): Male Female

Occupation: ______________________

Marital status (check one):

______ Single/ Never married
______ Common law
______ Divorced/ Separated
______ Partner
______ Married
______ Widowed

Are you responsible for childcare? (circle one): Yes No

Number of times you exercise per week: ______

Do you do exercise as training for a competitive sport? (circle one): Yes No

Primary exercise activities (check all that apply):

_____ running
_____ walking
_____ weights
_____ aerobics classes
_____ cardio equipment (cross trainer, etc.)
_____ sports
_____ swimming
_____ other

When you exercise, how long do you typically exercise for? (e.g., 30 minutes): _____

How many years have you been exercising for? ___

Demographic Questionnaire – Study 4

Age: ________

Weight: _______ (lbs)

Height: _______ (cm)

Body Mass Index (BMI) ______________

Race: ________

Income: ____________________ I do not wish to answer (check if appropriate): _

Education: ______________________________________

Occupation: _____________________________________

Marital Status: __________________________________

Do you have children? ____________ Number: ______ Ages: _________________

Think about the following definition of **regular exercise**:

"Regular exercise is any planned physical activity (e.g., brisk walking, jogging, bicycling, swimming, line-dancing, tennis) performed to increase physical fitness. Such activity should be performed 3 or more times per week for 20+ minutes per session, at a level that increases your breathing rate and causes you to break a sweat."

Do you exercise regularly according to this definition? (circle one): Yes No

Please answer the following questions if you *DO* exercise regularly,

How many times per week do you exercise? ____________

How many minutes is your typical exercise session? ________________

Please select the types of exercise activity that you *regularly* participate in (check all that apply):

____Cardiovascular exercise
____Strength training
____Flexibility
____Speed
____Other (please specify: ______________________________

Godin Leisure-Time Exercise Questionnaire

1. During a typical 7-Day period (a week), how many times, *on average*, do you do the following kinds of exercise for *more than 15 minutes* during your *free time*? Only count those exercise sessions that *are not* associated with the required practices, competitions, or training for your sport (if applicable). Count the number of exercise sessions during your week that are *at least 15 minutes in duration*, and write that number on the line provided.

Times Per Week

a) **STRENUOUS EXERCISE** (heart beats rapidly)

(e.g., running, jogging, hockey, football, soccer, squash, basketball, cross country skiing, judo, roller skating, vigorous swimming, vigorous long distance bicycling). ______________

b) **MODERATE EXERCISE** (not exhausting)

(e.g., fast walking, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, popular, and/or folk dancing). ______________

c) **MILD EXERCISE** (minimal effort)

(e.g., yoga, archery, fishing from river bank, bowling, horseshoes, golf, snow-mobiling, easy walking). ______________

2. During a typical 7-Day period (a week), in your leisure time, how often do you engage in any regular activity long enough to work up a sweat (heart beats rapidly)?

1. Often _______ 2. Sometimes _______ 3. Rarely/Never _______

Multidimensional Self-Efficacy for Exercise Scale

The following questions are about YOUR confidence for exercising regularly. Examples of such exercise include jogging, biking, swimming, and weight training. Please rate **HOW CONFIDENT YOU ARE THAT YOU CAN PERFORM** each of the exercise related tasks below.

Rate each item on the following scale:

0	10	20	30	40	50	60	70	80	90	100
No Confidence							Completely Confident			

How confident are you that you can . . .

1. Exercise when you feel discomfort. ______
2. Complete your exercise using proper technique. ______
3. Include exercise in your daily routine. ______
4. Exercise when you lack energy. ______
5. Follow directions to complete exercise. ______
6. Consistently exercise 3 times per week. ______
7. Exercise when you don't feel well. ______
8. Perform all of the required movements. ______
9. Arrange your schedule to include regular exercise. ______

Exercise Imagery Questionnaire

The following questions deal with imagery and exercise participation. Imagery involves "mentally" seeing yourself exercising. The image in your mind should approximate the actual physical activity as closely as possible. Imagery may include sensations like seeing yourself lifting a weight and feeling yourself move through an exercise. Imagery can also be associated with emotions (e.g., getting psyched up and energized), staying focused (concentrating on the exercises and not being distracted), or setting exercise plans/goals (imaging achieving the goal of losing weight). Please indicate the appropriate number representing your imagery use for each of the following items by circling that number.

	Never							**Always**	
To get me psyched up, I imagine exercising.	1	2	3	4	5	6	7	8	9
I imagine myself looking better from exercising.	1	2	3	4	5	6	7	8	9
To take my mind off my work, I imagine exercising.	1	2	3	4	5	6	7	8	9
When I think about exercising, I imagine perfecting my technique.	1	2	3	4	5	6	7	8	9
When I think about exercising, I imagine my form and body position.	1	2	3	4	5	6	7	8	9
To get me energized, I imagine exercising.	1	2	3	4	5	6	7	8	9
I imagine a "leaner-me" from exercising.	1	2	3	4	5	6	7	8	9
I imagine a "firmer-me" from exercising.	1	2	3	4	5	6	7	8	9
When I think about exercising, I imagine doing the required movements.	1	2	3	4	5	6	7	8	9

Behavioral Regulations in Exercise Questionnaire- Version 2 (Revised)

Why do you exercise? The following list identifies reasons why people exercise. Please indicate on the scale provided how true each statement is for YOU with (0) = Not true for me and (4) = Very true for me.

	Not true for me	Sometimes true for me	Moderately true for me	Often true for me	Very true for me
I feel like a failure when I haven't exercised in a while	0	1	2	3	4
I don't see the point in exercising	0	1	2	3	4
I get restless if I don't exercise regularly	0	1	2	3	4
I participate in exercise because it has become a fundamental part of who I am	0	1	2	3	4
I exercise because it is consistent with my values	0	1	2	3	4
I think it is important to make the effort to exercise regularly	0	1	2	3	4
I find my exercise a pleasurable activity	0	1	2	3	4
It's important to me to exercise regularly	0	1	2	3	4
I take part in exercise because it is consistent with my life goals	0	1	2	3	4
I consider exercise to be an important part of my identity	0	1	2	3	4
I get pleasure and satisfaction from participating in exercise	0	1	2	3	4
I feel under pressure from my friends/family to exercise	0	1	2	3	4
I exercise because it is fun	0	1	2	3	4
I exercise because other people say I should	0	1	2	3	4
I feel ashamed when I miss an exercise session	0	1	2	3	4
I exercise because others will not be pleased with me if I don't	0	1	2	3	4
I don't see why I should have to exercise	0	1	2	3	4
I enjoy my exercise sessions	0	1	2	3	4
I think exercising is a waste of time	0	1	2	3	4
I feel guilty when I don't exercise	0	1	2	3	4
I take part in exercise because my friends/family/spouse say I should	0	1	2	3	4
I can't see why I should bother to exercise	0	1	2	3	4
I value the benefits of exercise	0	1	2	3	4

APPENDIX B

IMAGERY SCRIPTS – STUDY 2

Task Script (Treadmill)

Mental imagery involves imagining yourself performing an activity. This is a technique that has been found to have powerful effects on helping people change their behaviours, self-concepts, and other thoughts related to themselves. Imagery incorporates all of the senses and allows you to not only see yourself engaging in a behaviour, but also feel what it is like to do it. The most effective images can also include sounds, smells, or even tastes that are associated with the behaviour. Imagery can be used to help you increase the amount you exercise. Specifically, you can use imagery to help you learn and master exercise tasks.

It is important to pay attention to using proper technique. Imagine yourself on a treadmill. Now, imagine yourself performing the movements perfectly. Be aware of your leg action. Keep your legs under your hips and your knees slightly bent. Make sure you contact the belt with your heels and push off from the balls of your feet. Let the speed of the belt dictate the length of your strides. Think about your arm action. Keeping your arms relaxed and elbows bent, let your arms swing forward and back. Think about keeping the core of your body supported and upright.

One thing that is required in order to achieve your goal is following the directions from an instructor on how to complete your exercise activities. Imagine yourself on a treadmill. Remember the instructions that the fitness leader gave you… take nice deep breaths, keep your upper body relaxed. Now, imagine what it feels like to be following these instructions exactly.

To do your aerobic exercise properly, you have to pay attention to the intensity. Imagine yourself exercising on a treadmill. Think about your heart beat. Imagine what it feels like to be exercising in a moderate heart rate range. Imagine that you feel your exertion, you're starting to breathe harder, to sweat a little bit, and you feel your legs pushing. You have to concentrate a bit to keep going.

Finally, imagine yourself completing the last minute of your workout. As you reach the 30-minute mark, imagine yourself turning down the speed and the incline on the treadmill and crossing over into your cool-down phase. Think of the changes in your body as you cool down properly, bringing your heart rate back down. Feel your legs moving more easily because of the lower speed and incline of the treadmill, feel the relief in your thighs and in your back. You can take easier, swingy motions as you cool down.

Task Script (Stepper)

Mental imagery involves imagining yourself performing an activity. This is a technique that has been found to have powerful effects on helping people change their behaviours, self-concepts, and other thoughts related to themselves. Imagery incorporates all of the senses and allows you to not only see yourself engaging in a behaviour, but also feel what it is like to do it. The most effective images can also include sounds, smells, or even tastes that are associated with the behaviour. Imagery can be used to help you increase the amount you exercise. Specifically, you can use imagery to help you learn and master exercise tasks.

It is important to pay attention to using proper technique. Imagine yourself on a stepper. Now, imagine yourself performing the movements perfectly. Be aware of your leg action. Keep the entire soles of your feet on the steps. Next, think about your arms. Keeping them relaxed, loosely grip the bars for balance. Make sure you are not using your arms to support you. Think about keeping the core of your body supported and upright. Concentrate on keeping your body over your legs. Feel yourself standing straight and strong, staying still and not swaying.

One thing that is required in order to achieve your goal is following the directions from an instructor on how to complete your exercise activities. Imagine yourself on a stepper. Remember the instructions that the fitness leader gave you… take nice deep breaths, keep your upper body relaxed. Now, imagine what it feels like to be following these instructions exactly.

To do your aerobic exercise properly, you have to pay attention to the intensity. Imagine yourself exercising on a stepper. Think about your heart beat. Imagine what it feels like to be exercising in that moderate heart rate range. Imagine that you feel your exertion, you're starting to breathe harder, to sweat a little bit, and you feel your legs pushing. You have to concentrate a bit to keep going.

Finally, imagine yourself completing the last minute of your workout. As you reach the 30-minute mark, imagine yourself turning down the speed and step height on the stepper and crossing over into your cool-down phase. Think of the changes in your body as you cool down properly, bringing your heart rate back down. Feel your legs moving more easily because of the lower tension on the bike, feel the relief in your thighs and in your back. You can take easier, swingy motions as you cool down.

Task Script (Rower)

Mental imagery involves imagining yourself performing an activity. This is a technique that has been found to have powerful effects on helping people change their behaviours, self-concepts, and other thoughts related to themselves. Imagery incorporates all of the senses and allows you to not only see yourself engaging in a behaviour, but also feel what it is like to do it. The most effective images can also include sounds, smells, or even tastes that are associated with the behaviour. Imagery can be used to help you increase the amount you exercise. Specifically, you can use imagery to help you learn and master exercise tasks.

It is important to pay attention to using proper technique. Imagine yourself on a rower. Now, imagine yourself performing the movements perfectly. Be aware of your body position. Keep your back straight. Next, think about your body action. As you row, maintain your posture and lean back to about 45 degrees. Concentrate on rowing at a constant pace, and keeping your legs slightly bent, even at the end of the movement. Imagine your arms being strong and pulling in to your rib cage.

One thing that is required in order to achieve your goal is following the directions from an instructor on how to complete your exercise activities. Imagine yourself on a rower. Remember the instructions that the fitness leader gave you… take nice deep breaths, keep your upper body relaxed. Now, imagine what it feels like to be following these instructions exactly.

To do your aerobic exercise properly, you have to pay attention to the intensity. Imagine yourself exercising on a rowing machine. Think about your heart beat. Imagine what it feels like to be exercising in that moderate heart rate range. Imagine that you feel your exertion, you're starting to breathe harder, to sweat a little bit, and you feel your legs pushing and your arms pulling. You have to concentrate a bit to keep going.

Finally, imagine yourself completing the last minute of your workout. As you reach the 30-minute mark, imagine yourself slowing down your movements and crossing over into your cool-down phase. Think of the changes in your body as you cool down properly, bringing your heart rate back down. Feel your body moving more easily because of the lower tension, feel the relief in your thighs and in your back. You can take longer, easier pulls as you cool down.

Task Script (Bike)

Mental imagery involves imagining yourself performing an activity. This is a technique that has been found to have powerful effects on helping people change their behaviours, self-concepts, and other thoughts related to themselves. Imagery incorporates all of the senses and allows you to not only see yourself engaging in a behaviour, but also feel what it is like to do it. The most effective images can also include sounds, smells, or even tastes that are associated with the behaviour. Imagery can be used to help you increase the amount you exercise. Specifically, you can use imagery to help you learn and master exercise tasks.

It is important to pay attention to using proper technique. Imagine yourself on a bike. Now, imagine yourself performing the movements perfectly. Be aware of your leg action. Keep your feet flexed as they push down, use your legs to help pull the pedal up. Imagine yourself keeping your pedal stroke strong and smooth. Think about your arm position, keeping your arms relaxed and elbows tucked in. Think about keeping the core of your body supported and your back straight.

One thing that is required in order to achieve your goal is following the directions from an instructor on how to complete your exercise activities. Imagine yourself on a bike. Remember the instructions that the fitness leader gave you. Take nice, deep breaths. Keep your upper body relaxed. Now, imagine yourself following those instructions exactly. Imagine what it feels like to be following these instructions exactly.

To do your aerobic exercise properly, you have to pay attention to the intensity. Imagine yourself exercising on a bike. Think about your heart beat. Imagine what it feels like to be exercising in a moderate heart rate range. Imagine that you feel your exertion, you're starting to breathe harder, to sweat a little bit, and you feel your legs pushing. You have to concentrate a bit to keep going.

Finally, imagine yourself completing the last minute of your workout. As you reach the 30-minute mark, imagine yourself turning down the tension on the bike, slowing your legs down and crossing over into your cool-down phase. Think of the changes in your body as you cool down properly, bringing your heart rate back down. Feel your legs moving more easily because of the lower tension on the bike, feel the relief in your thighs and in your back. You can sit back on the bike and let go of the handles.

Coping Script

Mental imagery involves imagining yourself performing an activity. This is a technique that has been found to have powerful effects on helping people change their behaviours, self-concepts, and other thoughts related to themselves. Imagery incorporates all of the senses and allows you to not only see yourself engaging in a behaviour, but also feel what the behaviour is like. The most effective images can also include, sounds, smells, or even tastes that are associated with the behaviour. Imagery can be used to help you increase the amount you exercise. Specifically, you can use imagery to help you learn to cope with challenging exercise situations.

Let's think about some of the things that sometimes impede our exercise sessions, and how we can overcome them. One thing that sometimes interferes with exercise is the feeling of low energy. Imagine yourself feeling non-energetic. Now, imagine coming to the exercise lab and completing your workout anyway. Feel yourself get re-energized from the feeling of making it to the end of your session.

Next, let's consider feeling discomfort during exercise. Sometimes our muscles get sore, especially when we're starting out an exercise program. Imagine feeling soreness in your muscles. Next, imagine yourself coming to the exercise lab and completing your exercise program anyway. Think about pushing through that discomfort, keeping your body moving and loosening up.

Another type of discomfort occurs when the exercise feels hard. Sometimes exercise just feels more difficult than normal, you feel like you have to put out so much more effort to do the same activity you normally do. Imagine how that feels. Now, think of yourself completing your exercise program anyway. Imagine yourself overcoming the difficulty and pushing to the end of your exercise session.

Another barrier to overcome is exercising when we don't feel perfectly well for some reason. Imagine yourself feeling a little under the weather, not really sick, just not feeling great. Next, imagine yourself coming to the exercise lab anyway. Imagine completing your workout, even though you originally felt a bit ill.

Scheduling Script

Mental imagery involves imagining yourself performing an activity. This is a technique that has been found to have powerful effects on helping people change their behaviours, self-concepts, and other thoughts related to themselves. Imagery incorporates all of the senses and allows you to not only see yourself engaging in a behaviour, but also feel what it is like to do it. The most effective images can also include sounds, smells, or even tastes that are associated with the behaviour. Imagery can be used to help you increase the amount you exercise. Specifically, you can use imagery to help you learn to schedule exercise into your regular routine.

Think about doing your exercise consistently 3 times per week. Imagine yourself developing a routine and organizing a regular schedule so that your activity patterns are nice and predictable. Think of a calendar page or a week in a day-timer. Imagine where you will schedule three visits to the lab for your exercise sessions. Consider the entire week at once and highlight where those exercise sessions will be.

Imagine one of your planned exercise days. Think about how to include exercise into your day on that day. Think about what you usually do in a typical day. Imagine it all laid out in a day-planner. Now, imagine making plans to come to the exercise lab. Think about when, during your day you will do this, and how you will coordinate this with your other daily activities.

Next, continue thinking about a day that you plan to exercise. Imagine something coming up that conflicts with your regularly scheduled exercise session on that day. Think about including some flexibility in your schedule to allow you to make a last minute change. Now, imagine yourself shifting your schedule around to fit your workout in. Imagine completing your workout at another time.

Sometimes you will miss a scheduled exercise session. Since exercise is a priority, think about how you will re-arrange your week to fit in the makeup session. Imagine how you will reschedule a missed workout. Imagine the layout of a non-exercise day. Think about how you can schedule a workout into that day.

APPENDIX C

IMAGERY SCRIPTS – STUDY 4

Week 1

Close your eyes and relax. Imagine that you are walking into the Exercise and Health Psychology Lab for your first workout. The lab is tidy and brightly lit. You hear upbeat music playing over the stereo. There are a few other exercisers on the machines. The faces are friendly. This is an inviting atmosphere. You may be feeling nervous about starting up an exercise program, you may be feeling butterflies in your stomach that's ok. Signing up for this study is a new and exciting step for you on your path to becoming a regular exerciser! It won't be long before you feel very comfortable and at home in an exercise environment. Imagine yourself in the lab, feeling like you belong.

Imagine yourself getting prepared for your workout. You are all dressed in your workout clothes, you are wearing comfortable running shoes. Imagine the feeling of the heart rate monitor around your rib cage and the watch around your wrist. Take a moment to appreciate what an accomplishment it is for you to be here. You want to become a regular exerciser, you have made an action plan for yourself and you are following through!

Next, choose a piece of exercise equipment to begin your workout. Maybe you want to walk on the treadmill, maybe you would prefer the bike or the stepper. Imagine yourself getting onto the equipment and beginning to move your body. You are starting at a slower pace, just to get your muscles warmed up. Notice how nice it feels to get your body moving. Even though you are not used to exercising on this equipment, you notice you feel at ease. As your movements become more comfortable and your muscles start to loosen up, you increase the intensity of your exercise. Maybe you increase the grade on the treadmill or the speed of the stepper. Maybe you are on the rower and you start to pull harder. Notice the change in your body. Your heart rate starts to increase; it feels good. You know you are doing something good for your body. As you start to breathe harder you can feel your lungs getting stronger. You can feel your muscles getting stronger.

Now, imagine that you are coming to the end of thirty minutes in your target heart rate zone. You have made it to the end of your workout. You might feel a bit tired. Maybe the last few minutes were a bit tough. As you begin to slow down and take off some of the intensity, you feel your muscles start to relax. Notice that you feel satisfied. You feel like you are in control.

Once your heart rate has come down and your breathing has slowed down, imagine yourself getting off the equipment. It feels a bit strange to be standing on solid ground. Notice that your body feels calm but your mind feels invigorated. You feel proud that you have completed your workout. As you do a light stretch, you think about the benefits you have given to your body. Take a moment to notice that having finished your first workout in the lab you feel even more comfortable here.

Now, start to think about your next workout. Think about when you are planning to come back. Imagine the exercises you will do. Maybe you will get on the same equipment you did today, maybe you will try something new. Notice that any nervousness you felt when you started your workout has gone away. Feel yourself getting excited about your next visit to the lab.

Week 2

Close your eyes and relax. Imagine that you are coming into the lab for your first workout of week 2. This is going to be your fourth workout in the lab. You walk in and put your outdoor clothes in the closet. Notice that you feel very comfortable in the lab. As you prepare for your workout you realize you know where to find things. You are starting to develop a routine for yourself. As you walk down the hallway to pick up your heart rate monitor, maybe you notice a familiar face. For others in the lab, you are a familiar face.

Before you begin your exercise you notice that you feel good in your exercise clothes. You feel comfortable. You are used to the feeling of the heart rate monitor around your rib cage. Imagine yourself signing into the book and choosing your equipment for the day. Maybe you have a favourite machine or maybe you will try something new. Feel the changes that happen in your body as you prepare to exercise. You are not even on the equipment yet and you can feel your heart rate increase, just a bit. Your body is excited for your workout.

Now, imagine getting onto your equipment and starting your workout. As you begin to move notice that your body is getting used to this feeling. Your warm-up is giving you a chance to loosen your muscles up. As your heart rate and your breathing pick up, your muscles start to feel warm. Your skin feels warm. The warmth in your body is helping to ease any tension you had when you arrived at the lab. Now that you have been exercising for a week, you notice that your body appreciates the chance to move.

Now that your body is warmed up, just like you do every time you exercise, imagine yourself increasing the intensity of your workout. Notice that this time increasing the intensity feels a bit more natural for you. Imagine what it feels like to settle into a comfortable rhythm in your target heart rate zone. As you exercise, you notice that your mind begins to wander. Coming to the lab to exercise is giving you a chance to take some time for yourself. This is a chance to be alone with your thoughts. For a while, you don't have to worry about your work, or school, or any of the things that occupy your mind throughout the day. Imagine how good it feels to know that you are doing something good for your body and your mind.

Now, imagine that you are coming to the end of your workout. As you begin to slow down and take off some of the intensity, take your attention to your muscles, they are feeling firm, but relaxed. You feel your breathing slow down. Notice the feeling in your lungs, it feels great to take slow, deep breaths. You feel revitalized. You feel strong. You feel satisfied.

Now, start to think about your exercise plan for the week ahead. Think about when you are planning to come back to the lab. Imagine the exercises you will do. Take a moment to recognize that this is your second week as a regular exerciser. You are in control. Feel yourself getting excited about your next visit to the lab.

Week 3

Close your eyes and relax. Imagine yourself coming to the exercise lab for your first workout of week three. By now, you feel at ease in the exercise lab. Picture the lab, the equipment, the other people, the sound of the music in the background. Notice that in the lab you feel like a confident exerciser. Take a moment to recognize that you have been exercising regularly for two weeks. Allow yourself to feel proud about the goals you have accomplished so far.

Imagine yourself going through your pre-workout routine. Picture yourself signing in, setting up your heart rate monitor, and deciding which machine you will exercise on today. Now, imagine yourself getting onto the equipment and starting your workout. Think about the way your body responds as you begin to exercise. Your heart rate starts to pick up, your breathing gets heavier and faster, you feel yourself start to sweat. All of these things feel good. You feel like you are in control of your body. After two weeks of regular exercise, you can feel when your body is in your target heart rate range without even having to look at the watch. This makes you feel like a regular exerciser.

As you exercise, your mind starts to wander. You notice that you are thinking about future exercise sessions. This week, you will get to choose where one of your exercise sessions will take place. You have made a plan about where this workout will take place. Maybe you will come into the lab for that workout but maybe you will do something else. During your workout you have time to think. Consider the types of exercise that you enjoy the most. Maybe you like to go for a walk outside. Maybe you have exercise equipment at home and you like to exercise there. Maybe you have decided to join a dance or aerobics class. Whatever you have decided to do, notice that you have the confidence to make your own decisions about exercise.

As you continue to exercise, bring your mind back to the way that you feel doing your workout in the lab. Feel your body move easily through the movements. You are working hard, but it feels comfortable to be doing it. Notice that you feel agile and strong. Now, think about how these feelings carry through into the rest of your day. Maybe you felt a bit tired during your first few weeks of exercise, now you notice that exercise is helping you to feel energized! Maybe you notice that your core feels strong, your posture is improving, and you feel taller. Maybe you notice you feel more flexible; it is easier for you to do simple day to day activities, reach for something or bend to pick something up. Maybe you notice you feel stronger, it is easier for you to carry groceries, or do your housework. The impact of exercising regularly is carrying over into your day to day life. You notice that you don't just feel like an exerciser when you are at the lab, you feel like an exerciser all the time.

Once you are finished your workout, notice that you have made little improvements in your fitness. Today, you feel better after your workout than you did last week. These improvements will continue. Imagine yourself a few weeks from now, exercise will energize you!

As you leave the lab, feeling proud about today's workout, think ahead to your other workouts this week. Feel yourself get excited to try exercising in a new setting. Think about how satisfying it will be to take control of your exercise routine this week.

Week 4

Close your eyes and relax. Imagine yourself at home, preparing for an exercise session. This time, you are not going to exercise in the lab, you are taking control of your exercise and choosing where you will work out. Imagine yourself putting together all of your things, taking out your exercise clothes, and putting on your running shoes. Think about where you will exercise. Maybe you are planning to go outside, maybe you own some personal exercise equipment and you will exercise at home, maybe you are going to go to a local fitness facility or community centre. No matter where you are planning to exercise, recognize how nice it is to have choices about how to make exercise fit into your day most conveniently. Imagine feeling free and in control.

Now imagine yourself starting your workout. Just like you have been doing in the lab for the past few weeks, you start with a light warm-up. Notice that your heart starts to beat faster, your muscles start to feel warmer and your breathing gets a bit heavier. Your exercise environment is new, but the way that your body is feeling is familiar. It feels good to be exercising.

Continue to imagine yourself exercising. You have moved into the more vigorous part of your workout. You can feel your heart beating, you can feel yourself sweating. These feelings help to reassure you that you are working at the proper intensity. You feel satisfied knowing that your body and your mind will benefit from this workout.

As you continue to exercise, notice your surroundings. Take a moment to appreciate that you have chosen this exercise setting. In order to make exercise a regular part of your life, it is important to figure out which types of exercises you like to do most and how you can fit them into your day. Giving yourself the chance to choose helps you to be confident that you will enjoy your workout. Imagine yourself really enjoying this workout.

When your workout is complete, you begin to cool down. Imagine that you have decreased the intensity of your workout and that you are beginning to slow down your movements. Notice how your body is feeling. Even though your muscles are starting to relax, they feel strong. You notice that your lungs feel flexible, you take a slow, deep breath and it feels nice and easy. You feel yourself relax. You notice your posture, you feel tall. As you think about the way your body feels, recognized that you are an exerciser. This is what it feels like to be an exerciser.

Week 5

Close your eyes and relax. Imagine yourself coming into the exercise lab. By now, the lab is a familiar, comfortable place for you. Hear the radio playing upbeat music and the gentle hum of the exercise equipment in the background. Notice that it is a bright, clean, and inviting place. You have been coming to the lab for more than a month now. Think about the changes you have made and the successes you have had since you started coming here.

Now imagine yourself making your way around the lab, preparing for your workout. You set your personal belongings aside, maybe you hand up a coat or a bag in the closet, you sign into the book, and you grab a heart rate monitor and put it on. You feel very comfortable here. Take a moment to notice that after a month, being an exerciser in this lab is a part of who you are. To others, you look like you belong here. You look like a confident exerciser.

Make your way over to your favourite exercise machine. Imagine yourself getting onto the equipment, and starting your warm-up, just like you always do. As you warm up, notice that you feel particularly good today. Your body feels strong and your mind feels alert. Imagine yourself really enjoying the way that exercise makes you feel. You feel really confident doing this exercise.

Now imagine that you have finished your warm-up and you are increasing the intensity of your workout. Maybe you are increasing the speed, moving your body faster, or maybe you are increasing the tension. As you increase the intensity to your usual level, you notice that your body feels more comfortable than it used to. Your actions are smooth and strong. You notice that your heart isn't beating quite as fast as it used to when you first started exercising. These feelings make you feel really good. Now, imagine yourself feeling so confident that you decide to increase the intensity a bit more. You don't make a huge change, just enough to feel a bit more tension in your muscles. Notice that it feels good to be working a bit harder. You know what your body can handle and you are sure that you can manage a bit more work today!

At the end of your workout, you adjust the settings on the machine to bring the intensity back down. Your muscles feel a bit different than they always do since they worked a little bit harder today. Take a moment to acknowledge that you have satisfied your body. Now, take your attention to your thoughts. Notice that you feel psyched up and mentally alert. You are excited that you successfully pushed your limits! You feel motivated for the rest of your workouts this week!

Week 6

Close your eyes and relax. Imagine yourself coming into the lab. By now this is a really familiar setting and a comfortable place for you.

Hear the radio playing up beat music and the gentle hum of the exercise equipment in the background. Notice that the lab is a bright, clean, and inviting place. You've been coming here for more than a month now. Think about the changes you've made and the success that you've had since you started coming here.

Now imagine yourself making your way around the exercise area and preparing for a workout. You set your personal belongings aside- maybe you hang up a coat or a bag in the closet, you sign into the book and you put on a heart rate monitor. You feel really comfortable here. Take a moment to notice that being an exerciser is part of who you are. You feel like you belong here. To others in the lab you look like you belong here. You look like a confident exerciser.

Now make your way over to your favorite exercise machine. Imagine yourself getting onto the equipment and starting your warm-up just like you always do. As you warm up notice that you feel particularly good today. Your body feels strong and your mind feels alert. Imagine yourself really enjoying the way that exercise makes you feel. You feel really confident doing this exercise.

Now imagine that you've finished your warm up and you're increasing the intensity of the workout. Maybe you're increasing the speed- moving your body faster, or maybe you're increasing the resistance. As you increase the intensity to your usual level you notice that your body feels more comfortable than it used to. Your actions are smooth and strong. You notice that your heart isn't beating quite as fast as it did when you first started exercising- this makes you feel really good.

Now imagine yourself feeling so confident that you decide to increase the intensity a little bit more. You don't make a huge change, just enough to feel your muscles work a bit harder. Notice that it feels good to be working a little bit harder. You know that your body can handle it, you're sure that your body can manage more work today.

Now imagine that you have come to the end of your workout. Picture yourself adjusting the settings on your machine to bring the intensity back down. Your muscles feel a bit different than they always do since they worked a little bit harder today. Take a minute to acknowledge that you satisfied your body.

Now take your attention to your thoughts. Notice that you feel psyched up and mentally alert. You're excited that you successfully pushed your limits- You feel motivated for the rest of your workouts this week.

Week 7

Close your eyes and relax. Imagine yourself coming to the exercise lab for your first workout of week 7. You feel at ease in this facility. Picture the equipment, the other people, and the sound of the music in the background. Notice that in here you feel like a confident exerciser.

Take a moment to recognize that you've been exercising regularly for 6 weeks. Allow yourself to feel proud about the goals that you've accomplished so far.

Now imagine yourself going through your pre-workout routine. Picture yourself signing in, setting up your heart rate monitor, and deciding which machine you will exercise on today.

Now imagine yourself getting onto the equipment and starting your workout. Think about the way your body responds as you begin to exercise. Your heart rate start to pick up, your breathing gets heavier and faster, and you feel yourself start to sweat. All of these things feel good. You feel like you're in control of your body. You can feel when your body gets to your target heart rate range without even having to looking at the watch. You feel in touch with your body like a regular exerciser.

As you exercise your mind starts to wander. You notice that you're thinking about future exercise sessions. This week, just like you have for the past 2 weeks you will get to chose where you will do 2 of your exercise sessions. You've made a plan about where and when you'll exercise. You know what type of exercise you will do. Imagine yourself doing this exercise. Notice that you enjoy the flexibility of being able to schedule your workouts into your life at the times that are most convenient for you. Imagine how nice it is doing the exercise that you like best.

As you continue to exercise bring your mind back to the way that you feel doing your workout. Feel your body move easily through the movements. You're working hard but it feels comfortable. Notice that you feel agile and strong. Notice that exercise is helping you to feel energized. Your body and your mind feel sharp and alert throughout the day.

Notice the strength that exercise has given you. It is easier for you to walk up a flight of stairs or carry a heavy object around your house. The impact of exercising regularly is carrying over into your day to day life. You notice that you don't just feel like an exerciser when you're working out, Exercise is a part of who you are all the time.

Once you're finished your workout, notice that you've made some improvements in your fitness. Today you feel better after your workout than you did last week. These little improvements have been building from week to week. You feel much more fit than you did when you first began the study. Imagine yourself a few weeks from now as you continue to make improvements.

As you leave the lab feeling proud about today's workout, think ahead to your other workouts this week. Feel yourself getting excited to workout in your preferred exercise setting. Think about how satisfying it is to have control over your exercise routine.

Week 8

Close your eyes and relax. Imagine yourself in your favorite place to exercise. Take a moment to notice what it is you like about his environment. Maybe it is convenient for you to get to. Maybe it is bright and clean and it helps you feel motivated and alert. Maybe there are other friendly faces around. Notice that in this environment you feel comfortable. As an exerciser you feel like you belong here.

Not take your attention to your clothes or your equipment. Notice that they make you feel good. Wearing your exercise gear is helping you to get psyched bout your workout.

As you begin your warm up feel yourself move freely and comfortably. As your heart rate starts to increase, your breathing gets deeper, and your muscles warm up. Notice that doing this exercise feels right.

Now imagine yourself increasing the intensity of your workout. Notice that exercising in this setting helps to make your workout feel particularly enjoyable. When you do your exercise here exercise doesn't feel like a chore, or something that you have to do. It feels nice to exercise in an environment that is comfortable and pleasant for you. Notice that you enjoy the flexibility of choosing your exercise setting. Being in control of your exercise environment helps you to make a connection between exercise and your personal values and goals.

Take your attention to how you feel when you're doing your workout. Notice that your heart beat is strong. You feel your muscles working. They feel firm and toned. Your mind is alert and you're aware of your surroundings.

Recognize that in this environment you look like a regular exerciser, you feel like a regular exerciser, you are a regular exerciser.

Feel yourself pushing your body through the main part of your workout. After 7 weeks of exercise you feel powerful and strong. Imagine the way that your body feels when you exercise. Your body is used to your exercise routine now. Think about the improvements you've made since you began the exercise program. Right now you're working harder than you could at the beginning of the program. You feel strong in your legs and in your core. You feel tall and flexible. Notice that when your body is working, your heart and your lungs respond quickly. You're experiencing the benefits of regular exercise.

Notice that the changes in your fitness were gradual but when you look back 7 weeks you notice the difference is substantial. Feel the confident that goes along with knowing you can achieve your exercise goals.

Now imagine yourself starting our cool down. You've just completed another workout. You've been exercising regularly for almost 2 months. Notice that you feel proud and confident.

Imagine the satisfaction of finishing a workout. Imagine the satisfaction of finishing 3 workouts in one week. Imagine feeling confident that you can plan your weekly workouts and carry them through. Imagine feeling satisfied that you've transformed yourself into a regular exerciser.

APPENDIX D

CONTROL CONDITION INFORMATION – STUDY 2

Understanding the Foods We Eat

The Macro-Nutrients

Proper nutrition is important for your health and well-being. Food provides the body with fuel that it needs to build muscle, bone, skin, and blood. There are three major energy sources; carbohydrates, proteins, and fats. We call these the macro-nutrients.

Carbohydrates

- Carbohydrates are the most efficient energy source. Carbohydrates are found in foods such as bread, beans, milk, popcorn, potatoes, cookies, spaghetti, and corn.
- Carbohydrates from fruits, vegetables, and grains (particularly whole grains) should give you the bulk of your calories each day.
- Each gram of carbohydrates provides your body with 4 kilocalories of energy.

Proteins

- Proteins are essential for supporting growth and maintenance of new body tissue, building enzymes and hormones, maintaining fluid and electrolyte balance, maintaining acid-base balance, maintaining a healthy immune system, building antibodies and providing the body with energy.
- Proteins are found in:
    - ***Animal Products***: E.g., meats, fish, dairy products.
    - ***Plant Products***: E.g., grains, nuts, fruits, vegetables.
- Each gram of protein provides your body with 4 kilocalories of energy.

Fats

- Fats provide your body with a concentrated source of energy and are needed for protection and insulation of your organs.
- Fats are also needed to transport fat-soluble vitamins (vitamins A, D, E, and K).
- There are several different types of fats:
    - ***Unsaturated Fat*** (the healthiest fat)
        - Lowers your cholesterol, may assist in reducing heart disease.
        - Sources = olives, olive oil, canola oil, cashews, almonds, peanuts, avocados.
    - ***Saturated Fat and Trans Fats*** (unhealthy fats!!)
        - Usually solid at room temperature (e.g., meat, cheese, processed and fast foods, many commercial baked goods).
        - These fats cause your body to produce more cholesterol.
        - **Limit your intake of saturated and trans fats.**
- Each gram of fat provides your body with 9 kilocalories of energy.

Useful Links:

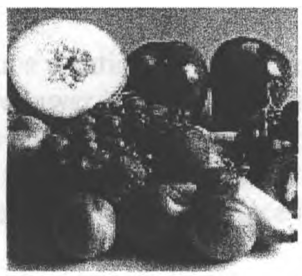
www.canadian-health-network.ca
www.healthyalberta.com
www.healthycanadians.gc.ca
www.dietitians.ca/public/content/eat_well_live_well/english/index.asp

Understanding the Foods We Eat
The Micro-Nutrients

In addition to the three major energy sources you learned about last time, your body also needs other nutrients in smaller quantities, these are called the micro-nutrients and include vitamins and minerals.

Vitamins

- Vitamins are vital to life and are indispensable to body functions.
- Vitamins are needed (in tiny amounts) to enable the body to digest, absorb, and build other nutrients into body structures.
- There are 2 types of vitamins:
- ***Fat-soluble vitamins (A, D, E, & K)*** are only found in foods containing fat. Fat soluble vitamins can be stored in the body until they are needed.
- Fat-soluble vitamins come from a variety of sources, e.g.,
  - A = carrots, mangoes, spinach
  - D = milk, salmon, shrimp
  - E = canola oil, mayonnaise, sunflower seeds
  - K = milk, cabbage, eggs
- ***Water-soluble vitamins (B & C)*** are not stored in the body. Any excess of these vitamins is excreted from the body through urine. Good sources of these vitamins include:
  - B = green peas, milk, baked potato
  - C= oranges, red peppers, broccoli



Minerals

- Minerals are essential for growth, healthy teeth and bones and for regulating the body's processes.
- It is impossible for the body to produce minerals; therefore you get them from the foods that you eat.

Eating a variety of foods will help to ensure that we receive all the nutrients our bodies need in order to function effectively.

Eating Well With Canada's Food Guide (2007)

Canada's Food Guide to healthy Eating was designed to help you make healthy food choices daily. The food guide separates foods into four different groups:

1. **Grain Products (Bread, pasta, cereal, etc.)**
   Women aged 19 to 50 → 6-7 servings daily
   Tip: Whole grain products are higher in fibre and they contain more vitamins and minerals, so choose these more often.

2. **Vegetables and Fruit (Carrots, bananas, potatoes, broccoli, etc.)**
   Women aged 19 to 50 → 7-8 servings daily
   Tip: Dark green, bright yellow, orange, and red vegetables and fruits contain more vitamins than other vegetables and fruits so choose them more often.

3. **Milk and Alternatives (Yogurt, cheese, milk, etc.)**
   Women aged 19 to 50 → 2 servings daily
   Tip: Choose lower-fat milk products because they contain the same amount of protein and calcium but with less fat (e.g., skim milk).

4. **Meat and Alternatives (Meat, fish, poultry, beans, peanut butter, etc.)**
   Women aged 19 to 50 → 2 servings daily
   Tip: When cooking meats, remove any visible fat to reduce fat content. Also, choose loewr-fat cooking methods (e.g., baking, broiling, or roasting).

Other Foods:

Some foods do not fit into the four food groups mentioned. These foods are generally higher in fat and/or calories and are lower in important nutrients. Examples: butter, margarine, jams, cream, sugar, candies, condiments (ketchup, mustard, etc.) and many snack foods (chips, popcorn, etc.). These foods can add a variety to meals; however they should be used in moderation, since they provide extra fat and minimal nutrients.

The food guide also provides information on the quantity of food that you should eat from each of the four food groups, to help you get all the required nutrients that your body needs.

Useful Links:
http://www.hc-sc.gc.ca/fn-an/food-guide-aliment/index_e.html
www.health.gov.bc.ca/library/publications/year/2002/HealthyEatingdoc.pdf
http://www.mhp.gov.on.ca/english/health/HEAL/actionplan-EN.pdf
www.heartandstroke.ca

Understanding the Foods We Eat
Water

The importance of water cannot be underestimated, human life begins in water. Water is a part of every cell in your body.

Water is essential for:

- Carrying nutrients in the body
- Cleansing the blood of waste
- Joint lubrication
- Shock absorption in the eyes, spinal cord, joints
- Maintaining the body's temperature
- Many chemical reactions that take place in the body

Exercise and Dehydration:

- Sweating is necessary during exercise to help your body regulate its temperature.
- Excess water loss during exercise can lead to fatigue and can therefore have a negative effect on your strength, endurance, and coordination.
- Even at low environmental temperatures sweat loss can exceed 1 litre per hour during strenuous exercise.

Water Recommendations:

- Drink about 8 glasses of water each day.
- Drink more water on hot days, or on days that you exercise.
- Ideally, you should drink water during and after exercise.
- If you feel thirsty that is a sign of dehydration, so be sure to drink water even if you do not feel thirsty. This will ensure that you are adequately hydrated.

APPENDIX E

CONTROL CONDITION INFORMATION – STUDY 4

Week 1 – Overview of Physical Activity and Health Outcomes

Physical activity is defined as any bodily movement produced by skeletal muscles that requires energy expenditure. Different types and amounts of physical activity are required in order to obtain different health outcomes. At least 30 minutes of regular, moderate-intensity physical activity on most days has been found to produce many health benefits. Engaging in regular exercise can also be a good way to remain active enough to achieve the health benefits that are associated with physical activity.

Cardiovascular exercise has received a lot of attention over the last 15 years as the centerpiece of physical fitness, weight management, and cardiorespiratory health. The terms cardiovascular exercise, cardiorespiratory fitness and aerobic exercise are all synonymous. This kind of exercise requires large muscle movement over a sustained period of time, elevating your heart rate to at least 50% of maximum level. Examples include walking, jogging, biking, swimming, and any other repetitious activity that can be performed over an extended period of time. This is the type of exercise you will be doing in this study.

Physical inactivity, (or a lack of physical activity) is an independent risk factor for chronic diseases. Overall, physical inactivity is estimated to cause 1.9 million deaths per year worldwide. Regular physical activity reduces the risk of cardiovascular disease and stroke. Physical activity also plays a role in the prevention of type II diabetes, colon cancer and breast cancer.

Engagement in regular physical activity has been linked to the retention of bone mineral density and therefore the prevention of osteoporosis. Muscle strengthening and balance training, two other types of physical activity, can help reduce falls and increase functional status among older adults.

Physical activity is a key determinant of energy expenditure, and thus is fundamental to energy balance. This means that physical activity plays a role in weight control. In order to control weight, an individual may need to engage in more activity than the recommended 30 minutes of regular, moderate-intensity physical activity on most days.

In addition to the previously mentioned benefits, being physically active also has some mental health benefits. Physical activity can help to reduce feelings of depression and anxiety. Physical activity can also help to reduce general stress levels. Taking time on a daily basis to engage in physical activity can provide people with a chance to have a mental break, a distraction from their busy life. Physical activity has also been found to reduce negative mood and enhance positive mood!! Participating in regular physical activity can also help to improve body image and self-esteem.

Finally, engaging in regular physical activity can provide social benefits. Many types of physical activity provide opportunities for social interactions; allowing participants to meet new people or work with others towards a common goal.

Cardiovascular exercise serves as a foundation for the activities of daily living, sports, and other outdoor activities. Your ability to engage in activities such as tennis, golf, skiing, dancing, basketball, volleyball, boxing, hiking, and strength training programs are all influenced by your cardiovascular fitness. Your enjoyment of day-to-day and physical activities will also greatly benefit from cardiovascular exercise because you will have more stamina, less fatigue and less risk of injury.

Week 2 – Physical Activity and Stress

Physical activity — whether it's a relaxing walk, bicycle racing or meditative tai chi — helps relieve stress. It is very clear that exercise does your body good. But did you also know that virtually any form of exercise can also help to reduce stress? Stress can be simply defined as "what we experience when we face challenges in our lives." Stress can be caused by a growing number of sources including biological sources (such as improper nutrition) psychological sources (such as perfectionism, anxiety, or depression) interpersonal sources (such as shyness, or loneliness) and physical sources (such illness, disease, or disability). When we are faced with stressors or challenges we experience a shift in balance in the chemical or hormonal composition of our bodies. In order to relieve the stress, we must find a way to regain balance. Exercise can be used to decrease the production of stress hormones and counteract your body's natural stress response. It's true! - The same regular exercise routine that helps prevent disease and builds muscle can also help you better manage stress. In fact, research has found that individuals who have higher levels of cardiovascular fitness are more able to handle stress than individuals with lower levels of fitness.

So, how does exercise reduce stress? Exercise increases your overall health and your sense of well-being, which puts more pep in your steps every day. But exercise also has some direct stress-busting benefits.

First, exercise pumps up your endorphins. Endorphins are your brain's feel-good neurotransmitters. Although this function is often referred to as a runner's high, a rousing game of tennis or a nature hike also can contribute to this same feeling.

Exercise can also be thought of as meditation in movement. After a fast-paced game of racquetball or several laps in the pool, you'll often find that you've forgotten the day's dilemmas and irritations and concentrated only on your body's movements. As you begin to regularly shed your daily tensions through movement and physical activity, you may find that this focus on a single task, and the resulting energy and optimism, can help you remain calm and clear in everything that you do.

Finally, exercise improves your mood which can go a long way to help relieve stress. Regular exercise can increase self-confidence and lower the symptoms associated with mild depression and anxiety. This can ease your stress levels and give you a sense of command over your body and your life.

Whatever you do, don't think of exercise as just one more thing on your to-do list. Find an activity you enjoy. Since all forms of physical activity can be equally stress relieving, it doesn’t matter what you do, what matters is that you do it! Whether it's an active tennis match or a meditative meander down to a local park and back, make it part of your regular routine. Any form of physical activity can help you unwind and become an important part of your approach to easing stress.

Week 3 - Physical Activity and the Prevention of Osteoporosis

Osteoporosis is a thinning of the bones that occurs over time for most people. Osteoporosis is a disease of the bones that affects men and women, especially women beyond menopause because estrogen helps to protect bone. With osteoporosis, the bones become brittle and weak and have a greater risk of fracture. Osteoporosis is associated with 1.2 million bone fractures each year.

There are certain characteristics that increase the chances of developing osteoporosis. Among them; a diet that is low in calcium and vitamin D and a lack of weight bearing exercise are three of the easiest to change.

Exercise of the right type, called "weight-bearing" helps keep bones strong by causing the muscles and tendons to pull on the bones, which in turn stimulates bone cells to produce more bone. The load on the bones can be created by your own bodyweight, as in running or jogging, or by external weights like dumbbells or gym machines in a weight training program.

All exercise benefits your general fitness. Weight-bearing exercise is best for strengthening bones. Some examples of weight bearing exercises are; running and jogging, gymnastics, Aerobics classes such as step, dance and pump aerobics. Weight lifting is also a weight bearing exercise. For this type of exercise you can use dumbbells, barbells, machines, or even your own body weight. Team sports involving running and throwing can also help to maintain bone mass. This type of sport includes; basketball, football, baseball, softball, volleyball. Individual sports that involve running (such as racket sports) can also be good for helping to maintain bone mass.

Research has found that engaging in physical activity can help to maintain bone mineral density. In a study involving 350 middle-aged women it was found that those who were most active in their daily lives had significantly greater bone density in their spines, femurs and forearms than less active women. Another study from found that running strengthens the leg bones of both older and younger women.

Exercise Prevents Falls and Fractures Too. Although strong bones may help you prevent fractures if you fall, the best way to protect from fall fractures is not to fall in the first place! Balance and strength are the keys to fall protection. Appropriate exercise as we age -- such as weight training -- not only helps keep bones healthy, it protects against falls and fractures as well improving balance and strength.

Week 4 - Exercise and Cardiovascular Health

There are many types of heart disease, including diseases of the heart valves, the arteries, and the muscle itself. The most common disease is coronary heart disease, which is a narrowing of the arteries that supply the heart with blood. This restriction is usually caused by a build-up of fatty “plaques” that are loaded with cholesterol. As the obstruction to blood flow becomes more severe, the heart becomes starved for oxygen and angina pectoris (chest pain) can result. A heart attack, or myocardial infarction, occurs when a clot forms over the plaque or when the fatty tissue peels off the artery wall, obstructing most or all of the blood flow.

Regular aerobic physical activity increases your fitness level and capacity for exercise. It also plays a role in both primary and secondary prevention of cardiovascular disease. Physical inactivity is a major risk factor for heart disease and stroke and is linked to cardiovascular mortality.

Regular physical activity can help reduce your risk of developing cardiovascular disease because it can help to control blood lipid abnormalities. Specifically, physical activity helps reduce triglyceride levels. Triglycerides are the chemical form in which most fat exists in food as well as in the body. High triglycerides are linked to developing coronary artery disease in some people. High Density Lipoproteins also known as HDLs are sometimes referred to as “good cholesterol” while Low Density Lipoproteins, or LDLs are considered to be the “bad cholesterol” in our bodies. With HDLs, the good cholesterol, higher levels are better. Low levels of "good" have been linked to a higher risk of coronary artery disease. Recent studies show that regular physical activity can significantly increase HDL cholesterol levels and thus reduce your risk.

So, how much exercise is necessary to reduce your cardiac risk? The fact is, the more exercise you do, the more you are reducing your cardiovascular risk. More than 40 studies in the scientific literature document that cardiac risk can be reduced by 30 - 50% by regular, moderate exercise - exercise averaging far less than one hour per day. Researchers followed more than 73,000 women for several years and found that those who reported walking at least 2.5 hours a week (roughly 20 minutes a day) reduced their cardiovascular risk by 30%. Women who exercised more than this reduced their risk even more. The point is, however, that 20 minutes a day was enough to gain a substantial improvement in cardiac risk.

What kind of exercise should you do? Almost any activity will be beneficial, as long as you increase your heart rate for more than 12 minutes. Studies show that the highest cardiovascular benefit occurs when exercising between 60 to 80% of your maximum heart rate. Furthermore, putting variety into your exercise keeps it more interesting. When you exercise to reduce your cardiovascular risk you can select from a wide variety of activities, including walking, jogging, cycling, weight lifting, or using exercise machines such as stair climbers, elliptical cross trainers.

Week 5 - Exercise and the prevention of Type II Diabetes

Within our bodies, our cells depend on a single simple sugar, glucose, for most of their energy needs. Our bodies have intricate mechanisms in place to make sure glucose levels in the bloodstream don't go too low or soar too high. We use insulin to control the balance of glucose in our body. Diabetes occurs when the body can't make enough insulin or can't properly use the insulin it makes.

Type II Diabetes, once called adult-onset diabetes, is striking an ever-growing number of adults. In the year 200, more than 171 million adults worldwide were living with Type II diabetes.

The problems behind the numbers are even more alarming. Diabetes is the leading cause of blindness and kidney failure among adults. It causes mild to severe nerve damage that, coupled with diabetes-related circulation problems, often leads to the loss of a leg or foot. Furthermore, diabetes significantly increases the risk of heart disease.

The good news is that type 2 diabetes is largely preventable. About 9 cases in 10 could be avoided by making simple lifestyle changes including: not smoking, keeping weight under control, eating a healthy diet, and exercising more.

Exercise increases the body's sensitivity to insulin, thus helping you prevent the onset of diabetes. Muscle cells help keep blood sugar levels in check because they pull the sugar out of the blood with the help of insulin. The better trained your muscles are, the better they are at doing this job. This is one reason that sedentary people are in the high risk group for diabetes.

Working your muscles more often and making them work harder improves their ability to use insulin and absorb glucose. This puts less stress on your insulin-making cells. The good news is that long bouts of hot, sweaty exercise aren't necessary to reap this benefit. Walking briskly for a half hour every day has been found to reduce the risk of developing type 2 diabetes by 30 percent. This amount of exercise has a variety of other benefits as well.

Both cardiovascular and strength training exercise are important in the prevention of the development of Type II diabetes, but for different reasons. Both types of exercise help the body to burn fat. A high level of body fat (in particular abdominal body fat) decreases the body's sensitivity to insulin. This decreased sensitivity to insulin is one of the major causes of type 2 diabetes. Cardiovascular exercise helps to burn the fat directly. The increased muscle mass from strength training also helps to burn fat, since muscles need energy. You don't need huge body builder type muscles to get this effect. A slight increase in muscle mass helps a lot.

Finally, an exercise program helps to keep your ratio of good to bad cholesterol high which helps to prevent diabetes, as well as many other diseases.

Week 6 - Exercise and the Relief of Depression and Anxiety

Exercise has long been touted as a way to maintain physical fitness and help prevent high blood pressure, diabetes and other diseases. A growing volume of research shows that exercise can also help improve symptoms of certain mental health conditions, including depression and anxiety. Exercise may also help prevent a relapse after treatment for depression or anxiety.

Research suggests that it may take at least 30 minutes of exercise a day for at least three to five days a week to significantly improve depression symptoms. But smaller amounts of activity — as little as 10 to 15 minutes at a time — can improve mood in the short term.

Just how exercise reduces symptoms of depression and anxiety isn't fully understood. Exercise has some physiological benefits which can improve feelings that are associated with depression and anxiety such as sadness, irritability, stress, fatigue, anger, self-doubt and hopelessness. Some evidence suggests that exercise raises the levels of certain mood-enhancing neurotransmitters in the brain. Exercise may also boost endorphins, the feel-good chemicals in your brain which can curb the sensing of pain by your brain. Exercise has also been found to reduce levels of cortisol. Cortisol is often referred to as the "stress hormone" as it is involved in your body's response to stress and anxiety. Cortisol influences your body to cope with a stressor by increasing blood pressure and blood sugar, and reducing immune responses. Reducing cortisol levels in the body can influence relaxation which can help to relieve feelings of depression and anxiety. Exercise can also release muscle tension allowing you to feel more relaxed throughout the day and to sleep better at night. Exercise also increases body temperature, which may have calming effects on your body and mind.

Exercise also has many psychological and emotional benefits which can play a role in helping to relieve feelings of depression or anxiety. First, exercise can help to increase your confidence. Being physically active can give you a sense of accomplishment. Meeting goals or challenges, no matter how small, can boost self-confidence at times when you need it most. Exercise can also make you feel better about your appearance and your self-worth. Exercise can also be a great way to give yourself a mental break or distraction. When you experience feelings of depression or anxiety, it's easy to dwell on how badly you feel. But dwelling interferes with your ability to problem solve and cope in a healthy way. Dwelling can also make feelings of depression more severe and longer lasting. Exercise can shift the focus away from unpleasant thoughts to something more pleasant, such as your surroundings or the music you enjoy listening to while you workout. Finally, exercise can also provide an important opportunity for social interactions. Feeling depressed or anxious can lead to isolation. That, in turn, can worsen your condition. Exercise may give you the chance to meet or socialize with others, even if it's just exchanging a friendly smile or greeting as you walk around your neighborhood.

Any type of exercise can help to reduce feelings of depression and anxiety, so pick an activity that you already like to do. Your body and mind can benefit from relaxing, low intensity exercises such as tai chi and yoga, more vigorous activities such as jogging, resistance training or playing sports and all types of exercise in between! Emphasizing having fun while you exercise can help to maximize the effects that exercise has on the relief of depression and anxiety.

Week 7 - Exercise and Cancer Prevention

Two in five Canadians face a cancer diagnosis in their lifetime. It is the leading cause of premature death in Canada. An estimated 159,000 new cases of cancer and 72,700 deaths from cancer occur in Canada each year. The burden of cancer in Canada is enormous, affecting the economic and social well-being of individual Canadians, their families and the country.

There are many known risk factors for cancer. Some risk factors are not modifiable (for example, age, gender, and genetic predisposition) however some risk factors are modifiable. Modifiable risk factors include smoking, poor diet, exposure to sunlight, and physical activity.

Colon cancer and breast cancer are among the most commonly diagnosed cancers. Physical activity has been found to play a role in the prevention of both of these types of cancer.

Your large intestine is kind of like a sewage plant. It recycles the stuff your body can use and stores the waste for disposal. The longer waste sits in the colon or rectum, the longer toxic materials have to leach out of the solidifying stool and back into your tissues. Exercise gets your body moving, which gets the waste in your body moving. This is because exercise stimulates peristalsis, a wave-like muscular contraction that helps push waste through your colon. Research indicates that exercising can decrease colon cancer risk by up to 40%. Exercise also tends to reduce the incidence of other risk factors for colon cancer, like obesity and diabetes.

In the case of colon cancer, intentional exercise seems to be less important than simply leading an active lifestyle. In general, people don't have to go to the gym three-to-five times a week for an hour in order to reduce their risk of developing colorectal cancer. People can reduce their risk by increasing physical activity in their daily lives. This can be accomplished by choosing a distant parking space, taking the stairs, shopping, cleaning, going for walks, playing with children or pets, and a multitude of other activities.

In the case of breast cancer, prevention it seems that exercise intensity does play a role. Research has found that women who said they did six or more hours per week of strenuous exercise may have reduced their risk of invasive breast cancer by 23 per cent compared to sedentary women.

High levels of estrogen have been linked to a higher risk of developing breast cancer. Women who exercise heavily tend to be older at the time of their first period and produce estrogen for a shorter time, lowering their exposure to the hormone over their lifetime, the researchers said. It has also been suggested that exercise helps by preventing weight gain, regulating insulin sensitivity and changing immune function. A woman's hormone levels naturally fluctuate throughout her life, and it has been found that exercise likely offers protection against breast cancer regardless of a woman's stage in life. This means when cancer prevention is concerned it is never too late to begin exercising!

Week 8 - Other Benefits of Exercise

A major part of physical activity that is often forgotten is the social benefit of participating. It can be an opportunity make new friends or even to develop existing relationships with friends or family members. There are many ways you can use physical activity to help you develop or enhance social relationships. One great way to get involved with others is to join a sports team. Sports provide a great opportunity to share in physical activity with people who share your interests and goals. It is important to understand however, that physical activity does not have to be competitive sport and you don't have to join a sports club or be part of a team. A walk on a Sunday afternoon is also physical activity and is an ideal opportunity to catch up with friends and family members. Walking around your neighbourhood also provides a great opportunity for you to interact with your neighbours and to feel connected to your community. If you are looking to use physical activity to meet new people, you may try joining an exercise class such as dance class or a running group. Many communities also provide opportunities to sign up for a charity event such as a 5 Km walk or run where you can meet new people, keep active, and support a good cause!

Physical activity has also been found to have social benefits that go beyond interpersonal interactions. In fact, physical activity is positively linked to work productivity. Research has found that workers who are physically active have reduced absenteeism and are more productive on the days that they are at work. In addition, companies who have more physically active employees have lower turnover compared to companies with fewer active employees. Research has found that workers who are more physically active are more productive, happier, and less stressed on days when they exercise before work or during their lunch break. In addition, workers who are regularly active report that they feel calmer on exercise days compared to non-exercise days.

Research has found that getting outside during the day can have some great mood-enhancing effects! Physical activity can be a great reason to get outside! Exercise on its own can help people to maintain a positive mood, but the benefits can be even greater if the influence of the outdoors is added to it!! Sometimes in our climate it is tough to imagine going outside to be active in the winter but as long as you dress appropriately for the weather, there are lots of active opportunities to enjoy! Skating, tobogganing, skiing or snowshoeing are great ways to be active in the outdoors. Even going for a neighbourhood walk in the wintertime can be a beautiful activity! In the summer, getting outside seems to be much easier to do! Walking, biking, hiking, roller-blading, and playing sports are among many activities that can get you outside to enjoy nature, your community, and the benefits of physical activity! Now that the weather is getting nicer, try to find an outdoor activity that you can do this summer!!

APPENDIX F

LETTER OF INFORMATION AND CONSENT FORMS – STUDIES 1, 2, 3, & 4

Western
Health Sciences

Kinesiology

The Association Between Exercise Behaviour and Self-Efficacy
Letter of Information

You are being invited to participate in a study titled "The Association Between Exercise Behaviour and Self-Efficacy." Research has indicated that self-efficacy (a form of situation-specific self-confidence) is associated with physical activity behaviour. Specifically, three types of self-efficacy (task, coping, and scheduling) may contribute to the frequency, intensity, and duration of an individual's exercise sessions. Identifying the way in which the various types of self-efficacy are linked to exercise behaviour will allow practitioners to tailor exercise and health promotion programs to the target population. If you agree to take part in this research you will be asked to complete the Leisure Time Exercise Questionnaire which examines your exercise behaviour, and the Multidimensional Self-Efficacy Scale (MSES) which assesses your self-efficacy for exercise. Completion of the MSES requires you to respond to statements based on how confident you feel in various exercise situations. When you have completed the questionnaires, please return them directly to the investigator. This process will take approximately 10 minutes to complete.

Your participation in this study is completely voluntary. Your agreement to participate in this study is indicated by completing and returning these questionnaires. You may refuse to participate, refuse to answer any question or withdraw from the study at any time with no effect on your status at UWO. There are no known risks associated with your participation in this study. If you chose to participate in this study, you will help to provide an understanding of how motivation to exercise is related to the frequency, intensity, and duration of leisure time exercise.

All data collected in the study is anonymous. If the results of this study are published, your name will not be used and no information that discloses your identity will be published. Your questionnaire results will be stored in a locked cabinet in a secure room and will be destroyed after three years.

This letter is yours to keep. If you have any questions, or would like more information about this study, please do not hesitate to contact the investigators listed below. If you have any questions about the ethical conduct of this study or your rights as a research subject, you may contact: Office of Research Ethics, The University of Western Ontario,
519-661-3036.

Thank you!

Investigators:
Dr. Craig Hall
Professor, School of Kinesiology
The University of Western Ontario

Lindsay Duncan
PhD Student, School of Kinesiology
The University of Western Ontario

Using Imagery Interventions to Increase Exercise Participation

You are invited to participate in a study being conducted by Dr. Craig Hall and Lindsay Duncan from the Faculty of Health Sciences at The University of Western Ontario. The primary purpose of this research is to examine how an imagery intervention influences the intention to exercise and actual exercise behaviour during a 12 week exercise program. In order to participate in the study you need to be a healthy non-exercising (once a week or less) female between the ages of 18-45 years who intends to begin exercising more frequently. You must not possess any health condition that would be contraindicated for exercise.

Procedures - If you agree to participate, you will complete the following:
Sub-maximal fitness test:
You will be required to undergo a fitness test conducted in the Exercise and Health Psychology Lab located in the Arthur and Sonia Labatt Health Sciences Building. You will sit on a bicycle, and you will start to pedal at a moderate pace. The tension on the bike will slowly be increased as you maintain a constant pedal rate. You will pedal for less than 10 minutes. A certified, trained kinesiologist will determine if the test should be terminated earlier if you fail to conform to the exercise test protocol, or experience any signs of excessive discomfort. The fitness test will be repeated after 12 weeks and at a 6 month follow up.

You will be given a 12 week cardiovascular program that also will be conducted in the Exercise and Health Psychology Lab in the Arthur and Sonia Labatt Health Sciences Building. The program will involve exercising 3 times a week at a moderate to high intensity. Compliance with the program will be monitored by attendance sheets located inside the lab, your heart rate while exercising, and the length of time you exercise. Each session in the lab will take approximately 45 minutes to complete.

Imagery Intervention
During the week following the initial assessment you will randomly placed into one of the experimental study groups and be required to visit the lab three times to meet with the researcher. Each meeting will be approximately 20 minutes in length. Once these three meetings have taken place you will begin the 12-week exercise program.

Questionnaires:
You will be asked to complete questionnaires that ask you about your motivation to exercise and your use of exercise imagery. Completion of the questionnaires should take approximately 10 minutes and will be administered prior to starting the program, and at 6 and 12 weeks. You will also be asked to complete these questionnaires 6 months after the exercise programs ends.

Feedback from the study
You may request the general findings of this research after the study is complete. If you have any concerns, please feel free to contact the researchers below. This letter is for you to keep.

Potential Risks and Discomforts
You should be aware that physical exercise is associated with certain risks including muscle soreness, muscle or joint injury, heat exhaustion/ stroke, increased heart rate, and in very rare instances heart attack. Every effort will be made to minimize these risks. If at any time you experience pain or difficulty breathing or do not feel well while exercising you should immediately notify the staff in attendance at the exercise or testing facility.

First Aid Protocol
If you receive any minor injury while exercising, you will be responsible for reporting this to the exercise supervisor, and will receive medical treatment on-site as necessary. A first aid kit and ice packs are available to treat minor injuries.

Our exercise program is designed to minimize muscle soreness, but if it occurs our exercise supervisors will be trained to administer the appropriate first aid which can relieve pain, limit swelling and protect the injured tissue, all of which help to speed healing.

The exercise supervisors are trained in first aid and will be available to provide immediate assistance in the case of a major medical emergency. The Student Emergency Response Team (SERT) and Dr. Lisa Fischer from the Fowler-Kennedy Sport Medicine Clinic will be contacted immediately for their assistance. Dr Fischer and SERT will assist until the 911 emergency services arrive. Participants who have a medical emergency will be removed from further participation in the study.

Potential Benefits
You may experience some of the benefits associated with increased physical exercise including increased energy, cardiovascular benefits, increased strength, better circulation, increased flexibility and weight loss. You may also experience increases in some psychological variables (e.g., increased motivation to exercise).

Voluntary Participation
Participation in this study is voluntary. You may refuse to participate, refuse to answer any questions or withdraw from the study at any time with no effect on your academic status. You do not waive any legal rights by signing the consent form.

Compensation
You will be allowed to use the facilities in the Exercise and Exercise Psychology Lab free of charge for the duration of the study. Parking at the Arthur and Sonia Labatt Health Sciences Building will also be free.

Confidentiality
Your participation in this study is completely confidential. The information from the fitness test and questionnaires will only be for the use of the researchers listed. The

completed questionnaires will be stored in a locked cabinet, inside a locked office. After 3 years, all of the questionnaires will be shredded. By participating in this research, you agree that your results may be used for scientific purposes, including publication in scientific and exercise & health specific journals. A master list will be maintained linking your name as a participant to an identifying number. Upon completion of the study, this list will be destroyed. The results of the study will be reported without identifying you personally thus maintaining your confidentiality.

Rights of Subjects
If you have any questions about the conduct of this study or your rights as a research participant you may contact: The Director - Office of Research Ethics
The University of Western Ontario
Tel: 519-661-3036.
Email: ethics@uwo.ca

Contact Information:
If you have any questions or concerns about the research, please feel free to contact Dr. Craig Hall at (519) 661-2111 X 88388 chall@uwo.ca, or Lindsay Duncan at , (519) 661-3404, lduncan@uwo.ca.

Informed Consent

I, ______________________________ have read the Letter of Information, have had the nature of the study explained to me and I agree to participate. All questions have been answered to my satisfaction.

Signature: ________________________________ Date:_______________

Name of Researcher: _________________________ Date: ______________

Signature: _____________________________________

Exercise Motivation: Examining its Relationships with Frequency, Intensity and Duration of Exercise

Letter of Information

You are being invited to participate in a study titled "Exercise Motivation: Examining its Relationships with Exercise Frequency, Intensity, and Duration." If you agree to take part in this research you will be asked to complete the Leisure Time Exercise Questionnaire which examines your exercise behaviour, and the Behavioural Regulations in Exercise Questionnaire, version 3 (BREQ-3) which assesses your motivation to exercise. Completion of the BREQ-3 requires you to respond to statements based on how frequently they apply to you. When you have completed the questionnaires, please return them to the investigator. This process will take approximately 15 minutes to complete.

Your participation in this study is completely voluntary. You may refuse to participate, refuse to answer any question or withdraw from the study at any time with no effect on your status at UWO. There are no known risks associated with your participation in this study.

All data collected in the study is anonymous. If the results of this study are published, your name will not be used and no information that discloses your identity will be published. Your questionnaire results will be stored in a locked cabinet in a secure room and will be destroyed after three years. Completion of the survey indicates your consent to participate.

This letter is yours to keep. If you have any questions, or would like more information about this study, please do not hesitate to contact the investigators listed below. If you have any questions about the ethical conduct of this study or your rights as a research subject, you may contact: The Director, Office of Research Ethics, The University of Western Ontario,
519-661-3036.

Thank you!

Investigators:

Dr. Craig Hall
Professor, School of Kinesiology
The University of Western Ontario

Lindsay Duncan
PhD Student, School of Kinesiology
The University of Western Ontario

Jenny O
PhD Student, School of Kinesiology
The University of Western Ontario

Letter of Information

Using Imagery Interventions to Increase Exercise Participation

You are invited to participate in a study being conducted by Dr. Craig Hall and Lindsay Duncan from the Faculty of Health Sciences at The University of Western Ontario. The primary purpose of this research is to examine how an imagery intervention influences the intention to exercise and actual exercise behaviour during an 8-week exercise program. In order to participate in the study you need to be a healthy female between the ages of 22 and 50 years who does not currently engage in regular exercise but intends to begin exercising more frequently. You must not possess any health condition that would be contraindicated for exercise.

Procedures - If you agree to participate, you will complete the following:

Sub-maximal fitness test:
You will be required to undergo a fitness test conducted in the Exercise and Health Psychology Lab located in the Arthur and Sonia Labatt Health Sciences Building. You will begin the test by standing still on a treadmill until a resting heart rate can be obtained (approximately 2 minutes). Once a resting heart rate has been established you will begin walking on the treadmill. The speed and the incline of the treadmill will be increased every two minutes and your heart rate will be monitored throughout the test. The test will take approximately 15 minutes to complete. A certified, trained kinesiologist will determine if the test should be terminated earlier if you fail to conform to the exercise test protocol, or experience any signs of excessive discomfort. The fitness test will be repeated after 8 weeks and at a 6 month follow up.

Exercise Program:
You will be given an 8-week cardiovascular program to follow. The program will involve exercising 3 times a week at a moderate to high intensity. In weeks 1 and 2, all three exercise sessions will take place in the Exercise and Health Psychology Lab (EHPL) in the Arthur and Sonia Labatt Health Sciences Building. In weeks 3 and 4 you will have the option to exercise in a preferred exercise location (i.e., at home, at your local community centre or fitness facility) for *one* of your exercise sessions (you will only be required to exercise at the EHPL twice per week). In weeks 4- 8 you will have the option to exercise in your preferred location for *two* of your exercise sessions (you will only be required to exercise at the EHPL once per week). Throughout the 8-week study, you may choose to conduct all three of your weekly exercise sessions at the EHPL.

Compliance with the program will be monitored by attendance sheets located inside the lab, your heart rate while exercising, the length of time you exercise, and self-reports of your out-of-lab exercise sessions. Each session in the lab will take approximately 45 minutes to complete.

Experimental Intervention
You will be randomly placed into one of the experimental study groups. Each participant, regardless of group, will meet with the researcher before their first exercise session each week. During these meetings you will be presented with information delivered by voice recording. These meetings will take place in the EHPL and will be approximately 15 minutes in length.

Questionnaires:
You will be asked to complete questionnaires that ask you about your motivation to exercise, your self-efficacy (confidence) related to exercise and your use of exercise imagery. Completion of the questionnaires should take approximately 15 minutes and will be administered prior to starting the program, and after 4 and 8 weeks. You will also be asked to complete these questionnaires 6 months after the exercise programs ends.

Feedback from the study
You may request the general findings of this research after the study is complete. If you have any concerns, please feel free to contact the researchers below. This letter is for you to keep.

Potential Risks and Discomforts
You should be aware that physical exercise is associated with certain risks including muscle soreness, muscle or joint injury, heat exhaustion/ stroke, increased heart rate, and in very rare instances heart attack. Every effort will be made to minimize these risks. If at any time you experience pain or difficulty breathing or do not feel well while exercising you should immediately notify the staff in attendance at the exercise or testing facility.

First Aid Protocol
If you receive any minor injury while exercising, you will be responsible for reporting this to the exercise supervisor, and will receive medical treatment on-site as necessary. A first aid kit and ice packs are available to treat minor injuries.

Our exercise program is designed to minimize muscle soreness, but if it occurs our exercise supervisors will be trained to administer the appropriate first aid which can relieve pain, limit swelling and protect the injured tissue, all of which help to speed healing.

The exercise supervisors are trained in first aid and will be available to provide immediate assistance in the case of a major medical emergency. The Student Emergency Response Team (SERT) and Dr. Lisa Fischer from the Fowler-Kennedy Sport Medicine Clinic will be contacted immediately for their assistance. Dr Fischer and SERT will assist until the 911 emergency services arrive. Participants who have a medical emergency will be removed from further participation in the study.

Potential Benefits
You may experience some of the benefits associated with increased physical exercise including increased energy, cardiovascular benefits, increased strength, better circulation, increased flexibility and weight loss. You may also experience increases in some psychological variables (e.g., increased motivation to exercise).

Voluntary Participation
Participation in this study is voluntary. You may refuse to participate, refuse to answer any questions or withdraw from the study at any time with no effect on your academic status. You do not waive any legal rights by signing the consent form.

Compensation
You will be allowed to use the facilities in the Exercise and Exercise Psychology Lab free of charge for the duration of the study. Parking at the Arthur and Sonia Labatt Health Sciences Building will also be free.

Confidentiality
Your participation in this study is completely confidential. The information from the fitness test and questionnaires will only be for the use of the researchers listed. The completed questionnaires will be stored in a locked cabinet, inside a locked office. After 3 years, all of the questionnaires will be shredded. By participating in this research, you agree that your results may be used for scientific purposes, including publication in scientific and exercise & health specific journals. A master list will be maintained linking your name as a participant to an identifying number. Upon completion of the study, this list will be destroyed. The results of the study will be reported without identifying you personally thus maintaining your confidentiality.

Rights of Subjects
If you have any questions about the conduct of this study or your rights as a research participant you may contact: The Director - Office of Research Ethics
The University of Western Ontario
Tel: 519-661-3036.
Email: ethics@uwo.ca

Contact Information:
If you have any questions or concerns about the research, please feel free to contact Dr. Craig Hall at (519) 661-2111 or Lindsay Duncan at, (519) 661-2111

Lab Hours:
Currently there are several exercise studies being conducted in the EHPL. In order to avoid bottle-necks in the fitness facility each study has been assigned specific hours in which the lab will be open for exercise. Please respect the hours that have been assigned to the exercise imagery study.

Informed Consent

I, ________________________________ have read the Letter of Information, have had the nature of the study explained to me and I agree to participate. All questions have been answered to my satisfaction.

Signature: _______________________________________ Date: ________________

Name of Researcher: _______________________________ Date: _______________

Signature: ____

APPENDIX G

THE UNIVERSITY OF WESTERN ONTARIO RESEARCH ETHICS APPROVAL NOTICES – STUDIES 1, 2, 3, & 4

ETHICS APPROVAL – STUDY 1

Office of Research Ethics

The University of Western Ontario
Room 4180 Support Services Building, London, ON, Canada N6A 5C1
Telephone: (519) 661-3036 Fax: (519) 850-2466 Email: ethics@uwo.ca
Website: www.uwo.ca/research/ethics

Western

Use of Human Subjects - Ethics Approval Notice

Principal Investigator: Dr. C.R. Hall
Review Number: 15535S **Review Level:** Full Board
Review Date: October 03, 2008

Protocol Title: The Association between Exercise Behaviour and Self Efficacy
Department and Institution: Kinesiology, University of Western Ontario
Sponsor:
Ethics Approval Date: November 06, 2008 **Expiry Date:** September 30, 2009
Documents Reviewed and Approved: UWO Protocol, Letter of Information
Documents Received for Information:

This is to notify you that The University of Western Ontario Research Ethics Board for Non-Medical Research Involving Human Subjects (NMREB) which is organized and operates according to the Tri-Council Policy Statement: Ethical Conduct of Research Involving Humans and the applicable laws and regulations of Ontario has granted approval to the above named research study on the approval date noted above.

This approval shall remain valid until the expiry date noted above assuming timely and acceptable responses to the NMREB's periodic requests for surveillance and monitoring information. If you require an updated approval notice prior to that time you must request it using the UWO Updated Approval Request Form.

During the course of the research, no deviations from, or changes to, the study or consent form may be initiated without prior written approval from the NMREB except when necessary to eliminate immediate hazards to the subject or when the change(s) involve only logistical or administrative aspects of the study (e.g. change of monitor, telephone number). Expedited review of minor change(s) in ongoing studies will be considered. Subjects must receive a copy of the signed information/consent documentation.

Investigators must promptly also report to the NMREB:

a) changes increasing the risk to the participant(s) and/or affecting significantly the conduct of the study;
b) all adverse and unexpected experiences or events that are both serious and unexpected;
c) new information that may adversely affect the safety of the subjects or the conduct of the study.

If these changes/adverse events require a change to the information/consent documentation, and/or recruitment advertisement, the newly revised information/consent documentation, and/or advertisement, must be submitted to this office for approval.

Members of the NMREB who are named as investigators in research studies, or declare a conflict of interest, do not participate in discussion related to, nor vote on, such studies when they are presented to the NMREB.

Chair of NMREB: Dr. Jerry Paquette

Ethics Officer to Contact for Further Information			
☑ Grace Kelly (grace.kelly@uwo.ca)	☐ Janice Sutherland (jsutherl@uwo.ca)	☐ Elizabeth Wambolt (ewambolt@uwo.ca)	☐ Denise Grafton (dgrafton@uwo.ca)

This is an official document. Please retain the original in your files. cc: ORE File

UWO NMREB Ethics Approval - Initial
V.2007-10-12 (rptApprovalNoticeNMREB_Initial) 15535S Page 1 of 1

ETHICS APPROVAL – STUDY 2

Western

Office of Research Ethics

The University of Western Ontario
Room 00045 Dental Sciences Building, London, ON, Canada N6A 5C1
Telephone: (519) 661-3036 Fax: (519) 850-2466 Email: ethics@uwo.ca
Website: www.uwo.ca/research/ethics

Use of Human Subjects - Ethics Approval Notice

Principal Investigator: Dr. C.R. Hall
Review Number: 13778E **Review Level:** Expedited
Review Date: November 21, 2007
Protocol Title: Using Imagery Interventions to Increase Exercise Participation - Study 2
Department and Institution: Kinesiology, University of Western Ontario
Sponsor: SSHRC-SOCIAL SCIENCE HUMANITIES RESEARCH COUNCIL
Ethics Approval Date: December 19, 2007 **Expiry Date:** December 31, 2008
Documents Reviewed and Approved: UWO Protocol, Letter of Information and Consent, Newspaper Ad, Poster.
Documents Received for Information:

This is to notify you that The University of Western Ontario Research Ethics Board for Health Sciences Research Involving Human Subjects (HSREB) which is organized and operates according to the Tri-Council Policy Statement: Ethical Conduct of Research Involving Humans and the Health Canada/ICH Good Clinical Practice Practices: Consolidated Guidelines; and the applicable laws and regulations of Ontario has reviewed and granted approval to the above referenced study on the approval date noted above. The membership of this REB also complies with the membership requirements for REB's as defined in Division 5 of the Food and Drug Regulations.

The ethics approval for this study shall remain valid until the expiry date noted above assuming timely and acceptable responses to the HSREB's periodic requests for surveillance and monitoring information. If you require an updated approval notice prior to that time you must request it using the UWO Updated Approval Request Form.

During the course of the research, no deviations from, or changes to, the protocol or consent form may be initiated without prior written approval from the HSREB except when necessary to eliminate immediate hazards to the subject or when the change(s) involve only logistical or administrative aspects of the study (e.g. change of monitor, telephone number). Expedited review of minor change(s) in ongoing studies will be considered. Subjects must receive a copy of the signed information/consent documentation.

Investigators must promptly also report to the HSREB:

a) changes increasing the risk to the participant(s) and/or affecting significantly the conduct of the study;
b) all adverse and unexpected experiences or events that are both serious and unexpected;
c) new information that may adversely affect the safety of the subjects or the conduct of the study.

If these changes/adverse events require a change to the information/consent documentation, and/or recruitment advertisement, the newly revised information/consent documentation, and/or advertisement, must be submitted to this office for approval.

Members of the HSREB who are named as investigators in research studies, or declare a conflict of interest, do not participate in discussion related to, nor vote on, such studies when they are presented to the HSREB.

Chair of HSREB: Dr. John W. McDonald

Ethics Officer to Contact for Further Information

☐ Janice Sutherland (jsutherl@uwo.ca)	☐ Jennifer McEwen (jmcewen4@uwo.ca)	☑ Grace Kelly (grace.kelly@uwo.ca)	☐ Denise Grafton (dgrafton@uwo.ca)

This is an official document. Please retain the original in your files.

cc: ORE File

ETHICS APPROVAL – STUDY 3

Office of Research Ethics

The University of Western Ontario
Room 00045 Dental Sciences Building, London, ON, Canada N6A 5C1
Telephone: (519) 661-3036 Fax: (519) 850-2466 Email: ethics@uwo.ca
Website: www.uwo.ca/research/ethics

Use of Human Subjects - Ethics Approval Notice

Principal Investigator: Dr. C R. Hall
Review Number: 13641S **Review Level:** Full Board
Review Date: October 5, 2007
Protocol Title: Exercise Motivation: Examining its Relationships with Frequency, Intensity and Duration of Exercise
Department and Institution: Kinesiology, University of Western Ontario
Sponsor:
Ethics Approval Date: November 3, 2007 **Expiry Date:** September 30, 2008
Documents Reviewed and Approved: UWO Protocol, Letter of Information
Documents Received for Information:

This is to notify you that The University of Western Ontario Research Ethics Board for Non-Medical Research Involving Human Subjects (NMREB) which is organized and operates according to the Tri-Council Policy Statement: Ethical Conduct of Research Involving Humans and the applicable laws and regulations of Ontario has granted approval to the above named research study on the approval date noted above.

This approval shall remain valid until the expiry date noted above assuming timely and acceptable responses to the NMREB's periodic requests for surveillance and monitoring information. If you require an updated approval notice prior to that time you must request it using the UWO Updated Approval Request Form.

During the course of the research, no deviations from, or changes to, the study or consent form may be initiated without prior written approval from the NMREB except when necessary to eliminate immediate hazards to the subject or when the change(s) involve only logistical or administrative aspects of the study (e.g. change of monitor, telephone number). Expedited review of minor change(s) in ongoing studies will be considered. Subjects must receive a copy of the signed information/consent documentation.

Investigators must promptly also report to the NMREB:

a) changes increasing the risk to the participant(s) and/or affecting significantly the conduct of the study;
b) all adverse and unexpected experiences or events that are both serious and unexpected;
c) new information that may adversely affect the safety of the subjects or the conduct of the study.

If these changes/adverse events require a change to the information/consent documentation, and/or recruitment advertisement, the newly revised information/consent documentation, and/or advertisement, must be submitted to this office for approval.

Members of the NMREB who are named as investigators in research studies, or declare a conflict of interest, do not participate in discussion related to, nor vote on, such studies when they are presented to the NMREB.

Chair of NMREB: Dr. Jerry Paquette

Ethics Officer to Contact for Further Information

☑ Grace Kelly [illegible]@uwo.ca	☐ Janice Sutherland [illegible]@uwo.ca	☐ Jennifer McEwen [illegible]@uwo.ca	☐ Denise Grafton [illegible]@uwo.ca

This is an official document. Please retain the original in your files. cc: ORE File

ETHICS APPROVAL – STUDY 4

Western

Office of Research Ethics

The University of Western Ontario
Room 4180 Support Services Building London, ON Canada N6A 5C1
Telephone (519) 661-3036 Fax (519) 850-2466 Email: ethics@uwo.ca
Website www.uwo.ca/research/ethics

Use of Human Subjects - Ethics Approval Notice

Principal Investigator: Dr. C.R. Hall
Review Number: 13296E **Revision Number:** 4
Review Date: August 18, 2009 **Review Level:** Expedited
Protocol Title: Using Imagery Interventions to Increase Exercise Participation - Study 1
Department and Institution: Kinesiology, University of Western Ontario
Sponsor:
Ethics Approval Date: August 18, 2009 **Expiry Date:** March 31, 2010
Documents Reviewed and Approved: Revised Study End Date
Documents Received for Information:

This is to notify you that The University of Western Ontario Research Ethics Board for Health Sciences Research Involving Human Subjects (HSREB) which is organized and operates according to the Tri-Council Policy Statement: Ethical Conduct of Research Involving Humans and the Health Canada/ICH Good Clinical Practice Practices: Consolidated Guidelines; and the applicable laws and regulations of Ontario has reviewed and granted approval to the above referenced revision(s) or amendment(s) on the approval date noted above. The membership of this REB also complies with the membership requirements for REB's as defined in Division 5 of the Food and Drug Regulations.

The ethics approval for this study shall remain valid until the expiry date noted above assuming timely and acceptable responses to the HSREB's periodic requests for surveillance and monitoring information. If you require an updated approval notice prior to that time you must request it using the UWO Updated Approval Request Form.

During the course of the research, no deviations from, or changes to, the protocol or consent form may be initiated without prior written approval from the HSREB except when necessary to eliminate immediate hazards to the subject or when the change(s) involve only logistical or administrative aspects of the study (e.g. change of monitor, telephone number). Expedited review of minor change(s) in ongoing studies will be considered. Subjects must receive a copy of the signed information/consent documentation.

Investigators must promptly also report to the HSREB:

a) changes increasing the risk to the participant(s) and/or affecting significantly the conduct of the study;
b) all adverse and unexpected experiences or events that are both serious and unexpected;
c) new information that may adversely affect the safety of the subjects or the conduct of the study.

If these changes/adverse events require a change to the information/consent documentation, and/or recruitment advertisement, the newly revised information/consent documentation, and/or advertisement, must be submitted to this office for approval.

Members of the HSREB who are named as investigators in research studies, or declare a conflict of interest, do not participate in discussion related to, nor vote on, such studies when they are presented to the HSREB.

Chair of HSREB: Dr. Joseph Gilbert

Ethics Officer to Contact for Further Information			
☐ Janice Sutherland (jsutherl@uwo.ca)	☐ Elizabeth Wambolt (ewambolt@uwo.ca)	☐ Grace Kelly (grace.kelly@uwo.ca)	☑ Denise Grafton (dgrafton@uwo.ca)

This is an official document. Please retain the original in your files. cc: ORE File