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INCREASING PHYSICAL ACTIVITY BEHAVIOUR IN FIRST- AND SECOND-DEGREE RELATIVES OF COLON CANCER PATIENTS: A MATTER OF SELF-REGULATION

(Spine title: Increasing Physical Activity in Relatives of Colon Cancer Patients)

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by

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Graduate Program in Kinesiology

A thesis submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy

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Abstract

The objective of the dissertation was to increase physical activity (PA) behaviour in relatives of colon cancer patients. Study 1 explored whether factual colon cancer information grounded in Protection Motivation Theory is a source of exercise motivation for relatives of colon cancer patients. Study 2 examined over a 12-week structured exercise program the effect of an: (a) efficacy intervention on task and self-regulatory (i.e., barrier, scheduling, goal-setting, relapse prevention) efficacy, (b) efficacy intervention on objectively measured exercise adherence (i.e., *frequency*, *intensity*, *duration*, dropout); and (c) whether task and self-regulatory efficacy predicted exercise adherence. Finally, Study 3 examined during a 9-month home-based PA program the effect of an: (a) efficacy intervention on task and self-regulatory efficacy, (b) efficacy intervention on objective PA (i.e., activity energy expenditure-AEE, sedentary, light, moderate, and vigorous activity); and (c) whether task and self-regulatory efficacy predicted objectively measured PA.

Study 1 demonstrated that colon cancer information is a meaningful source of exercise motivation for relatives of colon cancer patients. Following the DVD the intervention group believed that they were more *vulnerable* to developing colon cancer and that they had greater coping resources. Additionally, following the DVD the intervention group also scored higher on their *intentions* to exercise (M= 6.57; SE=.06) compared to the attention control group (M= 6.55; SE=.06). Finally, results demonstrated that coping appraisal predicted exercise *intention* at baseline and following the DVD.

Study 2 demonstrated that the groups did not differ on their reported efficacy beliefs throughout the 12-week structured exercise program. Additionally, the efficacy

intervention group exercised for longer *duration* early on (i.e., 0-4 weeks; $p < .01$; $\eta^2 = .07$) compared to the attention control group; however no differences emerged for *frequency* and *intensity*. Differential loss favouring the efficacy intervention group was demonstrated at weeks 4, 8, and 12. Self-efficacious beliefs were associated with dose measures of adherence. Scheduling efficacy was the strongest predictor of *frequency*, while task efficacy significantly predicted *duration* and *intensity*.

Finally, Study 3 showed that the groups did not differ on their efficacy beliefs throughout the 9-month home-based PA program. Although not statistically significant, results indicated that the efficacy intervention group exhibited higher AEE and less sedentary behaviour compared to the attention control group. Finally, regression analyses revealed that task and self-regulatory efficacy variable(s) predicted objectively measured PA behaviour.

Keywords: Colon cancer, exercise intentions, message tailoring, beliefs, task efficacy, self-regulatory efficacy, efficacy intervention, exercise adherence, physical activity.

Co-Authorship

The information presented in this doctoral dissertation is my original work. However, I would like to acknowledge the important contribution of my advisor, Dr. Harry Prapavessis. His guidance, assistance and insight were invaluable to the completion of all three dissertation studies.

Dedication

In loving memory of my Hero— Dad I owe a lifetime of thanks for so many wonderful memories, for teaching me the importance of reaching for the stars and doing my best, for always standing by me, and for giving me the greatest gift— unconditional love.

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Introduction

It is well established that regular physical activity provides meaningful health benefits, and contributes to the primary and secondary prevention of several chronic diseases (e.g., cardiovascular disease, stroke, hypertension, type 2 diabetes mellitus, osteoporosis — Warburton, Nicol, & Bredin, 2006a; Warburton, Nicol, & Bredin, 2006b). In particular, research has established that exercise and physical activity is consistently related to a risk reduction of colon cancer (Chao, et al., 2004; Evenson, et al., 2003; Friedenreich & Orenstein, 2002; Gotay, 2005; Lee, 2003; McTiernan, 2003; Quadrilatero & Hoffman-Goetz, 2003). Empirical evidence has suggested that the average risk reduction is 40-50%, but may be as high as 70% (Friedenreich & Orenstein, 2002). This inverse relationship between exercise and colon cancer risk remains constant after adjusting for confounding variables such as dietary intake or body mass index (Friedenreich & Orenstein, 2002). Relatives of colon cancer patients are at increased risk for colon cancer (Keku, et al., 2003); hence this is an important target population. Thus, gaining a greater understanding of the precise mechanisms by which we can encourage physical activity in a population of first- and second-degree relatives of colon cancer is an important priority.

Colorectal cancer[1] is one of the leading causes of cancer-related mortality in developed countries worldwide (Quadrilatero & Hoffman-Goetz, 2003). During the year 2009, an estimated 22,000 Canadians will be diagnosed with colorectal cancer (Canadian Cancer Society, 2009). Furthermore, it is expected that 9,100 Canadians will die of the

[1] Colorectal cancer is often considered as a single group, however colon and rectal cancers are separate diseases (Prabhudesai & Kumar, 2002). Thus, the current dissertation focuses on colon cancer, as research has found a lack of association between physical activity and rectal cancer (Friedenreich & Orenstein, 2002).

disease and its multiple adverse effects rendering colorectal cancer the second leading cause of cancer –related death among men and women in Canada (Canadian Cancer Society, 2009).

Despite the well-established benefits of physical activity, at least 60% of the world's population fails to engage in the recommended dose (i.e., *frequency*, *intensity*, and *duration* of physical activity) required to produce health benefits (World Health Organization, 2009). According to the 2004-2005 Canadian Community Health Survey, 51% of Canadian adults were classified as physically inactive (Canadian Fitness and Lifestyle Research Institute, 2005). Additionally, it is estimated that 50% of individuals who adopt an exercise program will drop out within the first year (ACSM, 2006). Hence, given the health benefits of physical activity; the dismal retention rates present an important public health challenge in the motivation of sedentary individuals to initiate, adopt, and maintain a physically active lifestyle.

Theoretical Considerations

Several health behaviour models have been developed to facilitate the understanding of precisely how individuals determine whether or not to adopt a given health behaviour, such as exercise or physical activity (e.g., the Health Belief Model—Rosenstock, Strecher, & Becker, 1988; Protection Motivation Theory—Rogers, 1975; 1983; Rogers & Prentice-Dunn, 1997; Social Cognitive Theory—Bandura, 1986; the Theory of Reasoned Action/ Theory of Planned Behaviour—Ajzen & Fishbein, 1980; Ajzen, 1991; the Transtheoretical Model of Behaviour Change—Prochaska, DiClemente, & Norcross, 1992). Although these theories share some commonalities,

fundamental differences exist between the beliefs postulated to predict behaviour change (Salovey, Rothman, & Rodin, 1998). Moreover, Rothman (2000) identifies specific concerns with behaviour change models. Specifically, Rothman highlights that some of these models make no reference to behavioural maintenance (i.e., the Health Belief Model; Rosenstock, Strecher, & Becker, 1988 and Protection Motivation Theory; Rogers, 1975; 1983; Rogers & Prentice-Dunn, 1997). Further, the theories of reasoned action (Ajzen & Fishbein, 1980) and planned behaviour (Ajzen, 1991) make no formal distinction between decisions needed to initiate or maintain the desired behaviour. This emphasis on the adoption of a behaviour is regrettable, as adoption of an exercise or physical activity program is merely the first step to behaviour change. Rothman (2000) advocates that future models of health behaviour change underscore the importance of behaviour maintenance.

Two of the aforementioned theories are of particular relevance to the purpose of this dissertation (i.e., physical activity intention, adoption, and maintenance in first-degree relatives of colon cancer patients). First, motivational theories have focused on understanding the motivational factors that underpin individual choices to perform or not perform health behaviours (Armitage & Conner, 2000). One such theory is Protection Motivation Theory (Rogers, 1975; 1983; Rogers & Prentice-Dunn, 1997). Protection Motivation Theory was chosen as the theory of choice for Study 1 as its primary purpose was to change intentions to exercise. Additionally, Protection Motivation Theory is a theoretical framework that was designed to explain health behaviour motivation (i.e., intention) from a disease prevention perspective (Courneya & Hellsten, 2001), and explains behavioural change in terms of threat and coping appraisal, which have been

found to be useful in predicting health related intentions (Milne, Sheeran, & Orbell, 2000). Threat appraisal is influenced by: (a) an individual's judgement of the likelihood of developing a particular health condition (i.e., colon cancer; perceived vulnerability); and (b) an individual's judgement of the severity of the consequences of developing the health condition (i.e., perceived severity). While coping appraisal consists of: (a) an individual's belief that the recommended coping response (e.g., exercise) is effective at reducing the risk of the health condition (i.e., response efficacy); and (b) an individual's belief that they can successfully perform the coping response (i.e., self-efficacy). Specifically, Protection Motivation Theory has proposed that perceived vulnerability, perceived severity, response efficacy, and self-efficacy, collectively influence an individual's intention (i.e., protection motivation) to perform the health behaviour, and subsequently intention influences actual exercise behaviour.

A second theory selected for Study 2 and 3 is Social Cognitive Theory (Bandura, 1986). Social Cognitive Theory (Bandura, 1986) was chosen as it is an approach designed to help understand human cognitions, actions, motivations, and emotions, whereby individuals actively shape their environments rather than react to them (Maddux & Gosselin, 2003). Additionally, Social Cognitive Theory (Bandura, 1986) assumes that people are goal-directed and guided by forethought, symbolization, self-reflection, self-regulation, and vicarious learning (Maddux, 1995). Within Social Cognitive Theory (Bandura, 1986), self-efficacy beliefs are suggested to be an important determinant of the initiation and maintenance of behaviour change (Bandura, 1997; Schwarzer, 2001). Self-efficacy is defined as "beliefs in one's capabilities to organize and execute the course of action required to produce given attainments" (Bandura, 1997, p3). It is proposed that

the successful implementation of behaviour change increases confidence levels, which in turn, facilitates further action. Conversely, it is posited that failures in behaviour change undermine efficacy levels, which ultimately is debilitative to behaviour change (Rothman, Baldwin, & Hertel, 2004).

Maddux and Gosselin (2003) have suggested that one of the most important consequences of the development of self-efficacy beliefs is the development of capacity for self-regulation. Self-efficacy has been proposed to encourage self-regulation by impacting goal-setting, the choice of activity pursued, persistence, effort expended, and problem-solving (Woodgate, 2005). Social Cognitive Theory (Bandura, 1986) is commonly employed in interventions designed to increase physical activity behaviour (Schneiderman, Antoni, Saab, & Ironson, 2001); whereby participants are taught behavioural skills (e.g., self-regulation).

Exercise and Physical Activity Interventions

Given the number of health benefits gained through the initiation and maintenance of a physically active lifestyle, numerous physical activity interventions have been implemented and tested. Few strategies, however, have produced long-term behaviour change (Rothman, 2000). Why are behaviour change and maintenance so illusive? The answer is multifaceted; hinging on the premise that the adoption of health behaviours is a difficult and complex process. According to Social Cognitive Theory (Bandura, 1986), for successful behaviour change, it is required that an individual overcomes challenges and obstacles, and self-efficacy and self-regulation are likely required. Self-efficacy reflects an individual's sense of competency and proficiency for a given behaviour, and consequently influences cognitive, emotional, and behavioural

processes. In turn, these processes affect individual control over selection of behaviours, activities, effort and persistence (Bandura, 1997).

Research has established that self-efficacy is one of the most well-known psychosocial determinants of exercise and physical activity behaviour and adherence (Bandura, 1986, 1997). Research has also established that self-efficacy plays a central role in the adoption and maintenance of physical activity in structured exercise programs (Bandura, 1997; McAuley, 1993; McAuley & Blissmer, 2000). Further, empirical research has demonstrated that higher levels of self-efficacy are associated with greater exercise participation, increased *frequency* of exercise behaviour, and greater likelihood to persevere and maintain an exercise program (Culos-Reed, et al., 2001; Godin, Desharnais, Valois, & Bradet, 1994; Marcus, Pinto, Silken, Audrain, & Taylor, 1994; McAuley & Mihalko, 1998; McAuley, Pena, & Jerome, 2001; Rodgers & Gauvin, 1998).

Much of the efficacy-related research in exercise psychology has focused on exploring task efficacy (Culos-Reed et al., 2001; McAuley & Mihalko, 1998), which is defined as an individual's belief in his or her ability to perform a given task. This focus on task efficacy in the exercise domain is unfortunate, as the importance of self-regulatory skills in the health behaviour change process has been underscored by both Bandura (1995, 2004) and Kirsch (1995). Self-regulation is defined as self-generated thoughts, feelings, and actions, which are systematically oriented towards attaining goals (Maddux & Gosselin, 2003). In order to successfully adopt and maintain an exercise program, it is required that individuals have high efficacious beliefs in their capabilities to not only perform the desired activity (i.e., task efficacy), but to effectively schedule exercise sessions into daily routines (i.e., scheduling efficacy), to overcome exercise

barriers (i.e., barrier efficacy), set and adapt exercise goals (i.e., goal-setting efficacy), and address and recover from exercise relapses (i.e., relapse prevention efficacy-Woodgate, 2005). Specifically, it has been proposed that task efficacy should be related to physical activity and exercise initiation, while coping efficacy (i.e., self-regulatory efficacy) should relate to the maintenance of the behaviour (Rodgers et al., 2002). Thus, it has been suggested that self-regulatory skills are essential, as the goal of exercise and physical activity promotion is not only to get people to be active, but to get them regularly active (Rodgers et al., 2002).

Given that self-regulatory skills are integral to health behaviour change, (specifically physical activity behaviours), further components of self-regulatory efficacy are being explored in the physical activity and exercise domain. To date, however, much of the self-regulatory efficacy research has examined barrier and scheduling efficacy (e.g., DuCharme & Brawley, 1995; Rodgers et al., 2002), with barrier efficacy being the most widely studied component. As such, barrier efficacy has emerged as the principal operationalization of self-regulatory efficacy (Woodgate, 2005).

Woodgate (2005) has argued that the operationalization of the self-regulatory efficacy construct may benefit from modification within the exercise domain for three important reasons. First, it has been suggested that self-regulatory efficacy encompasses a plethora of self-regulatory skills (Bandura, 1995). Thus proper assessment of the construct necessitates that multiple indicators (e.g., types) be utilized (cf. Bandura, 1986; McAuley & Mihalko, 1998; McAuley et al., 2001). Second, physical activity behaviour and maintenance is complex. Consequently, by not incorporating multiple indicators of self-regulatory efficacy into research in this domain, the measurement of self-regulatory

efficacy may be under-represented. Finally, Meichenbaum and Turk (1987) suggested that self-regulatory skills are best employed in an integrated fashion, and not independent of one another. For example, successful adoption and maintenance of an exercise program would not be possible without the ability to employ multiple self-regulatory skills (i.e., barrier, scheduling, goal-setting, and relapse prevention efficacy). Accordingly, emphasis is warranted on the need to broaden the operationalization of self-regulatory efficacy in future research in the exercise domain to facilitate our understanding of its role in the adoption and maintenance of physical activity behaviour.

Empirical evidence has demonstrated that self-regulatory efficacy are related to physical activity and exercise behaviour (e.g., Bray, Gyurcsik, Culos-Reed, Dawson, & Martin, 2001; Cramp & Brawley, 2009; DuCharme & Brawley, 1995; McAuley, Pena, & Jerome, 2001; Poag-Ducharme & Brawley, 1993; Poag & Brawley, 1992; Rejeski et al., 2003; Rodgers et al., 2002; Rodgers, Blanchard, et al., 2002; Rodgers, Munroe, & Hall, 2002; Rodgers & Sullivan, 2001; Woodgate, 2005). Empirical support has been provided for this relationship and it disseminates from two primary research directions: (a) the predictive ability of self-regulatory efficacy in physical activity behaviour, and (b) the effects on exercise behaviour following the experimental manipulation of self-regulatory efficacy.

Several studies have examined the ability of self-regulatory efficacy in the prediction of exercise intention and behaviour. For example, Poag and Brawley (1992) explored the relationships between goal efficacy and exercise behaviour in a sample of females participating in community conditioning classes. Results indicated that those participants high in reported goal efficacy perceived greater success in achieving their

goals at the end of the exercise program in comparison to their low-efficacy counterparts. In addition, participants' reported goal efficacy was significantly predictive of perceived goal attainment at the end of the program conclusion. Moreover, exercise self-efficacy was significantly related to subsequent *intensity* of exercise participation but not *frequency*. Bray, et al. (2001) examined both self-efficacy (i.e., barrier self-efficacy, scheduling self-efficacy, and exercise self-efficacy) and proxy efficacy as predictors of exercise behavior among exercise class initiates and experienced exercisers. Results revealed that hierarchical regressions indicated that among those who were exercise initiates, self-efficacy and proxy efficacy accounted for 34 percent of the variance in exercise class attendance. Rodgers, Munroe et al. (2002) examined the predictive ability of task and coping efficacy for exercise behaviour. The results indicated that task efficacy influenced behavioural intentions to exercise, while coping efficacy influenced was integral to the maintenance of exercise behaviour.

Other research in this area has highlighted that exercise experience ameliorates the difficulty of planning and scheduling regular exercise behaviour. To illustrate, DuCharme and Brawley, (1995) examined various aspects of self-regulatory efficacy (i.e., scheduling and barrier) on exercise attendance in novice exercisers over a 16-week period. Results demonstrated that both forms of efficacy significantly predicted behavioural intention throughout the exercise program (i.e., weeks 1 and 9), which was subsequently identified as the strongest, then found to be the best predictor of the first two months of attendance. Notably, there was a shift in the contribution to prediction noted at week 9, whereby scheduling efficacy explained more of the variance in behavioural intention than did barrier efficacy.

Self-regulatory efficacy has been further examined in the exercise domain in terms of its ability to discriminate between individuals as a function of their physical activity levels. A shift in the results demonstrated that the difficulty of planning and scheduling regular exercise becomes clear after gaining exercise experience. Additionally, in a study conducted by Rodgers and Sullivan (2001), it was demonstrated that scheduling and coping (i.e., self-regulatory) efficacy better discriminated between active and inactive individuals than did task self-efficacy among adults. Hence, findings from this study offered support for the contention that coping self-efficacy (i.e., barrier and scheduling) would play a central role in the maintenance of exercise behaviour (Rodgers et al., 2002). More specifically, results identified that coping and scheduling efficacy accounted for three times more response variance (i.e., 21 percent) in self-reported exercise behaviour between active and sedentary individuals than did task self-efficacy (i.e., 7 percent). Findings suggested that coping and scheduling efficacy are more important in the prediction of regular exercise behaviour. Rodgers et al. (2002) examined whether two different types of self-efficacy (i.e., task and scheduling self-efficacy) differentially influenced exercise intentions and behaviour. Findings suggested that task efficacy was strongly related to behavioural intention, and scheduling efficacy to exercise behaviour.

Finally, self-efficacy constructs have also been explored in relation to exercise dose. Rodgers, Blanchard and colleagues (2002) examined the pattern of psychological adaptations (i.e., task, scheduling, and coping self-efficacy) to exercise bouts differing in *frequency* and *intensity*. Participants were randomized to one of two 12-week exercise prescriptions: (a) a higher-*intensity*, shorter-*duration* condition, or (b) a lower-*intensity*,

longer- *duration* condition. At the conclusion of the program, significant increases to task and coping efficacy were demonstrated in both groups. Interestingly, participants assigned to the higher-*intensity*, shorter-*duration* group seemed to display an advantage in terms of coping and scheduling self-efficacy.

Although the Health Action Process Approach (HAPA; Schwarzer, 1992) was not a model used as a theoretical approach in the current dissertation it warrants acknowledgment because of its conceptualization of self-efficacies, which are similar to self-regulatory efficacy. The HAPA (Schwarzer, 1992) is a social-cognitive model of health behavior change, whereby health behavior change is viewed as a process consisting of two continuous self-regulatory processes, goal-setting (i.e., motivation) and goal-pursuit (i.e., volition) (Schwarzer, 2008). Self-efficacy is viewed as a crucial component of both intention formation and behaviour change in HAPA (Scholz, Sniehotta, & Schwarzer, 2005). The model contains three types of self-efficacy: (a) task self-efficacy, (b) coping self-efficacy, and (c) recovery self-efficacy. Within HAPA coping self-efficacy is reflected by one's beliefs in their capability to maintain the behavior, regardless of barriers specific to the maintenance period, while recovery self-efficacy is represented by one's beliefs about the ability to resume performing an action after a lapse (Luszczynska, Mazurkiewicz, Ziegelmann, & Schwarzer, 2007).

To date, several studies have explored whether maintenance and recovery self-efficacy are predictors of physical activity behaviour. Scholz, Sniehotta, and Schwarzer (2005) examined the usefulness of the HAPA model at predicting physical exercise of coronary heart disease patients four months after being discharged from a rehabilitation centre. Results confirmed that all the three factors (i.e., planning, maintenance self-

efficacy, and action control) served to mediate between earlier exercise intentions and later physical activity. Luszczynska and Sutton (2006) examined whether maintenance self-efficacy predicts physical activity among individuals who maintain an active lifestyle, as well as whether recovery self-efficacy predicts physical activity among those who relapse. Results found that in the subgroup of participants who maintained regular activity at eight months after myocardial infarction, maintenance self-efficacy predicted physical activity. Finally, Luszczynska et al. (2007) explored whether maintenance and recovery self-efficacy and intention predicted regular running or jogging behaviour over two years. Cross-lagged panel analysis revealed that recovery self-efficacy and intention jointly predicted running/jogging behavior 2 years later. Additionally, results found no effects of maintenance self-efficacy.

The aforementioned studies collectively demonstrate the importance of exploring self-regulatory efficacy when studying exercise adoption and adherence. Moreover, the role of self-regulatory efficacy in the maintenance of physical activity behaviour is further underscored.

Research has also examined the manipulation of self-regulatory efficacy and its influence on exercise behaviour has primarily focused on special populations. For example, Rejeski et al. (2003) conducted a randomized controlled clinical trial with older male and female patients undergoing cardiac rehabilitation. A group-mediated cognitive behavioural intervention was conducted, with a particular focus on the development of multiple self-regulatory skills. Results demonstrated improvements to barrier self-efficacy. Further, correlations suggested that positive changes to barrier efficacy during the last 45 days of treatment were related to positive 12-month changes to physical

activity behaviour (i.e., metabolic equivalents). Woodgate and Brawley (2008) demonstrated that a brief written message was effective in increasing cardiac rehabilitation program participants' scheduling self-efficacy for independent exercise.

In another special population, the effects of a group-mediated cognitive behavioural counseling plus exercise intervention were explored to determine if it was superior to the effects of a standard exercise care condition on postnatal mothers' self-regulatory efficacy, and self-directed physical activity (Cramp & Brawley, 2009). Results indicated that women in the intervention group exhibited success in the maintenance of their reported self-regulatory efficacy beliefs throughout the intervention. By contrast, participants in the standard exercise group reported declines to their efficacy beliefs, which suggested that the intervention might have served as a protective mechanism for efficacy beliefs among these women. Additionally, the group-mediated cognitive behavioural intervention plus exercise groups reported significantly greater time spent engaging in self-directed physical activity at the conclusion of the intensive and home-based phases of the intervention in comparison to the women in the control group. Overall, these studies demonstrated that it is possible to experimentally manipulate self-regulatory efficacy beliefs. Furthermore, positive changes in self-regulatory efficacy appear to be related to increases in physical activity behaviour. Finally, the importance of further exploring the utility of an exercise intervention comprising a self-regulatory component on physical activity behaviour and maintenance is highlighted.

Dissertation Objectives

Given that the adoption of a regular exercise program requires that individuals progress through three sequential phases: (a) increased intention to exercise, (b) initiation and adoption of exercise, and (c) the successful maintenance of the exercise behaviour over time (Estabrooks & Gyurcsik, 2003), these phases were taken into consideration in the objectives of this dissertation. Specifically, this dissertation aimed to examine these sequential phases among relatives of colon cancer patients, among whom the importance of physical activity is particularly critical.

Thus, the general purpose of Study 1 was to examine the effectiveness of an intervention grounded in Protection Motivation Theory (Rogers, 1975; 1983; Rogers & Prentice-Dunn, 1997) that seeks to *change* beliefs towards colon cancer and exercise intentions in inactive first- and second-degree relatives of colon cancer patients.

Using the same participants from Study 1, the objectives of Study 2 were to examine over a 12-week structured and supervised exercise program the: (a) effect of an efficacy intervention on task, barrier, scheduling, goal-setting and relapse prevention efficacy levels, (b) temporal patterns of these efficacious beliefs, (c) effect of an efficacy intervention on objectively measured exercise adherence (i.e., *frequency*, *intensity*, *duration*, and dropout), and (c) ability of proceeding efficacy beliefs (i.e., task, barrier, scheduling, goal-setting and relapse prevention) to predict exercise adherence.

Finally using the same participants from Study 2, the objectives of Study 3 were to examine over a 9-month home-based physical activity program the: (a) effect of a efficacy intervention on task, barrier, scheduling, goal-setting and relapse prevention efficacy, (b) effect of an efficacy intervention on objective physical activity behaviour

(i.e., energy expenditure, sedentary behaviour, light, moderate and vigorous *intensity* activity), and (c) ability of proceeding efficacy variables to predict objective physical activity.

As a final note, the present dissertation was completed using the integrated-article format, whereby each chapter consists of separate manuscripts that focus on distinct yet related research concepts. Specifically, all three studies are designed to increase physical activity behaviour in a population of first- and second-degree relatives of colon cancer patients. Therefore, some of the information presented in the dissertation may be repetitive.

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Study 1

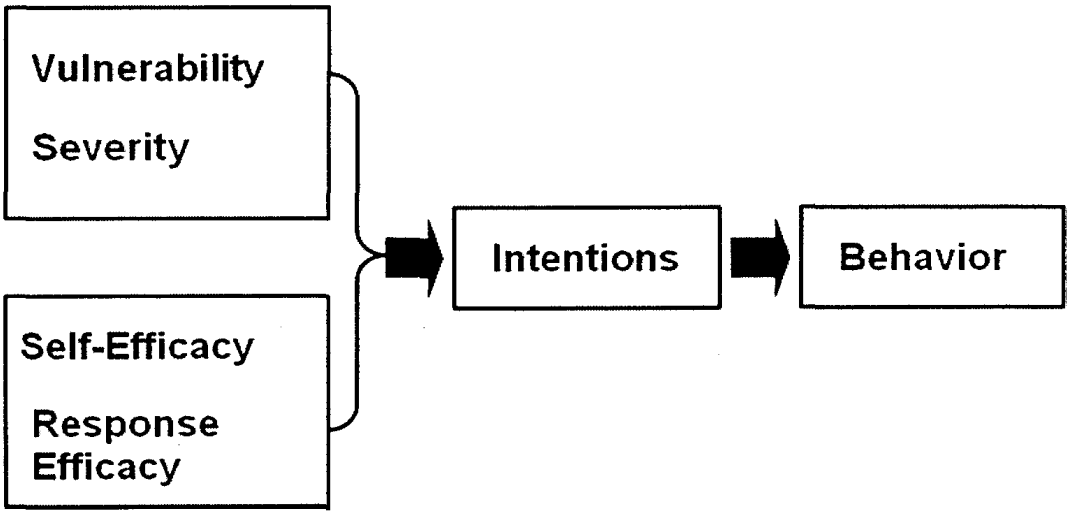
Colon cancer information as a source of exercise motivation for first- and second-degree relatives of colon cancer patients

Worldwide in more developed countries, colorectal cancer is one of the leading causes of cancer related mortality (Quadrilatero & Hoffman-Goetz, 2003). In Canada specifically, during the year 2009, an estimated 22,000 Canadians will be diagnosed with colorectal cancer and 9,100 will die of it making colorectal cancer the second leading cause of death from cancer in Canada (Canadian Cancer Society, 2009). Research has convincingly established that exercise and physical activity are consistently related to a risk reduction of colon cancer (Chao, et al., 2004; Evenson, et al., 2003; Friedenreich & Orenstein, 2002; Gotay, 2005; Lee, 2003; McTiernan, 2003; Quadrilatero & Hoffman-Goetz, 2003). From the studies that have been conducted, the average risk reduction is 40-50%, but may be as high as 70% (Friedenreich & Orenstein, 2002). This inverse relationship between exercise and colon cancer risk relationship still holds after adjusting for confounding variables such as dietary intake or body mass index (Friedenreich & Orenstein, 2002). Possible mechanisms for protection include the positive effect of exercise on insulin, prostaglandin, and bile acid levels, which all influence the growth and proliferation of colonic cells. Additionally, exercise reduces bowel transit time, thus reducing the *duration* of contact between faecal carcinogens and colonic mucosa (Batty, 2000). Given the established protective benefits of exercise for colon cancer, there is a need to develop and test novel, innovative and inexpensive ways to increase the likelihood that people, and in particular those with an elevated risk of colon cancer will adopt healthy exercise patterns. Thus, as relatives of colon cancer patients are at

increased risk for colon cancer (Johns & Houlston, 2001; Keku, et al., 2003) they represent an important target population to get active.

Accordingly, researchers have begun to explore whether information about the protective benefits of exercise for colon cancer can impact an individual's motivation to exercise. To date, two studies have been conducted using Roger's Protection Motivation Theory (Rogers, 1975; 1983; Rogers & Prentice-Dunn, 1997). Protection Motivation Theory is a theoretical framework that was designed to explain health behaviour motivation from a disease prevention perspective (Courneya & Hellsten, 2001), and explains behavioural change in terms of threat (i.e., perceived vulnerability and perceived severity) and coping appraisal (i.e., response efficacy and self-efficacy). Threat appraisal is influenced by: (a) an individual's judgement of the likelihood of developing a particular health condition (i.e., colon cancer; perceived vulnerability); and (b) an individual's judgement of the severity of the consequences of developing the health condition (i.e., perceived severity). While coping appraisal consists of: (a) an individual's belief that the recommended coping response (e.g., exercise) is effective at reducing the risk of the health condition (i.e., response efficacy); and (b) an individual's belief that they can successfully perform the coping response (i.e., self-efficacy). Specifically, Protection Motivation Theory proposes that perceived vulnerability, perceived severity, response efficacy, and self-efficacy, influences an individual's intention (or protection motivation) to perform the health behaviour, and then intention influences actual exercise behaviour (see Figure 1).

Figure 1. Protection Motivation Theory



Courneya and Hellsten (2001) conducted the first study using Protection Motivation Theory to examine whether colon cancer prevention information is a meaningful source of exercise motivation. Participants included 427 male and female undergraduate students who were randomly assigned to read one of 16 persuasive communications that independently manipulated the four Protection Motivation Theory constructs in a high (e.g., 1 in 9 chance of developing colon cancer) or a low fashion (i.e., 1 in 200 chance of developing colon cancer). Results demonstrated that participants were more motivated to exercise if they were led to believe that colon cancer was a severe disease and that exercise was an effective means of reducing the risk of developing colon cancer. Despite these promising findings, these results are not generalizable beyond an active, healthy, and young undergraduate population. Additionally, the scripts used were not based on factual colon cancer information, and finally, the primary outcome measure was intention to exercise and not actual exercise behaviour.

To remedy some of the aforementioned limitations, Graham, Prapavessis, and Cameron (2006) examined whether factual colon cancer prevention information could effectively motivate inactive individuals to consider exercising. Male and female teaching and school staff were randomized into one of three treatment conditions: (a) experimental, (b) attention control, and (c) non-contact control. Participants in the experimental group viewed a DVD which presented exercise and colon cancer information that manipulated the four Protection Motivation Theory constructs, while the attention control group viewed a DVD discussing diet and cancer in general. Results indicated that compared to the two control groups, the experimental group scored significantly higher on their overall coping appraisal as well as intentions to exercise. A trend effect in the expected direction also was found for exercise behaviour two weeks following the intervention. In addition, three of the four Protection Motivation Theory constructs were significantly related to exercise intention (perceived severity, response efficacy, and self-efficacy). These findings suggest that a media intervention grounded in theory can influence an individual's intention to exercise, and has a minimal influence on initial exercise behaviour.

The purpose of the current study was to extend the literature by addressing the limitations of the previous research conducted by Courneya and Hellsten (2001) and Graham et al. (2006) by examining the effectiveness of an intervention grounded in Protection Motivation Theory that seeks to *change* beliefs towards colon cancer and exercise and exercise intentions in inactive, first- and second-degree relatives of colon cancer patients. A secondary purpose was to examine which of the four Protection Motivation Theory variables would predict exercise intention. To our knowledge no

study has been designed to examine whether exercise and colon cancer information grounded in Protection Motivation Theory can *change* participants' beliefs and intentions, hence this is a novel component of our study. Additionally, we felt inactive relatives would be a highly receptive audience to Protection Motivation Theory based information on exercise and colon cancer because of their family connection to the disease (Quadrilatero & Hoffman-Goetz, 2003). More specifically, relatives of colon cancer patients are at increased risk for colon cancer (Johns & Houlston, 2001; Keku, et al., 2003). In addition, inactivity is an independent risk factor for the development of colon cancer, and represents a modifiable lifestyle behaviour (Friedenreich & Orenstein, 2002; Lee, 2003; Quadrilatero & Hoffman-Goetz).

It was hypothesized that relatives receiving the Protection Motivation Theory intervention would show higher change scores from baseline in perceived vulnerability, perceived severity, response efficacy, and self-efficacy compared to those not receiving the intervention. Consistent with theory (see Figure 1) it was also hypothesized that all four Protection Motivation Theory constructs would predict exercise intention. However, it is expected that the coping appraisal constructs would have greater predictive ability compared to the threat appraisal constructs (Milne, Sheeran, & Orbell, 2000).

Method

Participants

Participants included 166 inactive male (n = 56) and female (n = 110), first- and second- degree relatives of colon cancer patients who ranged in age from 18 to 62 years (M = 44.5; SD = 8.9). The majority of the participants (89.0%) were first-degree relatives and (95.0%) classified themselves as Caucasian. In order to meet the inactivity eligibility

criteria for this study, participants were screened on the Stage of Exercise Readiness Questionnaire (SERQ; Marcus, Rakowski, & Rossi, 1992- Appendix A). In order for participants to be eligible, they needed to be in the pre-contemplation (1.8%), contemplation (64.5%) or preparation (33.1%) stages according to the Transtheoretical Model (TTM; Prochaska & Veliver, 1997). One participant was in the action stage, and was included in the study as they had just started exercising within the past week.

Development of the Protection Motivation Theory and Other Material

An intervention and an attention control DVD were produced for use in the current study. The intervention DVD was designed to manipulate the four Protection Motivation Theory constructs; perceived vulnerability, perceived severity, response efficacy and self-efficacy. The DVD featured three medical oncologists from local cancer centers. The oncologists presented factual information regarding an individual's perceived vulnerability (e.g., "it [colon cancer] is the fourth most common cancer, but unfortunately it is the second most lethal..."), and the perceived severity of developing colon cancer (e.g., "there are several [treatment options] and they really fall into three groups: surgery, chemotherapy, and radiation"). A senior academic in the Kinesiology department from the University was enlisted to present information on the links between exercise and colon cancer ("... in fact, one can reduce at least statistically one's risk of developing colon cancer by about 50% it appears through exercise programs..."- response efficacy), as well as to provide some tips on how to increase one's self-efficacy to engage in exercise ("write these activity goals out and put reminders around the house..."- self-efficacy). The viewing time of the DVD was approximately 15-minutes.

Video format was chosen as it ensures that the content is standardized, and covers a broad range of literacy levels (Meade, 1996).

The attention control DVD featured two dieticians who provided information on the links between diet and cancer in general. The DVD was designed to help distinguish the effect of the intervention from the non-specific effect of receiving comparable attention. The attention control DVD was approximately 15-minutes in length.

Measures

Beliefs towards Colon Cancer and Exercise Questionnaire. The Beliefs towards Colon Cancer and Exercise Questionnaire is a 16-item measure, containing four items for each of the Protection Motivation Theory constructs; perceived vulnerability, perceived severity, response efficacy and self-efficacy (see Appendix B). The questionnaire has been used in the Protection Motivation Theory literature by Courneya and Hellsten (2001), and Graham et al. (2006). The items are rated on a seven-point likert scale, ranging from 1= "strongly disagree" to 7 = "strongly agree". Sample items related to colon cancer include: "Personally, I feel vulnerable to developing colon cancer at some point in my life" (i.e., perceived vulnerability); "I feel colon cancer would be a very serious illness for me to develop" (i.e., perceived severity); "I feel that physical exercise would help me to personally reduce my risk of colon cancer" (i.e., response efficacy). Finally, SE was assessed by using four items rated on a seven-point likert scale. These items have been used by other researchers (Courneya & Hellsten, 2001; Graham, Prapavessis, & Cameron, 2006). A sample item is "If I wanted to I could easily do the types and amount of physical exercise necessary to reduce my risk of colon cancer". The

subscales all demonstrated acceptable levels of internal consistencies ranging from .73 to .88 for pre- and .76 to .85 for post-DVD measures.

To provide support for the factor structure and composition of the beliefs towards exercise and colon cancer questionnaire a confirmatory factor analysis (CFA) was conducted. To accurately assess the fit of the model, both absolute and incremental fit indices were examined. The results showed that for the absolute fit indices the pre- and post-DVD chi-square was χ^2 (98, N= 166) = 181.18, p = .001 and χ^2 (98, N= 166) = 158.44, p = .001[2], while RMSEA was .07 and .06 for pre- and post-DVD respectively. All of the incremental fit indices demonstrated an adequate fitting model (IFI Pre-DVD = .94, IFI Post-DVD = .95; CFI Pre-DVD = .94, CFI Post-DVD = .94). Taken together, the results support the tenability of a 16-item four-factor model.

Exercise Intentions. Exercise intentions were assessed using three-items which are commonly used in the Protection Motivation Theory literature and were used by Courneya and Hellsten (2001) and Graham et al. (2006) to evaluate intentions to exercise (see Appendix B). The items are rated on a seven-point likert scale, ranging from 1 = "extremely unlikely" to 7 = "extremely likely". The scale demonstrated acceptable levels of internal consistency for pre- (α = .73) and post-DVD (α = .81) assessments.

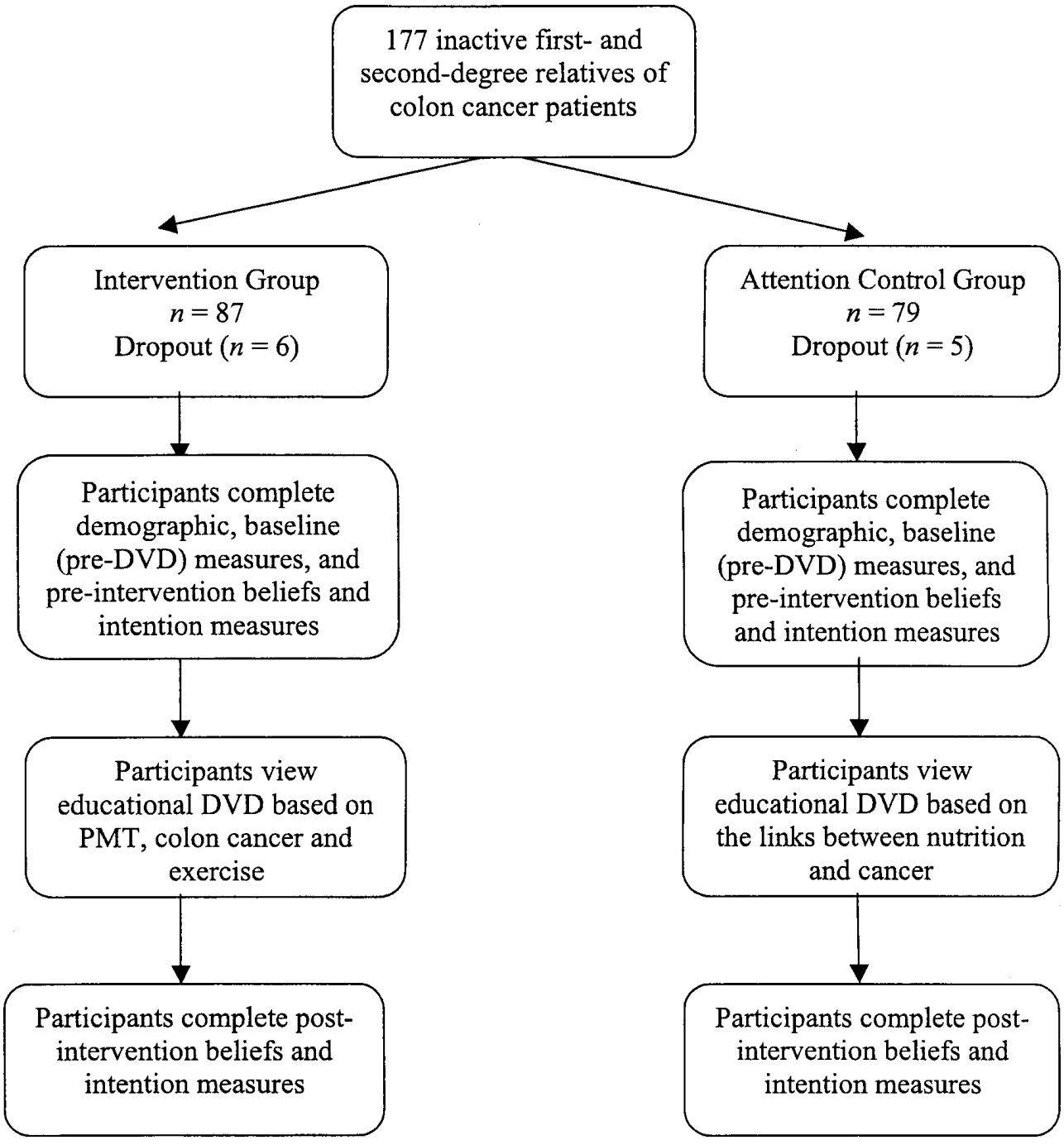
Procedure and design

Ethical approval was obtained by the host institution's ethics committee prior to recruiting participants. A two-group randomized control design was used. Participants were recruited through newspaper, online and radio ads, posters and from the Ontario Familial Colorectal Cancer Registry (http://www.phac-aspc.gc.ca/publicat/cdic-mcc/21-

[2] A non-significant Chi-square is desired but it is difficult to achieve with a larger sample size (Hu & Bentler, 1995).

2/f_e.html). Interested participants were asked to contact the principal investigator for further details about the research study. Once participants agreed to take part in the study, they were scheduled in for an initial meeting where consent (Appendix C) and baseline (pre-DVD) demographic information (i.e., age, gender, stage of exercise readiness, etc.) was obtained (Appendix D). Additionally, participants' beliefs towards colon cancer and exercise and exercise intentions were collected. One week following the initial meeting, participants returned to view either the intervention or attention control DVD. The DVDs were presented to participants in groups that ranged in size from 2 to 8 participants. Immediately following the viewing, participants were asked to complete the post-DVD questionnaire package, which contained the beliefs towards colon cancer and exercise questionnaire and exercise intention measure. Once participants completed the questionnaires they were thanked for their participation and the questionnaires were collected. The overall design of the study can be seen in Figure 2.

Figure 2. Flow diagram of design and overall procedure



Results

Group equivalency

Chi-square and one-way ANOVA procedures were used to test for group equivalency between the two treatment groups on demographic characteristics as these factors may influence beliefs about exercise and colon cancer and exercise intentions. As can be seen in Table 1 there was group equivalency across all demographic variables.

Correlations

Correlations were also conducted to examine the relationships among the demographic variables (i.e., age, BMI, gender, education level, ethnicity, stage of exercise readiness), the Protection Motivation Theory variables and exercise intentions. Gender was mildly positively correlated with stage of exercise readiness ($r = .19, p < .001$), baseline intention ($r = .14, p < .05$) and post-DVD vulnerability ($r = .13, p < .05$). Age demonstrated a small negative correlation with education level ($r = -.12, p < .05$), and with baseline response efficacy ($r = -.13, p < .05$). Education showed small positive relationships with baseline perceived severity ($r = .13, p < .05$) and baseline response efficacy ($r = .15, p < .05$). Stage of exercise readiness showed a small negative correlation to BMI ($r = -.28, p < .001$). Finally, BMI was mildly negatively correlated to baseline self-efficacy ($r = -.21, p < .001$).

Table 1.

Demographic characteristics for the two treatment conditions.

Variable	Intervention ($n = 87$)	Attention Control ($n = 79$)	Statistic	p-level
Age (years)	M= 44.55 (SD= 9.43)	46.05 (8.47)	$F(1, 166) = 1.51$	0.29
Education Level				
High School	17.2%	21.5%	$\chi^2(4, N=166) = 1.64$	0.80
College	41.4%	32.9%		
University- Bachelor	29.9%	30.4%		
University- Masters	10.3%	13.9%		
University- Ph.D.	1.1%	1.3%		
BMI	M= 29.89 (SD= 5.95)	28.84 (6.80)	$F(1, 166) = 1.11$	0.29
Ethnicity				
Caucasian	93.1%	98.7%	$\chi^2(4, N=166) = 3.48$	0.32
Native	1.1%	0.0%		
Hispanic	1.1%	0.0%		
Other	4.6%	1.3%		
Gender				
Male	31.0%	36.7%	$\chi^2(1, N=166) = 0.60$	0.44
Female	69.0%	63.3%		
Stage of Exercise Readiness				
Precontemplation	1.1%	2.5%	$F(1, 166) = 0.47$	0.49
Contemplation	67.8%	60.8%		
Preparation	31.0%	35.4%		
Action	0.0%	1.3%		

Descriptive Statistics for Protection Motivation Theory constructs and exercise intentions

Table 2 represents the descriptive statistics for the Protection Motivation Theory and exercise intention constructs.

Table 2.

Descriptive statistics for the Protection Motivation Theory variables and exercise intentions.

	Intervention Group (*n*)		Attention Control Group (*n*)	
	Mean	SError	Mean	SError
	Baseline/ Pre-DVD Intervention			
Vulnerability	5.13	.12	5.18	.12
Severity	6.00	.11	6.17	.10
Self-Efficacy	5.14	.10	5.22	.09
Response Efficacy	5.34	.11	5.54	.11
Intention	6.36	.07	6.55	.07
	Post-DVD Intervention			
Vulnerability	5.48	.10	5.18	.11
Severity	6.27	.09	6.29	.08
Self-Efficacy	5.36	.11	5.12	.10
Response Efficacy	6.18	.07	5.79	.09
Intention	6.57	.06	6.55	.06

SError- Standard error
Notes: Intervention (Protection Motivation Theory information); attention control (non-Protection Motivation Theory information)

Beliefs towards colon cancer and exercise

Separate 2 (treatment group) x 2 (time-pre/post DVD) repeated measures ANOVAs were conducted to examine for interaction effects for the Protection Motivation Theory constructs. For perceived vulnerability, results revealed a significant interaction effect F (1, 164) = 11.03, $p < .001$, $\eta^2 = .06$. The Protection Motivation Theory intervention group's score increased significantly ($p < .001$, $\eta^2 = .19$) from pre-to post DVD while the attention control group's score remained stable ($p = .930$, $\eta^2 = .00$). For response efficacy, results showed a significant interaction effect F (1, 164) = 21.40, $p < .001$, $\eta^2 = .12$. The Protection Motivation Theory intervention group's score increased significantly ($p < .001$, $\eta^2 = .43$) from pre- to post-DVD, while the attention control group's score also increased significantly ($p < .001$, $\eta^2 = .14$). For self-efficacy, results demonstrated a significant interaction effect F (1, 164) = 8.10, $p < .005$, $\eta^2 = .05$. The Protection Motivation Theory intervention group's score increased significantly ($p < .01$, $\eta^2 = .11$) from pre-to post DVD while the attention control group's score decreased ($p = .18$, $\eta^2 = .02$). Only a significant time effect F (1, 164) = 12.63, $p < .001$, $\eta^2 = .07$ was evident for perceived severity, as both groups' scores on severity increased from pre- to post-DVD.

Exercise Intentions

A 2 (treatment group) x 2 (time-pre/post DVD) repeated measures ANOVA revealed a significant interaction effect for exercise intention, F (1, 164) = 5.55, $p < .05$, $\eta^2 = .03$. Post hoc tests showed that the Protection Motivation Theory intervention group's score significantly increased ($p < .005$, $\eta^2 = .10$) from pre- to post-DVD, while the attention control group's score remained stable ($p = .94$, $\eta^2 = .00$).

Relationships between Protection Motivation Theory constructs and exercise intentions

Zero-order correlations between the Protection Motivation Theory variables and exercise intention are presented in Table 3. If relations were found between the predictor variables (i.e., Protection Motivation Theory) and the criterion variable (i.e., intention) of interest they were then entered into a regression analysis to determine their uncorrelated contribution.

Table 3.

Inter-correlations for the Protection Motivation Theory variables and exercise intentions.

	1	2	3	4	5	6	7	8	9	10
1. Pre Vulnerability	-	.33**	.08	-.01	.08	.79**	.26**	-.01	-.05	.10
2. Pre Severity		-	.30**	-.12	.18**	.29**	.69**	.02	-.02	.21**
3. Pre Response Efficacy			-	.29**	.39**	.12	.47**	.48**	.32**	.43**
4. Pre Self-Efficacy				-	.32**	.03	.06	.17**	.63**	.39**
5. Pre Intention					-	.14*	.24**	.21**	.25**	.59**
6. Post Vulnerability						-	.29**	.18**	.05	.22**
7. Post Severity							-	.23**	.09	.33**
8. Post Response Efficacy								-	.37**	.47**
9. Post Self-Efficacy									-	.52**
10. Post Intention										-

** $p < .001$, * $p < .05$

Predicting Exercise Intentions

For the pre-DVD intervention period intention was related to perceived severity, response efficacy, and self-efficacy but not to perceived vulnerability. When these three constructs were entered together into a standard multiple regression, response efficacy and self-efficacy made significant and unique contributions to predicting exercise intention, explaining 21.4% of the response variance (Table 4).

Table 4.

Predicting baseline (pre-DVD intervention) exercise intentions.

	B	t	R	R^2
			.46**	.21**
Severity	.12	2.05		
Self-Efficacy	.26**	4.35**		
Response Efficacy	.28**	4.59**		

$^{**}p < .001$

For the post-DVD intervention period all four Protection Motivation Theory constructs showed an association with intention. The regression analysis showed that self-efficacy, response efficacy and perceived severity made significant and unique contributions to predicting exercise intentions, explaining 43.0% of the response variance (Table 5).

Table 5.

Predicting post-DVD intervention exercise intentions.

	B	t	R	R^2
			.66**	.43**
Vulnerability	.10	1.63		
Severity	.20*	3.12*		
Self-Efficacy	.42**	6.71**		
Response Efficacy	.28**	4.32**		

$^{**}p < .001$; $^{*}p < .05$

Discussion

Our results support the notion that colon cancer information is a meaningful source of exercise motivation for first- and second-degree relatives of colon cancer patients. As hypothesized, the Protection Motivation Theory intervention developed for this study was effective in *changing* participants' threat (i.e., perceived vulnerability) as well as coping appraisal (i.e., response efficacy and self-efficacy). Specifically, the Protection Motivation Theory intervention group believed that they were more vulnerable to developing colon cancer and they also felt that they had greater coping resources to reduce the threat compared to the attention control group. Cohen (1988) recommended using the following values to interpret the strength of the effect .01 small, .06 medium and .14 large. Effect sizes using these criteria indicate that the effect for response efficacy was large whereas the effect for perceived vulnerability and self-efficacy was medium. This finding is in line with the majority of Protection Motivation Theory research (Floyd, Prentice-Dunn, & Rogers, 2000).

The attention control and the intervention group did not differ on their appraisal of the severity of colon cancer (i.e., perceived severity). The failure of our Protection Motivation Theory intervention to manipulate perceived severity may have been due to the fact that all participants had loved ones who had battled colon cancer, and thus, they were already aware of the seriousness of the disease. Additionally, as our sample was middle aged they may have been more aware of the severity of cancer as age is a risk factor for developing the disease (Canadian Cancer Society, 2009). Finally, a ceiling effect may have been operating as means scores for perceived severity were high (see Table 2), and thus this may have influenced the impact of the perceived severity material. Our failure to manipulate perceived severity is in line with the Graham et al. (2006) study, as they also did not manipulate perceived severity. However, the Courneya and Hellsten (2001) study was able to manipulate perceived severity, but this may have been due to the fact that they were presenting false cancer information.

Of the four Protection Motivation Theory constructs, perceived vulnerability and self-efficacy scores were the lowest irrespective of treatment condition (see Table 2). Lower perceived vulnerability scores may have been due to protective denial whereby participants discount the threat of developing a disease in order to protect themselves (cf. Wiebe & Korbel, 2003). Although the self-efficacy scores appear to be lower they were consistent with scores obtained by Graham et al. (2006). A possible reason for lower scores on the self-efficacy construct may have been due to the fact that participants were inactive and did not feel confident in their ability to engage in exercise. Another plausible reason is that the Protection Motivation Theory intervention material may not have strongly influenced participants' self-efficacy levels.

As hypothesized, the Protection Motivation Theory intervention was shown to be effective at *changing* participants' exercise intentions. Specifically, the Protection Motivation Theory intervention group scores on intentions to exercise increased from pre- to post-DVD intervention, while the attention control group scores remained stable across both time points. It should be acknowledged that the effect on exercise intention was small.

With respect to predicting exercise intentions, two of the four Protection Motivation Theory constructs (i.e., response efficacy and self-efficacy) made significant and unique contributions to pre-DVD intention scores, explaining 21.4% of the response variance. Of the two constructs, response efficacy had the strongest relationship with exercise intentions. Three of the four Protection Motivation Theory constructs (i.e., self-efficacy, response efficacy, and perceived severity) made significant and unique contributions to post-DVD exercise intentions score, explaining 43.0% of the response variance. Of the three constructs, self-efficacy made the strongest contribution, followed closely by response efficacy and then perceived severity to post-DVD exercise intentions. These results clearly demonstrate the importance of coping appraisal on exercise intentions, which is in line with the Milne, Sheeran, and Orbell (2000) meta-analysis on Protection Motivation Theory research. The fact that the amount of explained variance was doubled from pre- to post DVD provides further evidence for the successful manipulation of the Protection Motivation Theory constructs through the intervention.

Even though the findings from the current study are promising, this study is not without its limitations. The main limitation of the current study is the failure of our Protection Motivation Theory intervention materials to successfully manipulate perceived

severity. This is problematic, as all components of the Protection Motivation Theory framework need to be manipulated to adequately test its ability to facilitate exercise intentions and exercise behaviour through colon cancer prevention information. Another limitation is that the sample of males was considerably smaller than the sample of females. A larger sample of males would have allowed us to examine our data across gender. Additionally, the sample was comprised of mostly first-degree relatives of colon cancer patients. A comparable sample of second-degree relatives would also have allowed us to examine our data across familial history. A fourth and final limitation is that the results are not generalizable beyond first- and second-degree relatives of colon cancer patients.

Study 1 represents an initial attempt aimed at influencing exercise intention through Protection Motivation Theory (Rogers, 1975; 1983; Rogers & Prentice-Dunn, 1997), however this represents only the first step as the adoption of a regular exercise program which requires that individuals' progress through three sequential phases: (a) increasing intention to exercise, (b) initiation and adoption of exercise, and (c) the successful maintenance of the exercise behaviour over time (Estabrooks & Gyurcsik, 2003). Thus, the participants from the current study became involved in a larger trial that was designed to address each of the three sequential phases. Specifically, following the completion of the current study (Study 1), participants moved into a self-efficacy intervention designed to encourage them to adopt and maintain regular exercise over a 12-week structured facility-based exercise program (Study 2) and subsequent 9-month home-based physical activity program (Study 3). In order to effectively explore the adoption and maintenance of exercise behavior (Study 2 and 3) a stronger theoretical

perspective of behaviour change was needed such as self-efficacy, which is grounded in Social Cognitive Theory (Bandura, 1986). There is no doubt that experiential evidence establishing that exercise can be increased and maintained is essential before longitudinal prospective studies can be conducted to evaluate the protective benefits of exercise and physical activity against colon cancer.

In the present study no measure of initial exercise behaviour was included because it would have been impossible to disentangle the effects of the Protection Motivation Theory and the new self-regulation intervention on subsequent exercise behaviour. Based on previous work (Graham et al., 2006), it is unlikely that the Protection Motivation Theory intervention would have influenced (increased) exercise behaviour much beyond one to two weeks post-treatment.

In conclusion, the results of the present study demonstrate that a single exposure media intervention grounded in a Protection Motivation Theory framework is effective in changing relatives' exercise and colon cancer beliefs, as well as changing their exercise intentions. The results also show that the best predictors of exercise intentions are the coping appraisal constructs response efficacy and self-efficacy.

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Study 2

The Utility of an Efficacy Intervention on Exercise Adherence in Relatives of Colon Cancer Patients

Substantial evidence exists establishing that regular exercise and physical activity provides meaningful health benefits. Specifically, higher levels of physical activity have been associated with a reduced risk of cardiovascular disease, type 2 diabetes mellitus, obesity, certain cancers (e.g., colon and breast), as well as some mental health issues (Bauman, 2004). However, despite the well-established benefits of physical activity and exercise, at least 60% of the world's population fails to engage in the recommended amount of physical activity required to produce these health benefits (World Health Organization, 2009). Additionally, of the individuals who start an exercise program 50% of the individuals will dropout within the first year (ACSM, 2006), demonstrating the importance of understanding the motives that underpin the adoption and maintenance of healthy exercise patterns.

Regular exercise participation is a complex process that Social Cognitive Theory (Bandura, 1986) suggests requires overcoming challenges and obstacles, requiring both self-efficacy and self-regulatory efficacy. More specifically, Bandura (2004) suggests that changing complicated behaviours requires self-regulatory skills. Self-efficacy reflects one's beliefs in one's capabilities to manage and complete actions required to produce given attainments (Bandura, 1997). Self-efficacy is a determinant of exercise and physical activity behaviour and adherence (Bandura, 1986, 1997), and has been shown to play a central role in the adoption and maintenance of physical activity in structured exercise programs (McAuley & Blissmer, 2000).

Much of the efficacy-related research in exercise psychology has focused on exploring task efficacy (Culos-Reed et al., 2001; McAuley & Mihalko, 1998). The focus on task efficacy in the exercise domain is unfortunate, as the importance of self-regulatory skills in the health behaviour change process has been underscored by both Bandura (1995, 2004) and Kirsch (1995). Additionally, Maddux (1995) suggests that self-regulatory efficacy is more fundamental than task efficacy for most daily activities. Self-regulation reflects self-generated thoughts, feelings, and actions, which are systematically oriented towards attaining goals (Maddux & Gosselin, 2003). For exercise and physical activity behaviour, self-regulatory skills are necessary, as the goal of exercise and physical activity promotion is to help people to exercise regularly (Rodgers et al., 2002). More specifically, to successfully adopt and maintain an exercise program, one needs to have high efficacious beliefs in one's capabilities to effectively schedule exercise sessions into daily routines (i.e., scheduling efficacy), to overcome exercise barriers (i.e., barrier efficacy), set and adapt exercise goals (i.e., goal-setting efficacy), and address and recover from exercise relapses (i.e., relapse prevention efficacy).

With these recommendations, and that self-regulatory skills are essential to health behaviour change, further aspects of self-regulatory efficacy are being explored in the physical activity and exercise domain. However, to date, much of the self-regulatory efficacy research has examined barrier and scheduling efficacy (e.g., DuCharme & Brawley, 1995; Rodgers, et al., 2002), with barrier efficacy being the most widely studied component and operationalization of self-regulatory efficacy (Woodgate, 2005). The operationalization should be modified to encompass self-regulatory efficacy's multifaceted nature (Woodgate, 2005).

Empirical evidence has demonstrated that self-regulatory efficacy is related to physical activity and exercise behaviour (e.g., Bray, et al., 2001; Cramp & Brawley, 2009; DuCharme & Brawley, 1995; Poag-Ducharme & Brawley, 1993; Poag & Brawley, 1992; McAuley, Pena, & Jerome, 2001; Rejeski et al., 2003; Rodgers et al., 2002; Rodgers, Blanchard, et al., 2002; Rodgers, Munroe et al., 2002; Rodgers & Sullivan, 2001; Woodgate, 2005; Woodgate & Brawley, 2008). Empirical support has explored two primary research directions: (a) the predictive ability of self-regulatory efficacy in physical activity behaviour, and (b) the effects on exercise behaviour following the experimental manipulation of self-regulatory efficacy.

Several studies demonstrated that components of self-regulatory efficacy are predictive of exercise intention and behaviour (e.g., Bray, et al., 2001; Ducharme & Brawley, 1995; Poag & Brawley, 1992; Rodgers, Blanchard, et al., 2002; Rodgers et al., 2002; Rodgers & Sullivan, 2001). Additionally, research has examined the manipulation of self-regulatory efficacy and its influence on exercise behaviour (e.g., Cramp & Brawley, 2009; Rejeski et al, 2003; Woodgate & Brawley, 2008). Overall, these studies demonstrate that it is possible to experimentally manipulate self-regulatory efficacy beliefs, and that positive changes in self-regulatory efficacy appears to be related to increases in physical activity behaviour. The results of the aforementioned studies demonstrate the importance of further exploring the utility of an exercise intervention comprising a self-regulatory component on physical activity behaviour and maintenance.

The issues highlighted demonstrate the importance of exploring task and self-regulatory efficacy relationship with adherence to a structured exercise program. Thus, the objectives of the present study were to extend the current literature by: (a) testing the

utility of an efficacy intervention on task and self-regulatory (i.e., barrier, scheduling, goal-setting and relapse prevention) efficacy levels, (b) examining the temporal patterns of these efficacious beliefs, (c) testing an efficacy intervention's influence on objectively measured exercise adherence (i.e., *frequency*, *intensity*, *duration*, and dropout), and (d) examining the ability of efficacy to predict exercise adherence. Relatives of colon cancer patients who participated in Study 1 were chosen as the population of interest as colon cancer can be a genetic disease (Quadrilatero & Hoffman-Goetz, 2003). In addition, inactivity is an independent risk factor for the development of colon cancer, and represents a modifiable lifestyle behaviour (Quadrilatero & Hoffman-Goetz; Friedenreich & Orenstein, 2002; Lee, 2003).

It was hypothesized that relatives receiving the efficacy intervention would have higher task and self-regulatory (i.e., barrier, scheduling, goal-setting and relapse prevention) efficacy scores compared to the attention control condition. It also was hypothesized that only those in the efficacy intervention condition would show systematic increases in both task and self-regulatory efficacy. It was further hypothesized that relatives receiving the efficacy intervention would exercise with greater *frequency*, at a higher *intensity*, and for longer *duration* compared to those in the attention control condition. In addition it was hypothesized that those receiving the efficacy intervention would not dropout to the same extent as those in the attention control condition. It was finally hypothesized that the proceeding efficacy variables would predict objectively measured exercise adherence. Underscoring the need for scale congruence between the measures of efficacy and exercise adherence (Maddison & Prapavessis, 2004), it was anticipated that task efficacy would show a strong relationship

to both *intensity* and *duration* whereas self-regulatory efficacy would show a strong relationship to *frequency*. As proposed by Rodgers et al. (2002) it was expected that task efficacy would be required for the initiation of exercise behaviour and self-regulatory efficacy required for the maintenance of behaviour.

Method

Participants

Participants included one hundred and forty inactive first- and second-degree relatives of colon cancer patients from Study 1. Demographic characteristics for the sample are presented in Table 1.

Task and Self-Regulation Efficacy Measures

The following task and self-regulatory efficacy measures (i.e., barrier, scheduling, goal-setting, and relapse prevention) were rated on a scale from 0% (no confidence at all) to 100% (completely confident). To score the scales, mean efficacy values for each scale were calculated by summing items and dividing by the total number of items. Higher scores reflected greater efficacy, while lower scores represent lower efficacy levels (see Appendix E for all efficacy scales).

Task Efficacy. Task efficacy was assessed using the Self-Efficacy Scale (adapted from McAuley & Mihalko, 1998). The scale assesses participants' confidence on a scale about exercising for increasing *duration*s (i.e., 20, 30, 40, 50) at varying intensities (i.e., easy, moderate, hard). Instructions and examples were provided that defined the various *intensity* levels. A sample item from the scale is "I believe that I can exercise for 20 minutes at an easy effort without stopping". Cronbach alpha values demonstrated

reliable internal consistencies for all assessment points (α = .96 at baseline; α = .93 at week 4; α = .89 at week 8; and α = .91 week at 12).

Barrier Efficacy. Barrier efficacy was assessed using the Barriers Efficacy Scale (McAuley & Mihalko, 1998). Participants rated their confidence to overcome 12 common exercise barriers (e.g., bad weather, exercise was not enjoyable or fun). An example item from the scale is "I believe that I can exercise three times per week if the weather is very bad (i.e., hot, humid, rainy, snow, cold)". Cronbach alpha vales were adequate and demonstrated reliable internal consistencies for all assessment points (α = .90 at baseline; α = .92 at week 4; α = .90 at week 8; and α = .93 week at 12).

Table 1

Demographic characteristics for the two treatment conditions.

Variable	Intervention (n = 75)	Attention Control (n = 65)	Statistic	p-level
Age (years)	M= 44.25 (SD= 9.27)	46.98 (8.02)	$F(1, 140) = 3.23$	0.08
Relative Status				
First-Degree	88.0%	89.2%	$\chi^2(1, N=140) = 0.5$	0.82
Second-Degree	12.0%	10.8%		
Education Level				
High School	17.3%	21.5%	$X^2(4, N=140) = 1.14$	0.89
College	41.3%	33.8%		
University- Bachelor	29.3%	29.2%		
University- Masters	10.7%	13.8%		
University- Ph.D.	1.3%	1.5%		
Ethnicity				
Caucasian	94.7%	98.5%	$\chi^2(4, N=140) = 1.66$	0.44
Native	1.3%	0.0%		

Other	4.0%	1.5%		
Gender				
Male	26.7%	32.3%	$\chi^2(1, N=140) = 0.54$	0.46
Female	73.3%	67.7%		
Stage of Exercise Readiness				
Precontemplation	1.3%	1.5%	$F(1, 140) = 1.08$	0.30
Contemplation	68.0%	60.0%		
Preparation	30.7%	36.9%		
Action	0.0%	1.5%		

Scheduling Efficacy. Scheduling self-efficacy was assessed using a seven-item measure, which assessed participants' confidence in their ability to perform various scheduling tasks that would enable them to exercise regularly in the weeks ahead (DuCharme & Brawley, 1995; Rodgers et al., 2002; Woodgate, 2005; Woodgate & Brawley, 2008). When completing the scale, participants were instructed to consider their confidence to engage in these scheduling and organizational behaviours over the next 12 weeks. A sample item related to participants' confidence to "organize time and responsibilities around each exercise session during the next 12 weeks no matter what". The internal consistencies for the scale were good for all assessment points ($\alpha = .89$ at baseline; $\alpha = .93$ at week 4; $\alpha = .93$ at week 8; and $\alpha = .93$ week at 12).

Goal-Setting Efficacy. Goal-setting efficacy was assessed using a four-item measure that assessed participants' confidence regarding their exercise goal-setting ability (Brawley Rejeski, Angove, & Fox, 2003; Dawson & Brawley, 2000; Woodgate, 2005). A sample item related to participants' confidence to "set realistic goals for maintaining my exercise". The internal consistencies for the scale in the present study at

all assessment points were acceptable (α = .90 at baseline; α = .94 at week 4; α = .94 at week 8; and α = .85 week at 12).

Relapse Prevention Efficacy. Relapse prevention (Woodgate, 2005) efficacy was assessed using a seven-item measure, which assessed participants' confidence to deal with lapses in their exercise program. A sample item from the scale was, "identify the key factors that trigger lapses in my exercise program". The scale demonstrated acceptable levels of internal consistencies for all assessment points (α = .77 at baseline, α = .88 at week 4, α = .86 at week 8, and α = .91 week at 12).

Exercise Behaviour

Adherence to the exercise program was assessed using objective dose *frequency*, *intensity*, and *duration* data. Exercise *frequency* was evaluated using attendance records, where participants signed in before each exercise session. A dropout was also calculated from these *frequency* data. This was operationalized as participants who did not exercise for 6 consecutive weeks. Exercise *intensity* was assessed using exercise heart rates. Information on exercise heart rates was obtained using the Polar RS 400 heart rate monitor. The monitor was set-up to record minute-by-minute heart rate data while participants exercised, and was downloaded using Polar ProTrainer 5.0 software following every exercise session. Finally, exercise *duration* was determined through participants' recording the amount of time they spent exercising on each piece of exercise equipment (e.g., treadmill- 20 minutes) for each session. The amount of time recorded was cross-referenced with the information saved on the polar watch to ensure accuracy. For each dose measure, a cumulative score was computed for the following time points: weeks 0-4; weeks 5-8; and weeks 9-12.

Exercise Program

The 12-week structured exercise program was designed for inactive adults and employed cardiovascular exercise (e.g., walking, biking). Participants were encouraged to follow the ACSM/CDC (2009) guidelines, which recommend exercising 5 days a week at a moderate intensity for 30 minutes. However, at a minimum participants were instructed to exercise at least three-times a week in the exercise laboratory. At the beginning of the exercise program participants were given an exercise prescription (see Appendix F). The exercise prescription provided participants with personalized heart rate ranges as well as goals to attain at each exercise session (i.e., number of minutes to attain in their target heart rate zone and exercise *duration*) and increased. These specific exercise guidelines progressed as participants became fitter and acclimatized to the exercise program. Progression in *intensity* (i.e., heart rate ranges), minutes spent in target heart rate zone and exercise *duration* occurred at weeks 3 and 5.

Intervention Sessions

All participants took part in nine classroom sessions that were scheduled over the course of the 12-week structured exercise program. The sessions lasted between 20 to 45 minutes, and were scheduled weekly for the first 4 weeks, bi-weekly from week 6 to 10, and weekly for weeks 11 to 12. All intervention sessions took place in the exercise laboratory. Make-up sessions were scheduled for all participants who missed a classroom session. If possible, the make-up session was scheduled for the same week, to ensure that the classroom material was delivered as intended. Classroom session sizes ranged from three to 10 participants.

Classroom Session Materials

Participants were randomly assigned to one of two treatment conditions, an efficacy (i.e., task and self-regulatory) intervention group or to an attention control (i.e., nutrition) group. The theoretical framework for the content of the intervention material was based on Social Cognitive Theory (Bandura, 1986). Therefore, the primary focus of the intervention was to increase efficacy, both task and self-regulatory efficacy towards exercising using the four primary sources: (a) mastery accomplishments, (b) vicarious experiences, (c) social persuasion, and (d) physiological states. Additionally, the intervention material focused on promoting scheduling, barrier, goal-setting and relapse prevention efficacy.

Information on mastery accomplishments was provided through a detailed exercise log. Participants completed exercise logbooks, where they described their exercise activity (e.g., *duration* of exercise session, kilometers traveled, exercise heart rates, equipment used). Logbooks were reviewed extensively periodically to identify exercise progression (i.e., improvements in *duration* and *intensity* of exercise). Vicarious experience information was provided through detailed discussions of participants personal exercise behaviour as well as through presenting information from exercise experts on how to increase confidence towards exercising. Additionally, as exercisers worked out in a "gym like" environment, vicarious experience took place naturally, as individuals observed other exercisers. Social persuasion information was provided through role playing scenarios as well as by developing "buddy groups". Role playing scenarios involved describing a detailed scenario (e.g., a barrier to exercising) and having participants pair-up and discuss the scenario. One participant was asked to identify with

the scenario and argue as to why the barrier would keep them from exercising, while the other participant's role was to identify all the positives about exercising. For the buddy system, participants formed groups of two or three individuals. Buddy groups were encouraged to discuss exercise goals and schedules, check in regularly, provide encouragement and support and to exercise together (if desired). Finally, for physiological states, participants were taught how to accurately interpret their bodies' responses to exercise (e.g., increased heart rate, burning muscles, fatigue).

The nine intervention classroom sessions were designed to address pertinent exercise issues experienced during the adoption and maintenance of exercise. Sessions one through four were tailored to discuss how to exercise (e.g., principles of exercise, scheduling, overcoming barriers), sessions five through seven discussed maintenance (i.e., how to exercise regularly), while sessions eight and nine discussed transitioning from a supervised exercise program to exercising on your own.

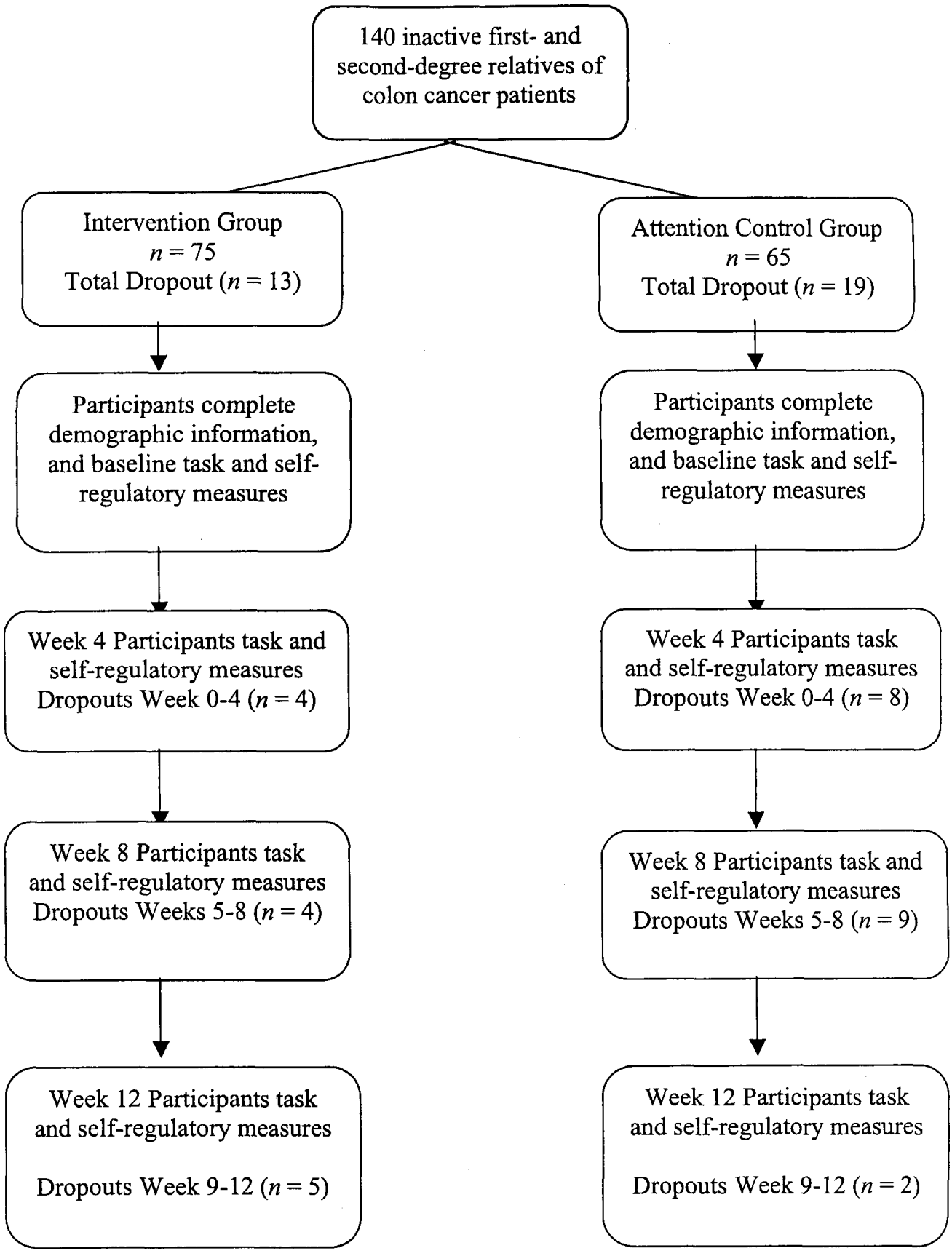
The attention control condition's classroom sessions focused on nutrition related information, and discussed a variety of different topics such as Canada's Food Guide to Health Eating (2007), reading food labels, grocery shopping and cooking tips. Additionally, the attention control participants were encouraged to keep a nutrition logbook. These sessions were identical to efficacy intervention sessions in terms of number and length of sessions as well as to the size of each class (see Appendix G).

Procedure and Design

Ethical approval was obtained by the host institution's ethics committee prior to recruiting participants. Participants were recruited through newspaper, online and radio ads, posters and from the Ontario Familial Colorectal Cancer Registry. Participants who

agreed to take part in the study were randomized to either an efficacy intervention or to an attention control condition. The baseline assessment consisted of a sub-maximal bike fitness test (i.e., Astrand protocol), body composition scan, and completion of a task and self-regulatory efficacy questionnaire. However, only task and self-regulatory efficacy data will be presented here. Self-efficacy and adherence to the exercise program was assessed at weeks 4, 8, and 12, respectively. The overall design of the study, along with attrition for each group at each follow-up can be seen in the flow diagram (see Figure 1).

Figure 1. Flow diagram of design and overall procedure



Results

Treatment of the Data

As attrition is common in longitudinal studies (see Figure 1), an intention-to-treat approach was used to replace missing data to ensure suitable statistical power. More specifically, a last outcome carried forward intention-to-treat analysis was used, as it assumes no change from the previous data point (Shao & Zhong, 2003). Separate two (group) by four (time- baseline, weeks 4, 8, and 12) repeated measures ANOVAs were conducted to examine group differences on task and self-regulatory efficacy (i.e., barrier, scheduling, goal-setting, and relapse prevention). Separate two (group) by three (time- weeks 0-4, 5-8, and 9-12) repeated measures ANOVAs were conducted to examine group differences on exercise adherence (i.e., *frequency*, *intensity*, and *duration*). In addition, dropout behaviour between groups was assessed using a chi-square analysis.

Standard and hierarchical regression analyses were performed to explore which proceeding efficacy variable(s) (i.e., task, barrier, scheduling, goal-setting, and relapse prevention) would predict exercise adherence. It should be noted that efficacy variables assessed during the same week as behavior (e.g., week 4 efficacy and week 4 exercise *frequency*), were not used as proceeding variables. Only efficacy variables that proceeded and showed a significant correlation to exercise adherence were entered into a regression (e.g., week 4 efficacy and baseline efficacy to exercise adherence at week 8). A one-way ANOVA was conducted to compare the effect of dropout behavior on efficacy levels (i.e., task, barrier, scheduling, goal-setting and relapse prevention). Specifically, dropout behavior was explored at week 4, 8 and 12, with proceeding

efficacy variables being entered as the dependant variable (e.g., week 4 dropout behavior and baseline efficacy).

Group Equivalency

Chi-square and one-way ANOVA procedures were conducted to test for group equivalency between the two treatment groups on demographic characteristics as these factors may influence exercise adherence. As can be seen in Table 1 there was group equivalency across all demographic variables.

Correlations were also conducted to examine the relationships among the demographic variables (i.e., age, gender, education level, ethnicity, stage of exercise readiness), the efficacy variables (i.e., task, barrier, scheduling, goal-setting, and relapse prevention), and exercise adherence (i.e., *frequency*, *intensity*, *duration*, and dropout). Age was mildly positively correlated with baseline relapse prevention efficacy ($r = .20, p < .05$), and mildly negatively correlated with education level ($r = -.18, p < .05$). Gender was mildly positively related to stage of exercise readiness ($r = .21, p < .05$), and mildly negatively correlated with baseline task efficacy ($r = -.19, p < .05$), baseline barrier efficacy ($r = -.20, p < .05$), week 4 barrier efficacy ($r = -.20, p < .05$), week 8 barrier efficacy ($r = -.25, p < .05$), and week 12 barrier efficacy ($r = -.21, p < .05$). Gender was also mildly negatively associated with week 8 and week 12 dropout behaviour ($r = -.18, p < .05$; $r = -.21, p < .05$, respectively). Stage of exercise readiness showed a small positive relationship with baseline task efficacy ($r = .24, p < .05$), and week 12 exercise *duration* ($r = .22, p < .05$). Education level was mildly positively related to baseline task efficacy ($r = .20, p < .05$). Finally, relative status was mildly positively associated with baseline

task efficacy ($r = .20, p < .05$), and week 4 task efficacy ($r = .20, p < .05$), while mildly negatively related to age ($r = -.18, p < .05$).

Self-Efficacy Differences

Results showed significant time effects for task efficacy, $F(3, 137) = 30.82, p < .001, \eta^2 = .40$, and for barrier efficacy $F(3, 137) = 14.54, p < .001, \eta^2 = .24$. Both task and barrier efficacy increased across time. A trend effect for scheduling efficacy was noted, $F(3, 137) = 2.10, p < .10, \eta^2 = .05$, with scheduling efficacy decreasing across the exercise program. Non significant time effects were found for goal-setting efficacy, $F(3, 137) = .19, p = .90, \eta^2 = .004$, and relapse prevention efficacy, $F(3, 137) = 1.03, p < .38, \eta^2 = .02$. Specifically, goal-setting scores remained stable, while relapse prevention efficacy slightly increased across the time points. Finally, there were no significant interaction effects for task efficacy $F(3, 136) = 30.25, p < .30, \eta^2 = .03$, barrier efficacy $F(3, 136) = .21, p < .89, \eta^2 = .005$, scheduling efficacy $F(3, 136) = 1.61, p < .19, \eta^2 = .04$, goal-setting efficacy $F(3, 136) = 1.05, p < .37, \eta^2 = .02$, and relapse prevention efficacy $F(3, 136) = 1.03, p < .38, \eta^2 = .02$.

Exercise Adherence Differences

Results showed that there was a significant interaction effect for *duration*, $F(2, 137) = 10.98, p < .01, \eta^2 = .07$, but not for *intensity*, $F(2, 137) = 1.67, p = .19, \eta^2 = .02$ and *frequency*, $F(2, 137) = 1.79, p = .17, \eta^2 = .03$. Planned comparisons test for *duration* showed that early in the exercise program (i.e., 0 to 4 weeks) the efficacy intervention group exercised significantly longer $F(1, 138) = 1.98, p = .02$ than their attention control counterpart. Significant time effects were noted for *intensity*, $F(2, 137) = 130.47, p < .001, \eta^2 = .66$, and *frequency*, $F(2, 137) = 15.45, p < .001, \eta^2 = .07$. Specifically,

exercise *intensity* and *frequency* decreased over the course of the 12-week exercise program.

Dropouts between groups were different at week 4 χ^2 (1, N = 154) = 2.88, p = .08; week 8 χ^2 (1, N = 154) = 5.54, p = .02; and week 12 χ^2 (1, N = 154) = 2.50, p = .08. Specifically, with 87.5% and 95.1%; 68.1% and 84.1%; and 65.3% and 76.8% of the attention control and the efficacy intervention group being retained at week 4, 8 and 12 respectively. Exercise adherence descriptives can be found in Table 2.

Predicting Exercise Adherence

The correlations between the efficacy variables and exercise adherence can be found in Table 3.

Exercise Frequency. No baseline efficacy variables were entered into a standard regression to predict week 4 exercise *frequency*, as they demonstrated no bivariate association.

Hierarchical regression results for the prediction of week 8 exercise *frequency* are presented in Table 4. Results showed that week 4 task, barrier, scheduling, goal setting, and relapse prevention efficacy explained 16% of week 8 exercise *frequency*. After controlling for all of the week 4 efficacy variables (step 1), the introduction of baseline scheduling and relapse prevention efficacy (step 2) did not make a significant contribution to the prediction of week 8 exercise *frequency* (F change (2, 126) = .82, p = .44). Results showed that the baseline efficacy variables increased the R^2 by 1%. Only scheduling efficacy at week 4 made a significant and unique contribution to the prediction of exercise *frequency*.

Hierarchical regression results for the prediction of week 12 exercise *frequency*

are presented in Table 5. Results showed that week 8 task, scheduling, goal setting and relapse prevention efficacy explained 15% of week 12 exercise *frequency*. After controlling for these efficacy variables at week 8 (step 1), the introduction of week 4 task, scheduling, goal-setting and relapse prevention efficacy (step 2) did not make a significant contribution to the prediction of week 12 exercise *frequency* (F change (2, 126) = .82, p = .44). Results showed that week 4 efficacy variables increased the R^2 by 3%. Only scheduling efficacy at week 4 made a significant and unique contribution to the prediction of exercise *frequency*.

Table 2

Descriptive statistics for the self-efficacy and exercise adherence variables.

	Intervention Group		Attention Control Group	
	Mean	SError	Mean	SError
		Self-Efficacy		
Baseline Task Efficacy	62.41	2.35	62.79	2.80
Baseline Barrier Efficacy	64.84	1.78	66.29	2.46
Baseline Scheduling Efficacy	84.21	1.68	88.24	1.37
Baseline Goal-Setting Efficacy	85.11	1.27	86.77	1.48
Baseline Relapse Prevention Efficacy	83.00	1.20	84.65	1.37
Week 4 Task Efficacy	76.44	1.78	74.97	2.48
Week 4 Barrier Efficacy	70.58	1.70	70.28	2.33
Week 4 Scheduling Efficacy	83.27	1.79	83.31	2.77
Week 4 Goal-Setting Efficacy	86.60	1.31	83.15	2.22
Week 4 Relapse Prevention Efficacy	85.56	1.35	82.93	1.86
Week 8 Task Efficacy	81.37	1.59	76.72	2.48
Week 8 Barrier Efficacy	74.23	1.66	74.70	2.37
Week 8 Scheduling Efficacy	81.38	2.01	82.78	2.80
Week 8 Goal-Setting Efficacy	86.13	1.33	84.22	2.39
Week 8 Relapse Prevention Efficacy	86.21	1.36	84.08	2.04
Week 12 Task Efficacy	81.19	1.66	77.22	2.49
Week 12 Barrier Efficacy	74.97	1.79	75.58	2.47
Week 12 Scheduling Efficacy	82.40	1.98	80.69	2.96
Week 12 Goal-Setting Efficacy	86.46	1.26	83.98	2.30
Week 12 Relapse Prevention Efficacy	86.50	1.40	84.34	2.08
		Exercise Adherence		
Cumulative Duration Weeks 0- 4	131.89	4.60	114.51	6.12

Cumulative Duration Weeks 5- 8	138.73	5.95	142.73	7.32
Cumulative Duration Weeks 9- 12	124.77	7.08	135.97	8.95
Cumulative Frequency Weeks 0- 4	9.44	.41	8.58	.45
Cumulative Frequency Weeks 5- 8	8.36	.45	8.28	.50
Cumulative Frequency Weeks 9- 12	7.09	.53	7.38	.50
Cumulative Intensity Weeks 0- 4	556.81	26.60	472.85	28.74
Cumulative Intensity Weeks 5- 8	257.60	17.53	233.30	19.61
Cumulative Intensity Weeks 9- 12	248.66	19.94	229.51	21.72

SError- Standard error

Notes: Intervention (efficacy group); attention control (nutrition group)

Table 3

Inter-correlations for the efficacy variables and the exercise adherence measures.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
1	-	.30**	.06	.11	.14	.49**	.25**	.14	.23**	.18**	.43**	.17*	.08	.17*	.15	.42**	.14	.09	.18*	.15	.22**	.18*	.15	.21*	.27**	.14	.10	.13	.11
2		-	.44**	.33**	.36**	.29**	.63**	.34**	.37**	.36**	.16	.47**	.24**	.20*	.21*	.23**	.47**	.29**	.33**	.30**	-.06	.05	.06	-.06	.08	.07	-.07	.09	.11
3			-	.52**	.43**	.15	.38**	.53**	.35**	.37**	.10	.35**	.28**	.23**	.25**	.15	.40**	.30**	.24**	.28**	.03	.15	-.02	-.04	.08	-.04	.11	.17*	.07
4				-	.69**	.17*	.26**	.23**	.41**	.39**	.10	.20*	.17	.27**	.26**	.15	.25**	.19*	.29**	.30**	-.01	.03	-.07	-.06	-.00	.03	.05	.07	.07
5					-	.22**	.30**	.22*	.40**	.44**	.12	.27**	.22**	.27**	.30**	.15	.26**	.17*	.25**	.29**	-.02	.06	-.02	-.11	-.01	-.01	.04	.17*	.12
6						-	.51**	.37**	.64**	.52**	.80**	.49**	.35**	.49**	.47**	.77**	.45**	.37**	.49**	.47**	.33**	.28**	.23**	.36**	.35**	.24**	.31**	.26**	.21*
7							-	.65**	.61**	.65**	.40**	.76**	.50**	.45**	.51**	.46**	.77**	.50**	.45**	.52**	.20*	.22*	.16	.18*	.16	.13	.19*	.20*	.13
8								-	.70**	.73**	.35**	.62**	.70**	.61**	.61**	.39**	.67**	.67**	.60**	.58**	.25**	.27**	.21*	.22**	.27**	.19*	.35**	.35**	.27**
9									-	.80**	.52**	.59**	.64**	.73**	.68**	.54**	.63**	.68**	.78**	.71**	.26**	.23**	.22*	.25**	.28**	.25**	.33**	.34**	.30**
10										-	.43**	.59**	.66**	.65**	.72**	.47**	.65**	.65**	.66**	.74**	.21*	.24**	.18*	.22*	.23**	.20*	.23**	.27**	.21*

11	-	.58 **	.45 **	.60 **	.58 **	.88 **	.50 **	.39 **	.51 **	.49 **	.40 **	.36 **	.27 **	.42 **	.37 **	.26 **	.37 **	.35 **	.23 **
12		-	.70 **	.65 **	.71 **	.56 **	.86 **	.60 **	.55 **	.58 **	.22 *	.23 **	.13	.21 *	.16	.10	.29 **	.26 **	.16
13			-	.79 **	.81 **	.42 **	.71 **	.84 **	.65 **	.65 **	.17 *	.29 **	.22 **	.21 *	.25 **	.25 **	.32 **	.40 **	.33 **
14				-	.86 **	.54 **	.59 **	.63 **	.73 **	.64 **	.18 *	.25 **	.18 *	.26 **	.31 **	.26 **	.28 **	.31 **	.22 **
15					-	.50 **	.64 **	.68 **	.64 **	.70 **	.23 **	.26 **	.16	.28 **	.29 **	.25 **	.35 **	.34 **	.23 **
16						-	.60 **	.46 **	.54 **	.51 **	.42 **	.40 **	.34 **	.42 **	.35 **	.29 **	.37 **	.34 **	.30 **
17							-	.73 **	.65 **	.69 **	.21 *	.27 **	.23 **	.17 *	.10	.11	.29 **	.30 **	.25 **
18								-	.77 **	.77 **	.16	.28 **	.24 **	.14	.22 **	.21 *	.27 **	.38 **	.38 **
19									-	.85 **	.19 *	.23 **	.24 **	.16	.22 **	.21 *	.23 **	.30 **	.30 **
20										-	.16	.26 **	.23 **	.13	.17	.20 *	.26 **	.32 **	.29 **
21											-	.59 **	.45 **	.83 **	.44 **	.36 **	.69 **	.49 **	.34 **
22												-	.62 **	.44 **	.68 **	.50 **	.51 **	.76 **	.48 **

23	-	.35**	.48**	.72**	.38**	.54**	.77**																						
24		-	.54**	.45**	.57**	.36**	.23**																						
25			-	.76**	.31**	.48**	.34**																						
26				-	.30**	.40**	.55**																						
27					-	.69**	.56**																						
28						-	.70**																						
29							-																						

Please Note: 1= Baseline task efficacy, 2= baseline barrier efficacy, 3= baseline scheduling efficacy, 4= baseline goal-setting efficacy, 5= baseline relapse prevention efficacy, 6= week 4 task efficacy, 7= week 4 barrier efficacy, 8= week 4 scheduling efficacy, 9= week 4 goal-setting efficacy, 10- week 4 relapse prevention efficacy, 11= week 8 task efficacy, 12= week 8 barrier efficacy, 13= week 8 scheduling efficacy, 14= week 8 goal-setting efficacy, 15- week 8 relapse prevention efficacy, 16= week 12 task efficacy, 17= week 12 barrier efficacy, 18= week 12 scheduling efficacy, 19= week 12 goal-setting efficacy, 20- week 12 relapse prevention efficacy, 21= exercise *duration* week 4, 22= exercise *duration* week 8, 23= exercise *duration* week 12, 24= exercise *intensity* week 4, 25= exercise *intensity* week 8, 26= exercise *intensity* week 12, 27= exercise *frequency* week 4, 28= exercise *frequency* week 8, and 29= exercise *frequency* week 12.

Table 4

Hierarchical regression analysis for predicting Week 8 Exercise Frequency

	B	t	R	R^2	R^2 Change
	Predicting Week 8 Exercise Frequency				
Step 1			.41**	.16**	.16**
Week 4 Task Efficacy	.17				
Week 4 Barrier Efficacy	-.14				
Week 4 Scheduling Efficacy	.36*				
Week 4 Goal-Setting Efficacy	.13				
Week 4 Relapse Prevention Efficacy	-.10				
Step 2			.42	.18	.01
Week 4 Task Efficacy	.19	1.64			
Week 4 Barrier Efficacy	-.15	-1.3			
Week 4 Scheduling Efficacy	.44*	2.83*			
Week 4 Goal-Setting Efficacy	.09	.56			
Week 4 Relapse Prevention Efficacy	-.16	-1.02			
Baseline Scheduling Efficacy	-.06	-.56			
Baseline Relapse Prevention	.13	1.28			

**$p < .001$; *$p < .05$

Table 5

Hierarchical regression analysis predicting for Week 12 Exercise Frequency

	B	t	R	R^2	R^2 Change
	Predicting Week 12 Exercise Frequency				
Step 1			.39**	.15**	.15**
Week 8 Task Efficacy	.25*				
Week 8 Scheduling Efficacy	.49*				
Week 8 Goal-Setting Efficacy	-.16				
Week 8 Relapse Prevention Efficacy	-.18				
Step 2			.43	.18	.03
Week 8 Task Efficacy	.26	1.77			
Week 8 Scheduling Efficacy	.43*	2.61*			
Week 8 Goal-Setting Efficacy	-.32	-1.67			
Week 8 Relapse Prevention Efficacy	-.11	-.55			
Week 4 Task Efficacy	-.07	-.42			
Week 4 Scheduling Efficacy	.06	.45			
Week 4 Goal-Setting Efficacy	.34	1.92			
Week 4 Relapse Prevention Efficacy	-.18	-1.11			

**$p < .001$; *$p < .05$

Exercise Duration. For the prediction of week 4 exercise *duration*, baseline task efficacy was entered into a regression. The model explained 5.0% of the response variance (see Table 6).

Hierarchical regression results for the prediction of week 8 exercise *duration* are

presented in Table 7. Results showed that week 4 task, barrier, scheduling, goal setting, and relapse prevention efficacy explained 11% of week 8 exercise *duration*. After controlling for all of the week 4 efficacy variables (step 1), the introduction of baseline task efficacy (step 2) did not make a significant contribution to the prediction of week 8 exercise *duration* (F change (1, 127) = .41, p = .52). Results showed that baseline task efficacy increased the R^2 by .04%. None of the variables made a significant and unique contribution to the prediction of week 8 exercise *duration*.

Hierarchical regression results for the prediction of week 12 exercise *duration* are presented in Table 8. Results showed that week 8 task, scheduling, and goal setting, efficacy explained 10% of week 12 exercise *duration*. After controlling for all of the week 8 efficacy variables (step 1), the introduction of week 4 task, scheduling, goal-setting and relapse prevention efficacy (step 2) did not make a significant contribution to the prediction of week 12 exercise *duration* (F change (4, 125) = .28, p = .89). Results showed that baseline task efficacy increased the R^2 by .08%. None of the variables made a significant and unique contribution to the prediction of week 12 exercise *duration*.

Table 6

Regression analysis for predicting Week 4 Exercise Duration

	B	t	R	R^2	R^2 Change
	Predicting Week 4 Exercise Duration				
Step 1			.22*	.05*	.05*
Baseline Task Efficacy	.22*	2.64*			

$^{**}p < .001$; $^{*}p < .05$

Table 7

Hierarchical regression analysis for predicting Week 8 Exercise Duration

	B	t	R	R^2	R^2 Change
	Predicting Week 8 Exercise Duration				
Step 1			.34*	.11*	.11*
Week 4 Task Efficacy	.27*				
Week 4 Barrier Efficacy	-.04				
Week 4 Scheduling Efficacy	.25				
Week 4 Goal-Setting Efficacy	-.13				
Week 4 Relapse Prevention Efficacy	.04				
Step 2			.34	.12	.004
Week 4 Relapse Prevention Efficacy	.24	1.9			
Week 4 Task Efficacy	-.05	-.39			
Week 4 Barrier Efficacy	.25	1.80			
Week 4 Scheduling	-.12	-.75			

Efficacy		
Week 4 Goal-Setting Efficacy	.05	.29
Baseline Task Efficacy	.06	.64

$^{**}p < .001$; $^{*}p < .05$

Table 8

Hierarchical regression analysis for predicting Week 12 Exercise Duration

	B	t	R	R^2	R^2 Change
	Predicting Week 12 Exercise Duration				
Step 1			.31*	.10*	.10*
Week 8 Task Efficacy	.29*				
Week 8 Scheduling Efficacy	.21				
Week 8 Goal-Setting Efficacy	-.17				
Step 2			.33	.11	.01
Week 8 Task Efficacy	.30	1.93			
Week 8 Scheduling Efficacy	.16	1.04			
Week 8 Goal-Setting Efficacy	-.22	-1.30			
Week 4 Task Efficacy	-.01	-.07			
Week 4 Scheduling Efficacy	.09	.60			
Week 4 Goal-Setting Efficacy	.10	.55			
Week 4 Relapse Prevention Efficacy	-.05	-.29			

$^{**}p < .001$; $^{*}p < .05$

Exercise Intensity. For the prediction of week 4 exercise *intensity*, baseline task efficacy was entered into a regression. The model explained 4% of the response variance (see Table 9).

Hierarchical regression results for the prediction of week 8 exercise *intensity* are presented in Table 10. Results showed that week 4 task, scheduling, goal-setting, and relapse prevention efficacy explained 15% of week 8 exercise *intensity*. After controlling for all of the week 4 efficacy variables (step 1), the introduction of baseline task efficacy (step 2) did not make a significant contribution to the prediction of week 8 exercise *intensity* (F change (1, 128) = 2.24, p = .14). Results showed that baseline task efficacy increased the R^2 by .02%. None of the variables made a significant and unique contribution to the prediction of week 8 exercise *intensity*.

Hierarchical regression results for the prediction of week 12 exercise *intensity* are presented in Table 11. Results showed that week 8 task, barrier, scheduling, goal setting, and relapse prevention efficacy explained 9% of week 12 exercise *intensity*. After controlling for all of the week 8 efficacy variables (step 1), the introduction of week 4 task, scheduling, goal-setting and relapse prevention efficacy (step 2) did not make a significant contribution to the prediction of week 12 exercise *intensity* (F change (4, 124) = .23, p = .92). Results showed that baseline task efficacy increased the R^2 by .07%. None of the variables made a significant and unique contribution to the prediction of week 12 exercise *intensity*.

Table 9

Hierarchical regression analysis for predicting Week 4 Exercise Intensity

	B	t	R	R^2	R^2 Change
	Predicting Week 4 Exercise Intensity				
Step 1			.21*	.04*	.04*
Baseline Task Efficacy	.21*	2.49*			

**p < .001; *p < .05

Table 10

Hierarchical regression analysis for predicting Week 8 Exercise Intensity

	B	t	R	R^2	R^2 Change
	Predicting Week 8 Exercise Intensity				
Step 1			.38**	.15**	.15**
Week 4 Task Efficacy	.28*				
Week 4 Scheduling Efficacy	.24				
Week 4 Goal-Setting Efficacy	.03				
Week 4 Relapse Prevention Efficacy	-.12				
Step 2			.40	.16	.02
Week 4 Task Efficacy	.22	1.84			
Week 4 Scheduling Efficacy	.23	1.77			
Week 4 Goal-Setting Efficacy	.05	.29			
Week 4 Relapse Prevention Efficacy	-.12	-.78			
Baseline Task Efficacy	.14	1.50			

**$p < .001$; *$p < .05$

Table 11

Hierarchical regression analysis for predicting Week 12 Exercise Intensity

	B	t	R	R^2	R^2 Change
	Predicting Week 12 Exercise Intensity				
Step 1			.30*	.09*	.09*
Week 8 Task Efficacy	.16				
Week 8 Scheduling Efficacy	.12				
Week 8 Goal-Setting Efficacy	.03				
Week 8 Relapse	.04				

Prevention					
Step 2			.31	.10	.007
Week 8 Task Efficacy	.12	.80			
Week 8 Scheduling Efficacy	.12	.71			
Week 8 Goal-Setting Efficacy	-.03	-.16			
Week 8 Relapse Prevention	.09	.41			
Week 4 Task Efficacy	.04	.22			
Week 4 Scheduling Efficacy	.01	.05			
Week 4 Goal-Setting Efficacy	.13	.71			
Week 4 Relapse Prevention Efficacy	-.11	-.66			

$^{**}p < .001$; $^{*}p < .05$

Dropout. Results demonstrated that there were no significant differences between the baseline efficacy variables and dropout behaviour at week 4; task F (1, 139) = .47, p = .50, η^2 = .00, barrier F (1, 139) = .27, p = .60, η^2 = .00, scheduling F (1, 139) = .24, p = .62, η^2 = .00, goal-setting F (1, 139) = .07, p = .80, η^2 = .00, and relapse prevention F (1, 139) = .07, p = .80, η^2 = .00. Significant differences were found for all week 4 efficacy variables and week 8 dropout behaviour; task F (1, 139) = 3.58, $p < .05$, η^2 = .03, barrier F (1, 139) = 6.73, $p < .05$, η^2 = .05, scheduling F (1, 139) = 6.70, $p <$ .05, η^2 = .05, goal-setting F (1, 139) = 4.79, $p < .05$, η^2 = .03, and relapse prevention F (1, 139) = 7.00, $p < .05$, η^2 = .05. Specifically, it was found that participants who continued to participate in the study had higher efficacy levels compared to those who dropped out. Finally, significant differences were found for all week 8 efficacy variables and week 12 dropout behaviour; task F (1, 139) = 12.83, $p < .001$, η^2 = .09,

barrier F (1, 139) = 14.67, $p < .001$, $\eta^2 = .10$, scheduling F (1, 139) = 13.04, $p < .001$, $\eta^2 = .09$, goal-setting F (1, 139) = 13.69, $p < .001$, $\eta^2 = .09$, and relapse prevention F (1, 139) = 12.09, $p < .001$, $\eta^2 = .08$. Specifically, it was found that participants who continued to participate in the study had higher efficacy levels compared to those who dropped out.

Discussion

One aim of the present study was to test an efficacy intervention's influence on efficacy levels (both task and self-regulatory) in first- and second-degree relatives of colon cancer patients. It was hypothesized that relatives receiving the efficacy intervention would have higher efficacy scores; however this hypothesis was not supported as there were no efficacy differences between groups. This finding was surprising but several plausible explanations can be identified. First, efficacy differences may not be present between groups as both groups are receiving the best source of efficacy through participating in the exercise program (i.e., mastery experiences). This is a particularly salient point, given the uniformly high efficacious beliefs of participants. Second, it has been suggested that practicing self-regulation may led to the improvement in regulatory abilities (Oaten & Cheng, 2006). Thus, it is plausible that having the attention control condition practice self-regulation (i.e., completing a nutrition logbook) may have led to the improvement of other self-regulatory abilities such as exercise behaviour. Third, the efficacy measures may not have been sensitive enough to detect changes given the 10% increments of the scales used. This is a plausible explanation as participants may have rounded up or down making it difficult to detect changes in efficacy scores. Finally, a different mode of

delivery (i.e., one-on-one) or a different intervention style (i.e., group-mediated cognitive behavioural intervention) may yield more positive results. Specifically, a group-mediated cognitive-behavioural intervention based on Social Cognitive Theory (Bandura, 1986) and group dynamics (Cartwright, 1951) has been found to be effective at increasing efficacious beliefs (e.g., Cramp & Brawley, 2006).

Additionally, our results for task and barrier efficacy are similar to the patterns found by Maddison and Prapavessis (2004), in that both task and barrier efficacy scores increased over the course of the 12-week structured exercise program. Scheduling efficacy was found to decrease during the 12-week structured exercise program. This decrease is not surprising as once the 12-week structured exercise program terminated participants were moving into a 9-month home-based exercise program where they did not have access to the exercise and health psychology lab and where they would be responsible for scheduling their exercise sessions into their daily lives. Goal-setting efficacy remained stable across all time points, while relapse prevention efficacy scores increased slightly. With respect to these two self-regulatory cognitions, participating in a structured exercise program where goals for *frequency*, *intensity* and *duration* of exercise as well as make up sessions are provided mitigates the development of these cognitions.

A secondary aim was to test an efficacy intervention's influence on objectively measured exercise adherence (i.e., *frequency*, *intensity*, and *duration*) during a 12-week structured exercise program. Specifically, it was expected that relatives receiving the efficacy intervention would exercise with greater *frequency*, at a higher *intensity*, and for longer *duration* than their attention control counterparts. This hypothesis was only

partially supported, as there were no differences between groups on their exercise *frequency* or *intensity* for any time periods. However, it was found that the efficacy intervention group exercised for significantly longer *duration* early on in the exercise program (i.e., weeks 0 to 4) compared to the attention control group. This difference may suggest that the efficacy intervention is successful at increasing participants' initial confidence in their abilities to exercise for longer *duration.* However this initial confidence boost to exercise for longer *duration* was not sustained as the exercise program progressed as the attention control condition is receiving mastery experiences, which is the best source of efficacy (Bandura, 1986). A plausible reason for the results only partially supporting the hypothesis is that the efficacy intervention material (i.e., task, barrier, scheduling, goal-setting, and relapse prevention) may not have strongly influenced participants' confidence in their abilities to exercise more frequently and at a higher *intensity* over and above their own personal mastery experiences. Significant time effects for exercise *frequency* and *intensity* were noted, demonstrating that both decreased over the course of the 12-week structured exercise program. This decline in exercise *frequency* is in line with an efficacy based intervention study conducted by McAuley et al. (1994), who found that exercise *frequency* decreased for both groups (i.e., intervention and control).

It also was hypothesized that those in the attention control condition would show higher drop out rates than their efficacy intervention counterparts. This hypothesis was supported, as differential loss in the expected direction between groups (i.e., efficacy intervention and attention control) was present at week 4, 8, and 12. Specifically, almost 77% of the participants in the efficacy intervention group were retained, while

only 65% of the participants in the attention control group were retained at week 12. This result suggests that the efficacy intervention covering both task and self-regulatory efficacy information had a considerable impact on participant's continued participation in a structured exercise program. The practical implications of the high retention rates for the efficacy intervention group are that these individuals are continuing to exercise, and as such will likely experience health benefits (i.e., reduction in their risk of developing colon cancer). This is of practical importance for relatives of colon cancer patients as exercise can reduce the risk of developing colon cancer by 40-50% on average (Friedenreich & Orenstein, 2002). Additionally, it was found that participants who were retained at week 8 and 12 had significantly higher efficacy scores on all efficacy variables compared to those who dropped out. This suggests that efficacy beliefs play an important role in continued exercise participation.

The different types of self-regulatory (i.e., barrier, scheduling, goal-setting, and relapse prevention) and task efficacy were generally all mildly or moderately positively correlated at all measurement time points (see Table 3). The only time point that these measures were not correlated was at baseline. This is not surprising, as new exercisers are likely not to be confident to the same extent on all efficacy measures (i.e., task and self-regulatory). This noteworthy pattern reveals that as participants become more active their efficacy skills are not independent from one another. In other words, someone's confidence in their ability to set and adapt appropriate goals would not be independent to their ability to prevent or recover from a relapse. This finding is in line with Bandura's (1986) notion of skill integration, establishing that task and self-

regulatory efficacy (i.e., barrier, scheduling, goal-setting, and relapse prevention) are important skills needed to successfully maintain an exercise program.

A final aim was to examine which of the efficacy variables (i.e., task or self-regulatory) predicted exercise adherence. From our results, task and scheduling efficacy were the only variables to provide meaningful and significant prediction to the exercise adherence measures (i.e., *frequency*, *intensity*, and *duration*). It is unfortunate that the efficacy intervention was not able to effectively manipulate task and scheduling efficacy as these variables were found to be predictors of exercise adherence. Specifically, for exercise *frequency*, scheduling efficacy was the strongest predictor. This finding is not that surprising as it is expected that an individual's confidence in their ability to effectively schedule their exercise session would likely influence the *frequency* of exercise behaviour (Rodgers & Sullivan, 2001). Additionally, our results are in line with the Poag-DuCharme and Brawley (1993) study, where scheduling efficacy was found to be a significant predictor of exercise, while barrier efficacy was not. However, our results are contradictory to Rodgers et al. (2002) contention that task efficacy should be related to physical activity and exercise initiation, while self-regulatory efficacy should relate to the maintenance of the behaviour, as task efficacy continued to predict exercise maintenance.

For exercise *duration* and *intensity*, task efficacy was the strongest predictor of week 4 exercise intensity and duration. These results are not unexpected as the task efficacy scale assesses participants' confidence regarding their ability to exercise for increasing *durations* at varying intensities (i.e., easy, moderate, and hard). Overall, the results of the present study demonstrate the importance of assessing task efficacy as

well as multiple self-regulatory efficacy variables as they are valuable in prospectively predicting exercise adherence. The results also demonstrated scale correspondence between cognition and behaviour, with baseline task efficacy demonstrating a stronger relationship to *duration* and *intensity* at all assessment points. Additionally, scheduling efficacy at all time points, week 4 goal-setting, and week 12 relapse prevention efficacy had a stronger association to exercise *frequency* at all assessment points (see Table 3).

The present study had several methodological strengths that warrant acknowledgement. This is the first research trial to explore the following issues in a population of relatives of colon cancer patients: (a) testing the utility of an efficacy intervention on task and self-regulatory (i.e., barrier, scheduling, goal-setting and relapse prevention) efficacy levels, (b) examining the temporal pattern of these efficacious beliefs, (c) testing the utility of an efficacy intervention influence on objectively measured exercise adherence (i.e., *frequency*, *intensity*, *duration* and dropout), (d) examining the ability of efficacy to predict exercise adherence. Another strength was the prospective/longitudinal study design, which allowed for the examination of the relationship between efficacy and future exercise behaviour. An added strength was that the study employed a randomized control design.

The main limitation of the current study is that the primary investigator who measured the key outcomes was not blinded to group allocation as she was responsible for administering the efficacy and attention control interventions. A further limitation is that the results are not generalizable beyond first- and second-degree relatives of colon cancer patients—a highly efficacious and adherent sample. Additionally, the sample of males in the study was considerably smaller than the sample of females, thus a larger

sample of males would have allowed us to examine our data across gender. Finally, the sample was comprised of mostly first-degree relatives of colon cancer patients making it unfeasible to examine our data across familial history. Future research is needed to determine the most effective way of increasing self-regulatory efficacy, as it represents an essential component of exercise behaviour.

In conclusion, the results of the present study demonstrate the importance of exploring both task and self-regulatory efficacy when examining health behaviour change (e.g., exercise behaviour) and maintenance (Bandura, 1995, 2004; Rodgers et al., 2002). Once completing a structured exercise program individuals need to make the transition to exercising in the real world where the task and self-regulatory challenges will likely not be the same. Thus Study 3 represents an attempt to explore self-efficacy's role in a home-based physical activity program.

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Study 3

Examining the Effect of an Efficacy Intervention on Efficacy and Objective Physical Activity in First- and Second-Degree Relatives of Colon Cancer Patients in a 9-Month Home-Based Physical Activity Program

Indisputable evidence exists establishing that regular physical activity provides meaningful health benefits, and contributes to the primary and secondary prevention of several chronic diseases (Warburton, Nicol, & Bredin, 2006a; Warburton, Nicol, & Bredin, 2006b). However, despite the well-established benefits of physical activity, at least 60% of the world's population fails to engage in the recommended amount required to produce health benefits (World Health Organization, 2009). More specifically, 51% of Canadians adults were classified as inactive according to the 2004-2005 Canadian Community Health Survey (Canadian Fitness and Lifestyle Research Institute, 2005). Additionally, of the individuals who start an exercise program, it is estimated that 50% will dropout within the first year (ACSM, 2006). Thus, given the health benefits and the dismal retention rates, motivating people to adopt and maintain a physically active lifestyle is an important public health burden and challenge.

Nevertheless, some debate exists in the literature regarding the optimal and minimum amount of physical activity needed to achieve health benefits (Warburton, Nicol, & Bredin, 2006a). Most health agencies such as the American College of Sports Medicine (ACSM, 2009) and the Center for Disease Control and Prevention (CDC, 2009) recommend that at a minimum individual's should perform 30-minutes of moderate *intensity* activity on five days of the week (i.e., 150-minutes), which equates to an average energy expenditure of about 4200 kilojoules (kJ) or 1000 kilocalories

(kcal) per week. An energy expenditure of about 1000 kcal per week has been associated with significant health benefits (Warburton, Nicol, & Bredin, 2006a), and more specifically is associated with a 20%–30% reduction in all-cause mortality (Lee & Skerrett, 2001; Paffenbarger, Hyde, Wing, & Hsieh, 1986; Paffenbarger et al., 1993). However, the CDC also recommends that individuals should increase their physical activity to 300-minutes of moderate *intensity* activity (i.e., 2000 kcal per week or 8400 kJ) to profit from additional and more extensive health benefits (CDC, 2009). This increased recommendation is supported by data from the Harvard Alumni Health Study that demonstrated that men who expended ≥ 2000 kcal per week in leisure time physical activity lived an average of 2.15 years longer than their male counterparts that expended less than <500 kcal of weekly activity (Paffenbarger & Lee, 1998). The study also examined the energy expenditure needed to reduce the incidence rate of colon cancer. Specifically, it was also found that 225 men in the study developed colon cancer. The men in the study who expended 1000 kcal per week in physical activity (e.g., walking) demonstrated half of the incidence rates of colon cancer compared to their less active counterparts. This amount of energy expenditure is equivalent to the standard ACSM/ CDC (2009) guidelines to participate in 30 minutes of moderate intensity physical activity 5 days a week.

In order to effectively examine the relationship between physical activity and health, accurately measuring physical activity is essential (Esliger & Tremblay, 2007). Rennie and Wareham (1998) state that properly designing exercise and physical activity interventions requires precise epidemiological data, which is dependent on the validity of the physical activity measure. One such way of accurately assessing physical activity

is through the use of accelerometers, such as the Actical®. Accelerometers provide an objective measure as well as a record of physical activity patterns (i.e., *frequency*, *intensity* and *duration*) over an extended period of time (e.g., 7 days). A major strength of accelerometers is that they provide a valid indicator of overall physical activity, particularly under free-living conditions (Welk, 2002), which is needed for the improved surveillance of these physical activity behaviours (Esliger & Tremblay, 2007).

Despite the well-established benefits, and the need to get the world's population engaged in the recommended amount of physical activity, few intervention strategies aimed at changing physical activity behaviour have produced long-term behaviour change (Rothman, 2000). This demonstrates that behaviour change and maintenance are complicated issues. Bandura (2004) suggests that changing complicated behaviours requires not only task efficacy but self-regulatory skills. Self-regulation reflects self-generated thoughts, feelings, and actions, which are systematically oriented towards attaining goals (Maddux & Gosselin, 2003).

To date, most of the efficacy-related research in exercise psychology has focused on task efficacy (Culos-Reed et al., 2001; McAuley & Mihalko, 1998). However, with the acknowledgement that for exercise and physical activity behaviour, self-regulatory skills are necessary (Bandura, 1995; 2004; Kirsch, 1995; Rodgers et al., 2002), aspects of self-regulatory efficacy are being explored in the physical activity and exercise domain.

Research has demonstrated that self-regulatory efficacy is related to physical activity and exercise behaviour (e.g., Bray et al., 2001; Cramp & Brawley, 2009;

DuCharme & Brawley, 1995; Poag-Ducharme & Brawley, 1993; Poag & Brawley, 1992; McAuley, Pena, & Jerome, 2001; Rejeski et al., 2003; Rodgers et al., 2002; Rodgers, Blanchard, et al., 2002; Rodgers, Munroe, et al., 2002; Rodgers & Sullivan, 2001; Woodgate, 2005; Woodgate & Brawley, 2008). More specifically, research has established that components of self-regulatory efficacy are predictive of exercise intention and behaviour (e.g., Ducharme & Brawley, 1995; Poag & Brawley, 1992; Rodgers, Blanchard, et al., 2002; Rodgers, et al, 2002; Rodgers & Sullivan, 2001), and that the successful manipulation of self-regulatory efficacy appears to be related to increases in physical activity behaviour. (e.g., Cramp & Brawley, 2009; Rejeski et al, 2003). The results of the aforementioned studies demonstrate the importance of further exploring the utility of an exercise intervention comprising a self-regulatory component on physical activity behaviour and maintenance. Additionally, gaps in the literature demonstrate the importance of exploring the ability of self-regulatory efficacious beliefs to predict objectively measured physical activity patterns.

Additionally, self-efficacy has also been found to be an important component of exercise and physical activity behaviour in unstructured community-based settings (e.g., Poag-DuCharme & Brawley, 1993; Sallis et al., 1986). Poag-DuCharme and Brawley (1993) examined the use of Self-Efficacy Theory to investigate the exercise involvement of beginner and experienced participants in both structured and unstructured community-based exercise settings. Results found that the involvement in community-based exercise settings, was predicted by both cognitive (i.e., self-efficacy) and behavioral (i.e., behavioral intention) factors.

Additionally, self-efficacy has been found to play an important role in unstructured community-based settings following termination from a structured exercise program. McAuley (1992) examined the role played by exercise self-efficacy in the maintenance of exercise participation of previously sedentary middle-aged adults 4 months after the termination of a formal exercise program. Results demonstrated that self-efficacy significantly predicted exercise behaviour at follow-up. More recently, McAuley, Jerome, Elavsky, Marquez, and Ramsey (2003), examined the utility of self-efficacy, exercise-induced affect, social support, and value judgments ability to predict the long-term exercise behavior of older adults. Participants were contacted 18 months beyond termination of a 6-month randomized exercise trial. Results demonstrated that self-efficacy predicted self-reported physical activity at 6 and 18 months post-program termination. Additionally, more efficacious individuals at program termination reported higher levels of physical activity at 6- and 18-month follow-ups.

The issues highlighted demonstrate the importance of exploring task and self-regulatory efficacy on the maintenance of physical activity behaviour. Thus, the objectives of the present study were to extend the current literature by examining the: (a) effect of an efficacy intervention on task and self-regulatory (i.e., barrier, scheduling, goal-setting and relapse prevention) efficacy, (b) temporal pattern of these efficacious beliefs, (c) effect of an efficacy intervention on objectively measured free-living physical activity behaviour (i.e., activity energy expenditure— AEE, sedentary behaviour, light, moderate and vigorous *intensity* activity), and (d) proceeding efficacy variables ability to predict objective physical activity in a population of first- and second-degree relatives of colon cancer patients participating in a 9-month home-based

physical activity program. It is important to explore self-regulatory issues in a home-based program, as it would be expected that one will struggle with more task and self-regulatory challenges as they become more responsible for their exercise and physical activity behaviour. Relatives of colon cancer patients were chosen as the population of interest as colon cancer can be a genetic disease and are an "at-risk" population (Quadrilatero & Hoffman-Goetz, 2003). In addition, inactivity is an independent risk factor for the development of colon cancer, and represents a modifiable lifestyle behaviour (Quadrilatero & Hoffman-Goetz, 2003; Friedenreich & Orenstein, 2002; Lee, 2003).

It was hypothesized that relatives receiving the efficacy intervention would have higher levels of task and self-regulatory efficacy compared to those in the attention control condition. It also was hypothesized that only those in the efficacy intervention condition would show systematic increases in both task and self-regulatory efficacy. It was further hypothesized that relatives receiving the efficacy intervention would have higher AEE, spend less time (i.e., minutes) in sedentary behaviour and light activity, and more time in moderate and vigorous *intensity* activity compared to the attention control condition. Finally, it was hypothesized that task and self-regulatory efficacy variables would predict objective physical activity behaviour (i.e., AEE, sedentary behaviour, light, moderate and vigorous *intensity* activity).

Method

Participants

The sample was comprised of one hundred and seven first- and second-degree relatives of colon cancer patients ($M = 45.7$ years, $SD = 8.7$) from Study 2. The

majority of participants' were females (67.3%), first-degree relatives (91.0%), and classified themselves as Caucasian (96.4%). Participants were randomized into two treatment conditions and remained in the same treatment condition following a 12-week structured exercise program: (a) an efficacy intervention group or (b) an attention control (i.e., nutrition) group.

Task and Self-Regulatory Efficacy Measures

The same task and self-regulatory efficacy measures from Study 2 were employed in Study 3. The task and self-regulatory efficacy measures demonstrated reliable internal consistencies for all assessment points (task efficacy — $\alpha = .92$ at baseline; $\alpha = .96$ at month 3; $\alpha = .96$ at month 6; and $\alpha = .95$ at month 9; barrier efficacy— $\alpha = .92$ at baseline; $\alpha = .78$ at month 3; $\alpha = .95$ at month 6; and $\alpha = .95$ at month 9; scheduling efficacy— $\alpha = .93$ at baseline; $\alpha = .97$ at month 3; $\alpha = .98$ at month 6; and $\alpha = .98$ at month 9; goal-setting efficacy— $\alpha = .85$ at baseline; $\alpha = .96$ at month 3; $\alpha = .72$ at month 6; and $\alpha = .96$ at month 9; and relapse prevention efficacy— $\alpha = .92$ at baseline, $\alpha = .97$ at month 3, $\alpha = .94$ at month 6, and $\alpha = .95$ at month 9).

Physical Activity Behaviour

Objective physical activity (i.e., AEE = daily kcals/min/kg) was assessed using the Actical® (MiniMitter, Oregon). The Actical® is a small (approximately 2.8 × 2.7 × 1.0cm3), lightweight (17g), and water resistant omnidirectional accelerometer. The device is sensitive to low frequency movements in the range of 0.5–3.2 Hz, which is the common range for human movement (Heil, 2006). The Actical® has been shown to be a valid and reliable predictor of energy expenditure in adults (Heil, 2006). Participants were instructed to wear the device on their hip for seven consecutive days, for their

waking hours. Data were collected at 15-second epochs. For complete data, participants were required to provide a minimum of ten hours per day for at least five days (including weekend; Trost, McIver, & Pate, 2005). The Actical® sensors were programmed with the participant's personal information (e.g., age, weight, and height) to provide an estimate of activity related AEE. Adopting a pragmatic approach, AEE per day were summed and divided by the days worn to provide mean daily AEE.

In addition, the average time per week in minutes within predetermined cut-points (i.e., sedentary, light, moderate, and vigorous) was compared between treatment groups. These cut-points were in line with those defined by the (CDC, 2009).

Physical Activity Program

The 9-month home-based physical activity program was designed to be a continuation of the 12-week structured exercise program detailed in study 2. Participants were encouraged to follow the ACSM/ CDC (2009) physical activity guidelines, however at a minimum they were encouraged to exercise at least three times a week, for a minimum of 40-minutes at a moderate *intensity* level. Participants were not provided with specific recommendations on what activities to be involved in; rather they were encouraged to find an activity that interested them (e.g., joining a gym, running outdoors).

Intervention Email Material

For the intervention group, the email material was designed to address pertinent exercise issues experienced during the adoption and maintenance of physical activity behaviour in the 9-month home-based program. The email material covered a variety of topics including but not limited to goal-setting, scheduling, overcoming barriers and

exercise lapses, and was based on the four sources of efficacy (i.e., mastery experiences, vicarious experiences, social persuasion, physiological states). The attention control group's email material focused on nutrition related information, and discussed a variety of different topics such as Trans fats, antioxidants, and recipe modification tips (see Appendix H).

Procedure and Design

Ethical approval was obtained by the host institution's ethics committee prior to recruiting participants. Participants were recruited through newspaper, online and radio ads, posters and from the Ontario Familial Colorectal Cancer Registry. Participants who agreed to take part in the study were enrolled in a 9-month home-based physical activity program, and stayed in the same treatment condition (i.e., efficacy or attention control) from the second study's randomization. The baseline assessment consisted of a sub-maximal bike fitness test (i.e., astrand protocol), body composition scan using the iDEXA, completion of the task and self-regulatory efficacy questionnaire, and physical activity behaviour measurement using the Actical®. The task and self-regulatory questionnaire was again administered at month 3, month 6, and month 9, while objective physical activity behaviour was assessed by the Actical® at month 1, month 3, month 6, and month 9.

The intervention material for both groups was delivered weekly for month 1, bi-weekly for month 2 and monthly for months 3 to 9. The efficacy group's emails focused on promoting scheduling, barrier, goal-setting and relapse prevention efficacy, while the attention control group's emails focused on nutrition information.

A manipulation check was in place, whereby participants were asked to complete an activity or answer some questions that were contained in each email. Answers to the activity or questions were returned to the primary investigator by email. This ensured that participants were reading the email material.

Results

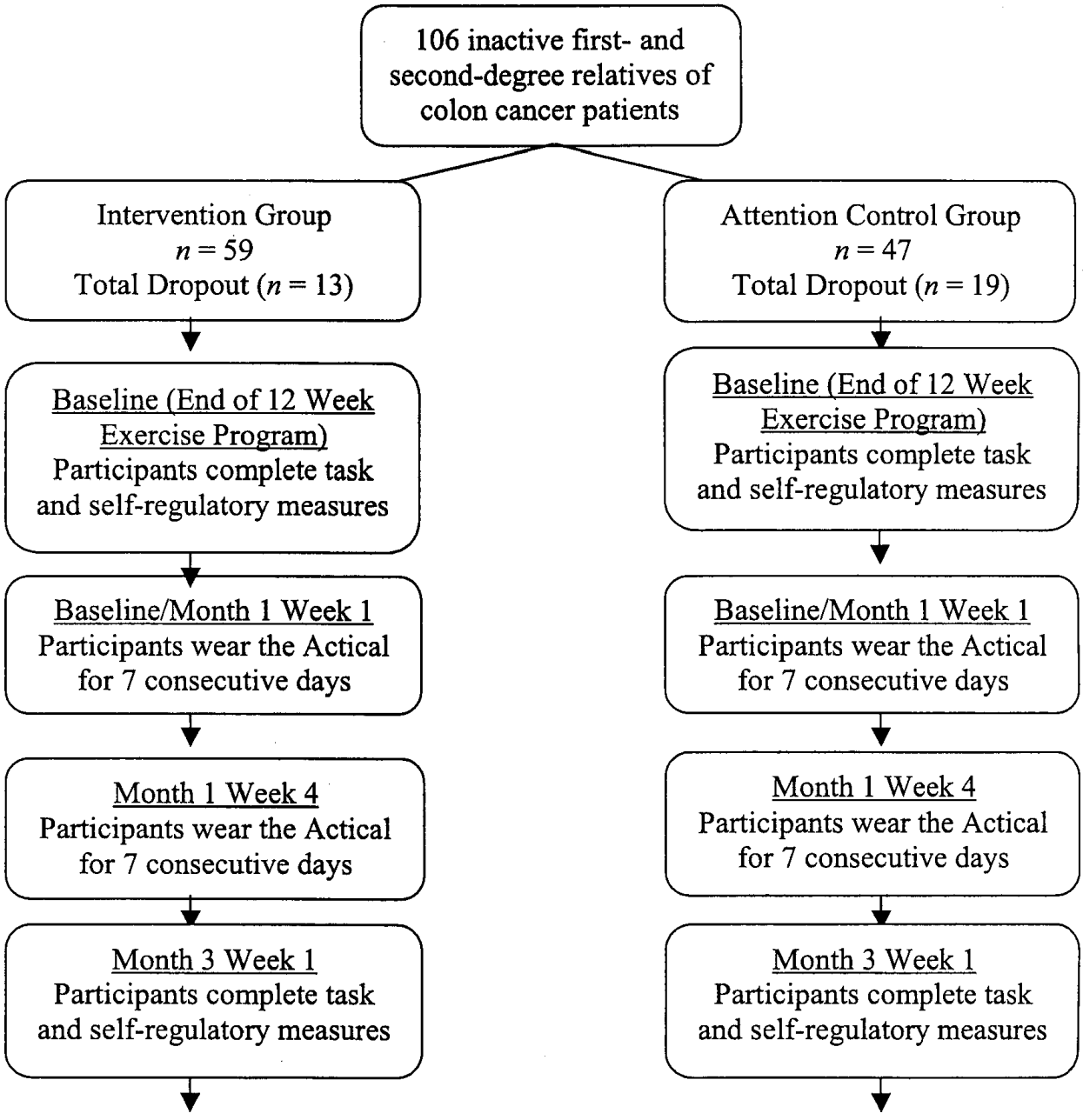
Treatment of the Data

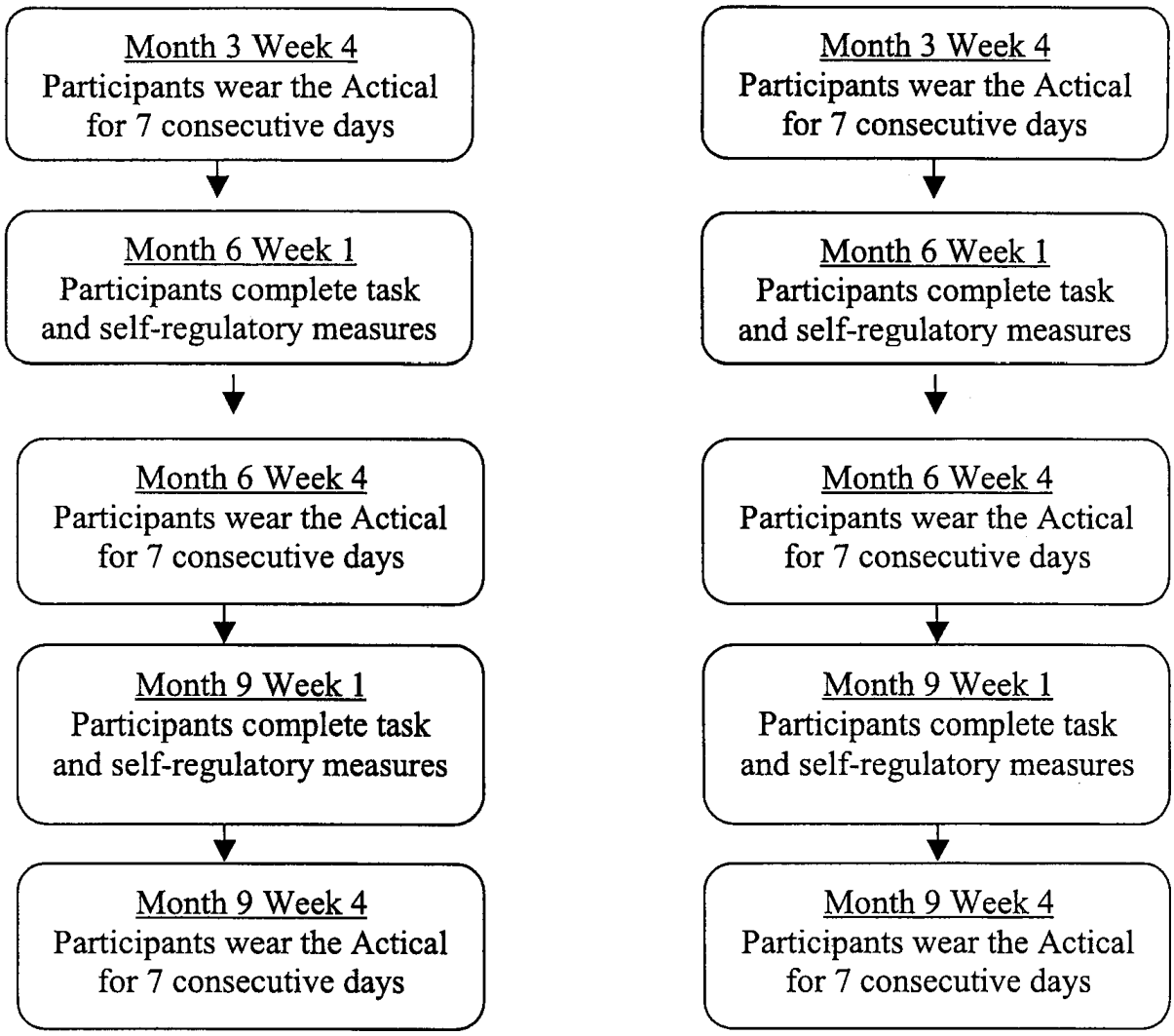
As attrition is common in longitudinal studies (see Figure 1), an intention-to-treat approach was used to replace missing data to ensure suitable statistical power. More specifically, a last outcome carried forward intention-to-treat analysis was used, as it assumes no change from the previous data point (Shao & Zhong, 2003). For the efficacy variables, 1.9% of the data was estimated at baseline, 2.8% at month 3, 2.8% at month 6 and 6.6% at month 9. For the physical activity behaviour, 3.8% of the data was estimated at baseline, 3.8% at month one, 9.4% at month three, 10.4% at month six, and 5.7% at month nine.

Separate two (group) by four (time- baseline, month 3, month 6 and month 9) repeated measures ANOVAs were conducted to examine differences in task and self-regulatory (i.e., barrier, scheduling, goal-setting, and relapse prevention) efficacy. Separate two (group) by five (time- week 1/baseline, month 1, month 3, month 6, and month 9) repeated measures ANOVAs were conducted to examine differences in energy expenditure, sedentary behaviour, light *intensity* activity, moderate *intensity* activity, and vigorous *intensity* activity. Standard and hierarchical regression analyses were performed to explore which efficacy variable(s) (i.e., task, barrier, scheduling, goal-setting, and relapse prevention) would predict future objectively measured physical

activity behaviour. Only efficacy variables that proceeded and showed a significant correlation to physical activity behaviour were entered into a regression (e.g., month 3 efficacy and baseline efficacy to month 6 AEE). Additionally, as the efficacy questionnaires were always completed before physical activity behaviour was assessed, it was possible for the variables assessed around the same month to be entered in the regression (see Figure 1).

Figure 1. Flow diagram of design and overall procedure





Group Equivalency

Chi-square and one-way ANOVA procedures were used to test for group equivalency between the two treatment groups on demographic characteristics as these factors may influence AEE and efficacy variables. As can be seen in Table 1 there was group equivalency across all demographic variables.

Table 1

Demographic characteristics for the two treatment conditions.

Variable	Intervention ($n = 59$)	Attention Control ($n = 47$)	Statistic	p-level
Age (years)	M= 45.17 (SD= 9.03)	46.64 (8.13)	$F(1, 106) = 0.76$	0.39
Relative Status				
First-Degree	91.5%	89.4%	$\chi^2(1, N=106) = 0.14$	0.71
Second-Degree	8.5%	10.6%		
Education Level				
High School	16.9%	23.4%	$X^2(4, N=106) = 1.77$	0.78
College	40.7%	29.8%		
University- Bachelor	30.5%	26.2%		
University- Masters	10.2%	8.5%		
University- Ph.D.	1.7%	2.1%		
Ethnicity				
Caucasian	93.2%	97.9%	$\chi^2(4, N=106) = 1.46$	0.48
Native	1.7%	0.0%		
Other	5.1%	2.1%		
Gender				
Male	27.1%	40.4%	$\chi^2(1, N=106) = 2.10$	0.15
Female	72.9%	59.6%		

Correlations were also conducted to examine the relationships among the demographic variables (i.e., age, gender, education level, ethnicity), the efficacy variables (i.e., task, barrier, scheduling, goal-setting, and relapse prevention), and AEE. Age was mildly positively correlated with month 3 and month 6 relapse prevention efficacy ($r = .19, p < .05$; $r = .20, p < .05$— respectively), and mildly negatively

correlated with month 9 task efficacy ($r = -.21, p < .05$). Gender was negatively related to energy expenditure at all assessment points ($r = -.45, p < .001$; $r = -.44, p < .001$; $r = -.34, p < .001$; $r = -.29, p < .001$; $r = -.33, p < .001$). Education level was mildly positively related to ethnicity ($r = .22, p < .05$). Finally, relative status was not correlated with any of the demographic variables, efficacy variables or AEE.

Descriptive Statistics for Efficacy Variables and AEE.

Table 2 represents the descriptive statistics for the task and self-regulatory efficacy variables, while Table 3 represents the descriptive statistics for objective physical activity behaviour.

Task and Self-Regulatory Efficacy

Significant main effects for time for task, $F(1, 102) = 5.94, p < .001$; $\eta^2 = .15$; barrier, $F(1, 102) = 4.66, p < .005$; $\eta^2 = .12$; scheduling, $F(1, 102) = 7.08, p < .001$; $\eta^2 = .17$, goal-setting $F(1, 102) = 8.02, p < .001$; $\eta^2 = .19$; and relapse prevention efficacy, $F(1, 102) = 7.68, p < .001$; $\eta^2 = .18$, such that all the efficacy variables decreased across time were found. No treatment group by time interaction effect was found for task, $F(1, 102) = .18, p = .91$; $\eta^2 = .01$; barrier, $F(1, 102) = 1.24, p = .30$; $\eta^2 = .04$; scheduling, $F(1, 102) = .08, p = .97$; $\eta^2 = .00$; goal-setting, $F(1, 102) = .19, p = .90$; $\eta^2 = .01$; and relapse prevention, $F(1, 102) = .21, p = .89$; $\eta^2 = .01$.

Table 2

Descriptive statistics for the efficacy variables

	Intervention Group		Attention Control Group	
	Mean	SError	Mean	SError
Baseline Task	82.40	1.70	82.80	2.31
Baseline Barrier	78.54	1.63	81.58	2.32
Baseline Scheduling	85.46	1.64	84.19	2.92
Baseline Goal-Setting	87.13	1.35	87.77	2.26
Baseline Relapse Prevention	87.92	1.40	87.37	2.01
Month 3 Task	80.18	2.28	78.70	3.26
Month 3 Barrier	80.17	4.37	74.92	3.27
Month 3 Scheduling	76.70	3.20	76.66	3.72
Month 3 Goal-Setting	79.81	2.83	81.09	3.21
Month 3 Relapse Prevention	82.55	2.70	82.17	3.20
Month 6 Task	79.65	2.25	78.55	3.26
Month 6 Barrier	75.13	2.31	76.94	2.90
Month 6 Scheduling	76.11	3.11	76.99	3.90
Month 6 Goal-Setting	79.53	2.47	81.60	6.45
Month 6 Relapse Prevention	80.25	2.80	80.59	2.95
Month 9 Task	75.67	2.46	76.47	3.18
Month 9 Barrier	73.91	2.49	73.04	3.20
Month 9 Scheduling	74.78	3.04	75.84	4.18
Month 9 Goal-Setting	79.36	2.35	78.11	3.95
Month 9 Relapse Prevention	81.30	2.59	78.97	3.40

Table 3

Descriptive statistics for objective physical activity

	Intervention Group		Attention Control Group	
	Mean	SError	Mean	SError
Baseline AEE (average/day)	755.26	44.19	721.84	35.74
Month 1 Week 4 AEE	772.59	71.27	704.85	41.95
Month 3 Week 4 AEE	792.23	62.17	667.26	42.95
Month 6 Week 4 AEE	670.40	36.07	630.08	34.68
Month 9 Week 4 AEE	659.98	37.86	614.46	35.01
Baseline Sedentary (minutes/week)	3234.43	112.55	3203.22	100.17
Month 1 Week 4 Sedentary	3172.79	101.15	3254.55	98.35
Month 3 Week 4 Sedentary	3062.15	120.62	3235.68	103.83
Month 6Week 4 Sedentary	3103.95	114.6	3375.45	108.89
Month 9 Week 4 Sedentary	3063.98	108.68	3135.93	89.53
Baseline Light (minutes/week)	1506.48	433.56	1552.46	480.58
Month 1 Week 4 Light	1381.05	446.36	1524.28	472.94
Month 3 Week 4 Light	1607.63	830.70	1489.74	470.67
Month 6 Week 4 Light	1393.63	615.82	1449.39	438.80
Month 9 Week 4 Light	1346.23	360.67	1386.22	404.85
Baseline Moderate (minutes/week)	1040.25	509.16	1048.07	357.95
Month 1 Week 4 Moderate	936.11	484.80	1014.72	374.85
Month 3 Week 4 Moderate	968.36	493.02	980.46	393.83
Month 6 Week 4 Moderate	828.71	323.01	924.76	331.60

Month 9 Week 4 Moderate	871.25	318.11	906.28	394.90
Baseline Vigorous (minutes/week)	17.14	39.80	27.46	46.66
Month 1 Week 4 Vigorous	16.82	33.51	25.87	50.89
Month 3 Week 4 Vigorous	16.30	39.66	19.22	38.13
Month 6 Week 4 Vigorous	23.73	50.71	22.24	46.06
Month 9 Week 4 Vigorous	6.18	17.05	11.83	27.82

Objective Physical Activity

Results showed that there was a significant time effect for AEE, F (1, 97) = 6.56, $p < .001$; $\eta^2 = .21$, such that AEE systematically declined over the 9 months. No treatment by time interaction effect F (1, 97) = .98, p =.42; $\eta^2 = .04$ was found— see Table 3 and Figure 2. Results showed a trend time effect for sedentary behaviour F (1, 97) = .1.97, p =.11; $\eta^2 = .08$, but no interaction effect, F (1, 97) = 1.23, $p = .30$; $\eta^2 =$ .05— see Table 3 and Figure 3. Results also revealed a significant main effect for time for the light *intensity*, F (1, 97) = 4.77— see Table 3 and Figure 4, $p < .001$; $\eta^2 = .16$; moderate *intensity*, F (1, 97) = 6.12, $p < .001$; $\eta^2 = .20$; and vigorous *intensity*, F (1, 97) = 4.17, $p = .21$; $\eta^2 = .06$ cut-off points. For these same three intensities, no interaction effect was found for light, F (1, 97) = 1.49, $p = .21$; $\eta^2 = .06$; moderate, F (1, 97) = 1.13, $p = .35$; $\eta^2 = .05$; and vigorous, F (1, 97) = .65, $p = .61$; $\eta^2 = .03$ cut-off points.

Figure 2. AEE across time points for the efficacy intervention (INT) and attention control (AC) groups

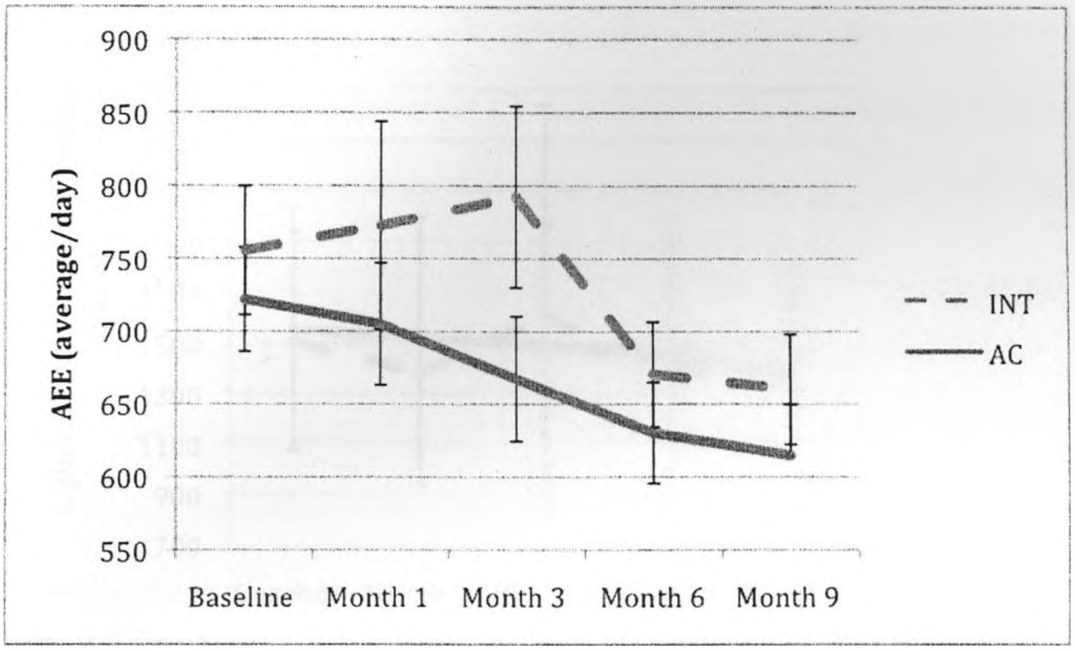


Figure 3. Sedentary minutes per week across time points for the efficacy intervention (INT) and attention control (AC) group

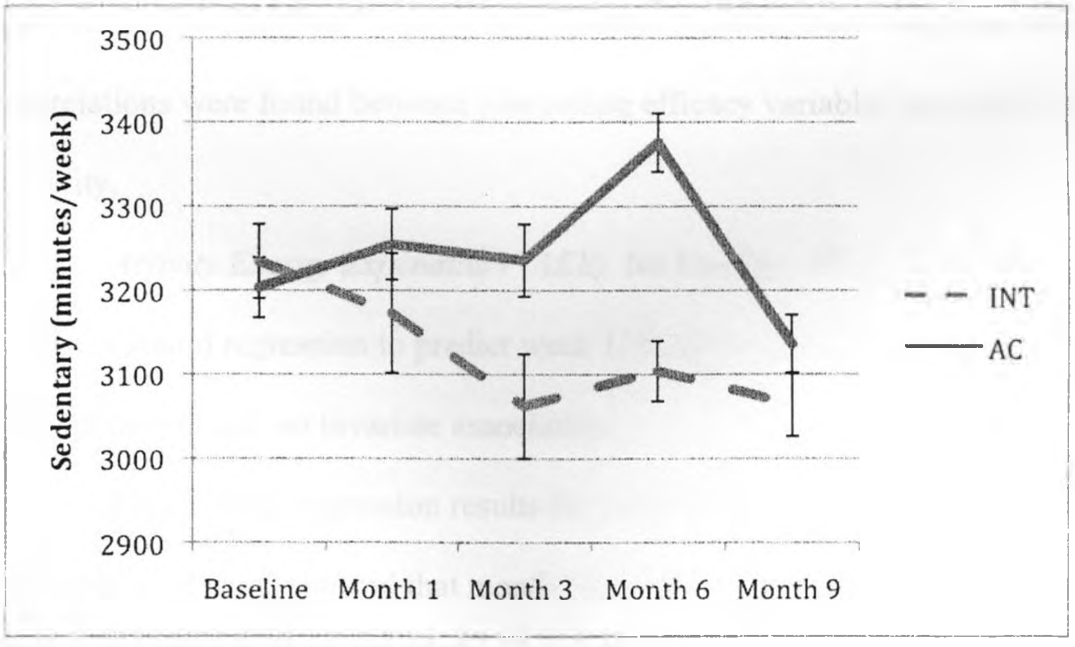
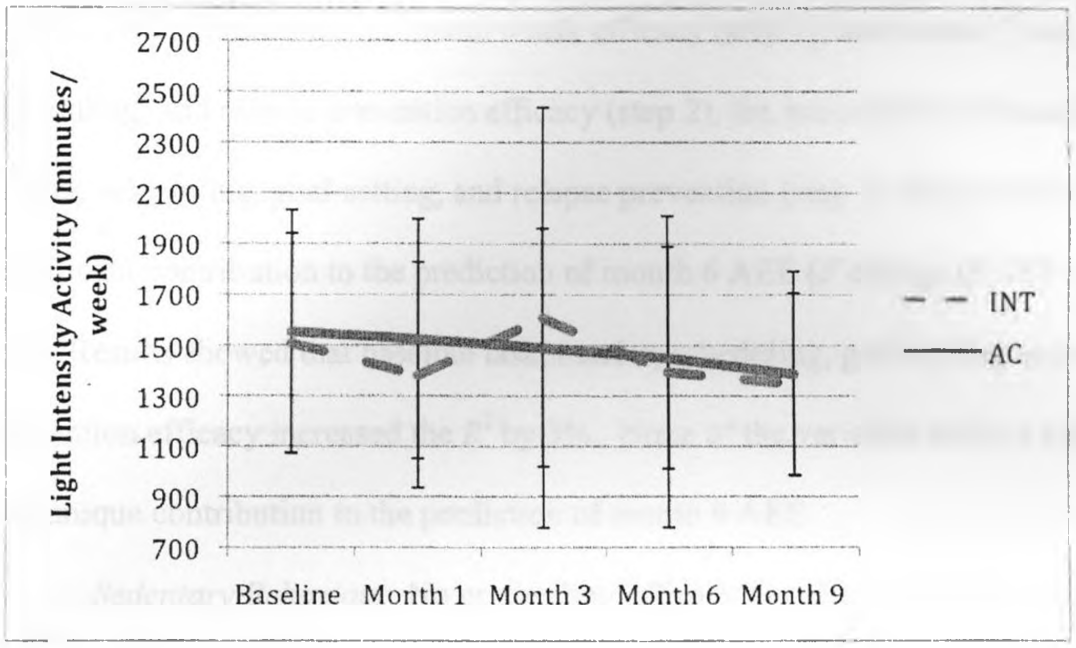


Figure 4. Light intensity activity minutes per week across time points for the efficacy intervention (INT) and attention control (AC) group



Predicting Objective Physical Activity

The correlations between the efficacy variables and AEE, sedentary behaviour, light *intensity* activity, moderate *intensity* activity and vigorous *intensity* physical activity can be found in Tables 4-8. Regression models were computed only if bivariate correlations were found between proceeding efficacy variables and objective physical activity.

Activity Energy Expenditure (AEE). No baseline efficacy variables were entered into a standard regression to predict week 1/ baseline, month 1 and month 3 AEE, as they demonstrated no bivariate association.

Hierarchical regression results for the prediction of month 6 AEE are presented in Table 9. Results showed that month 6 task efficacy explained 8% of month 6 AEE. After controlling month 6 task efficacy (step 1), the introduction of month 3 task, scheduling, and relapse prevention efficacy (step 2) did not make a significant

contribution to the prediction of month 6 AEE (F change (3, 80) = .38, p = .77). Results showed that month 3 task, scheduling, and relapse prevention efficacy increased the R^2 by 1%. After controlling for month 6 task efficacy (step 1), and month 3 task, scheduling, and relapse prevention efficacy (step 2), the introduction of baseline task, barrier, scheduling, goal-setting, and relapse prevention (step 3) did not make a significant contribution to the prediction of month 6 AEE (F change (5, 75) = .47, p = .80). Results showed that baseline task, barrier, scheduling, goal-setting and relapse prevention efficacy increased the R^2 by 3%. None of the variables made a significant and unique contribution to the prediction of month 6 AEE.

Sedentary Behaviour. No proceeding efficacy variables were associated with sedentary behaviour at week 1, month 1, month 3 and month 6.

Hierarchical regression results for the prediction of month 9 sedentary behaviour are presented in Table 10. Results showed that month 6 scheduling, goal-setting, and relapse prevention efficacy explained 11% of month 9 sedentary behaviour. After controlling for month 6 scheduling, goal-setting and relapse prevention efficacy (step 1), the introduction of month 3 goal-setting efficacy (step 2) did not make a significant contribution to the prediction of month 9 sedentary behaviour (F change (1, 75) = .05, p = .82). Results showed that month 3 task, scheduling, and relapse prevention efficacy increased the R^2 by .01%. None of the variables made a significant and unique contribution to the prediction of month 9 sedentary behaviour.

Light Intensity Activity. No proceeding efficacy variables were associated with light physical activity at week 1, month 1 and month 3.

For the prediction of month 6 light intensity activity, baseline scheduling, goal-setting and relapse prevention efficacy predicted 9.0% of the response variance (see Table 11).

Hierarchical regression results for the prediction of month 9 light *intensity* activity are presented in Table 12. Results showed that month 9 barrier, scheduling and goal-setting efficacy explained 12% of month 9 light *intensity* activity. After controlling for month 9 barrier, scheduling, and goal-setting efficacy (step 1), the introduction of baseline relapse prevention efficacy (step 2) did not make a significant contribution to the prediction of month 9 light *intensity* activity (F change (1, 56) = .20, p = .66). Results showed that baseline relapse prevention efficacy increased the R^2 by .03%. None of the variables made a significant and unique contribution to the prediction of month 9 light *intensity* activity.

Table 4

Inter-correlations for the efficacy variables and activity energy expenditure (AEE).

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	-	.59**	.56**	.51**	.47**	.60**	.27**	.40**	.43**	.70**	.50**	.36**	.32**	.30**	.66**	.50**	.51**	.45**	.45**	.45**	.14	.16	.17	.22**	.16
2		-	.68**	.62**	.66**	.45**	.40**	.53**	.56**	.55**	.52**	.74**	.45**	.46**	.41**	.36**	.52**	.38**	.43**	.36**	.12	.15	.11	.22*	.13
3			-	.78**	.75**	.52**	.23**	.58**	.51**	.53**	.63**	.56**	.47**	.44**	.43**	.42**	.35**	.52**	.48**	.50**	.14	.09	.14	.29**	.07
4				-	.82**	.53**	.29**	.56**	.60**	.59**	.50**	.56**	.45**	.50**	.46**	.33**	.38**	.49**	.51**	.50**	.13	.02	.07	.30**	.09
5					-	.53**	.29**	.59**	.60**	.65**	.54**	.62**	.47**	.49**	.52**	.40**	.53**	.64**	.61**	.65**	.07	.07	.09	.25*	.10
6						-	.51**	.70**	.70**	.67**	.90**	.58**	.35**	.50**	.38**	.71**	.50**	.50**	.50**	.48**	.18	.14	.16	.21*	.14
7							-	.37**	.44**	.34**	.42**	.37**	.08	.24**	.09	.27**	.19	-.05	.06	-.05	.04	.04	.04	.09	.05
8								-	.89**	.92**	.67**	.74**	.75**	.71**	.70**	.45**	.57**	.61**	.54**	.58**	.14	.13	.16	.23*	.07
9									-	.94**	.61**	.75**	.69**	.75**	.72**	.47**	.62**	.58**	.62**	.56**	.13	.08	.12	.20	.06
10										-	.60**	.74**	.73**	.73**	.79**	.41**	.62**	.62**	.60**	.63**	.14	.12	.14	.21**	.07
11											-	.65**	.47**	.57**	.44**	.69**	.53**	.47**	.45**	.48**	.21	.18	.24**	.28**	.20
12												-	.71**	.75**	.70**	.47**	.67**	.45**	.48**	.46**	.10	.09	.15	.20	.17
13													-	.81**	.88**	.44**	.54**	.65**	.53**	.58**	.00	.03	.11	.14	.01
14														-	.82**	.29**	.48**	.42**	.43**	.43**	-.01	-.07	.09	.14	.04
15															-	.33**	.53**	.57**	.50**	.53**	-.00	.03	.10	.11	.04
16																-	.66**	.70**	.61**	.59**	.16	.17	.23	.19	.20
17																	-	.81**	.82**	.76**	.11	.16	.13	.19	.25
18																		-	.86**	.88**	.11	.16	.18	.24	.16
19																			-	.88**	.07	.09	.15	.25	.19

20	-	.12	.11	.18	.24	.17																			
21		-	.74**	.76**	.75**	.74**																			
22			-	.77**	.61**	.67**																			
23.				-	.77**	.68**																			
24					-	.80**																			
25						-																			

Please Note: 1= Baseline task efficacy, 2= baseline barrier efficacy, 3= baseline scheduling efficacy, 4= baseline goal-setting efficacy, 5= baseline relapse prevention efficacy, 6= month 3 task efficacy, 7= month 3 barrier efficacy, 8= month 3 scheduling efficacy, 9= month 3 goal-setting efficacy, 10- month 3 relapse prevention efficacy, 11= month 6 task efficacy, 12= month 6 barrier efficacy, 13= month 6 scheduling efficacy, 14= month 6 goal-setting efficacy, 15- month 6 relapse prevention efficacy, 16= month 9 task efficacy, 17= month 9 barrier efficacy, 18= month 9 scheduling efficacy, 19= month 9 goal-setting efficacy, 20- month 9 relapse prevention efficacy, 21= week 1 AEE, 22= month 1 AEE, 23= month 3 AEE, 24= month 6 AEE, and 25= month 9 AEE.

Table 5

Inter-correlations for the efficacy variables and sedentary behaviour.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	-	.59**	.56*	.51**	.47**	.60**	.27**	.40**	.43**	.43**	.70**	.50**	.36**	.32**	.30**	.66**	.50**	.51**	.45**	.45**	-.09	-.06	-.07	-.06	-.09
2		-	.68*	.62**	.66**	.45**	.40**	.53**	.56**	.55**	.52**	.74**	.45**	.46**	.41**	.36**	.52**	.38**	.43**	.36**	.00	.004	-.07	-.02	-.00
3			-	.78**	.75**	.52**	.23*	.58**	.51**	.53**	.63**	.56**	.47**	.44**	.43**	.42**	.35**	.52**	.48**	.50**	-.08	-.04	-.04	-.09	-.08
4				-	.82**	.53**	.29**	.56**	.60**	.59**	.50**	.56**	.45**	.50**	.46**	.33**	.38**	.49**	.51**	.50**	-.12	-.03	-.03	-.09	-.10
5					-	.53**	.29**	.59**	.60**	.65**	.54**	.62**	.47**	.49**	.52**	.40**	.53**	.64**	.61**	.65**	-.04	.00	-.05	-.07	-.01
6						-	.51**	.70**	.69**	.67**	.90**	.58**	.35**	.50**	.38**	.71**	.50**	.50**	.50**	.48**	-.03	-.03	-.05	-.02	-.03
7							-	.37**	.44**	.34**	.42**	.37**	.08	.24*	.09	.27*	.19	-.05	.06	-.06	.09	.07	.06	.06	.12
8								-	.90**	.92**	.67**	.74**	.75**	.71**	.70**	.45**	.57**	.61**	.54**	.58**	.12	.08	.12	.10	.20
9									-	.94**	.61**	.75**	.69**	.75**	.72**	.47**	.62**	.58**	.62**	.56**	.09	.07	.08	.10	.23*
10										-	.60**	.74**	.73**	.73**	.79**	.41**	.62**	.62**	.60**	.63**	.06	.04	.08	.10	.20
11											-	.65**	.47**	.57**	.44**	.70**	.53**	.48**	.45**	.48**	-.02	-.02	-.05	-.04	-.00
12												-	.71**	.75**	.70**	.47**	.67**	.45**	.48**	.46**	.05	.08	.08	.07	.15
13													-	.81**	.88**	.44**	.55**	.65**	.53**	.58**	.08	.13	.14	.08	.28*
14														-	.82**	.29*	.48**	.42**	.43**	.43**	.09	.17	.11	.09	.31**
15															-	.33**	.53**	.57**	.50**	.54**	.09	.13	.17	.14	.30**
16																-	.66**	.70**	.61**	.59**	-.16	-.10	-.09	.04	.00
17																	-	.81**	.82**	.76**	-.08	-.11	.02	.10	.12
18																		-	.86	.88	-	-	-.07	-.03	.01

	**	**	.12	.11			
19	-	.88**	-.04	-.12	-.06	-.05	.08
20		-	-.06	-.12	-.08	-.03	.03
21			-	.67**	.56**	.50**	.63**
22				-	.64**	.55**	.59**
23					-	.70**	.69**
24						-	.70**
25							-

Please Note: 1= Baseline task efficacy, 2= baseline barrier efficacy, 3= baseline scheduling efficacy, 4= baseline goal-setting efficacy, 5= baseline relapse prevention efficacy, 6= month 3 task efficacy, 7= month 3 barrier efficacy, 8= month 3 scheduling efficacy, 9= month 3 goal-setting efficacy, 10- month 3 relapse prevention efficacy, 11= month 6 task efficacy, 12= month 6 barrier efficacy, 13= month 6 scheduling efficacy, 14= month 6 goal-setting efficacy, 15- month 6 relapse prevention efficacy, 16= month 9 task efficacy, 17= month 9 barrier efficacy, 18= month 9 scheduling efficacy, 19= month 9 goal-setting efficacy, 20- month 9 relapse prevention efficacy, 21= week 1 sedentary behaviour, 22= month 1 sedentary behaviour, 23= month 3 sedentary behaviour, 24= month 6 sedentary behaviour, and 25= month 9 sedentary behaviour.

Table 6

Inter-correlations for the efficacy variables and light intensity activity.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	-	.59**	.56**	.51**	.47**	.60**	.27**	.40**	.43**	.43**	.70**	.50**	.36**	.32**	.30**	.66**	.50**	.51**	.45**	.45**	.06	.11	.01	.15	.06
2		-	.68**	.62**	.66**	.45**	.40**	.53**	.56**	.55**	.52**	.74**	.45**	.46**	.41**	.36**	.52**	.38**	.43**	.36**	.09	.06	-.05	.18	.08
3			-	.78**	.75**	.52**	.23*	.58**	.51**	.53**	.63**	.56**	.47**	.44**	.43**	.42**	.35**	.52**	.48**	.50**	.15	.13	.06	.23*	.11
4				-	.82**	.53**	.29**	.56**	.60**	.59**	.50**	.56**	.45**	.50**	.46**	.33**	.38**	.49**	.51**	.50**	.12	.13	.08	.27**	.18
5					-	.53**	.29**	.59**	.60**	.65**	.54**	.62**	.47**	.49**	.52**	.40**	.53**	.64**	.61**	.65**	.19	.17	.07	.30**	.25*
6						-	.51**	.70**	.69**	.67**	.90**	.58**	.35**	.50**	.38**	.71**	.50**	.50**	.50**	.48**	.02	-.01	.03	.10	.07
7							-	.37**	.44**	.34**	.42**	.37**	.08	.24*	.09	.27*	.18	-.05	.06	-.06	-.02	.02	.02	.08	.11
8								-	.90**	.92**	.67**	.74**	.75**	.71**	.70**	.45**	.58**	.61**	.54**	.58**	.08	.01	.08	.12	.07
9									-	.94**	.61**	.75**	.69**	.75**	.72**	.47**	.62**	.58**	.62**	.56**	.12	.06	.11	.19	.18
10										-	.60**	.74**	.73**	.73**	.79**	.41**	.62**	.62**	.60**	.63**	.10	.05	.12	.17	.15
11											-	.65**	.47**	.57**	.44**	.69**	.53**	.47**	.45**	.48**	-.01	-.01	.07	.12	.07
12												-	.71**	.75**	.70**	.47**	.67**	.45**	.48**	.46**	.10	.06	.11	.15	.19
13													-	.81**	.88**	.44**	.55**	.65**	.53**	.58**	.06	.07	.16	.20	.19
14														-	.82**	.29*	.48**	.42**	.43**	.43**	-.06	-.08	.10	.16	.18
15															-	.33**	.52**	.57**	.50**	.53**	.02	.04	.16	.17	.18
16																-	.66**	.70**	.61**	.59**	.08	.19	.15	.18	.24
17																	-	.81**	.82**	.76**	.06	.19	.00	.15	.30*

18	-	.86**	.88**	.25	.35**	.15	.31*	.34**
19		-	.88**	.19	.30*	.13	.28*	.30*
20			-	.21	.21	.14	.23	.23
21				-	.77**	.60**	.60**	.58**
22					-	.49**	.60**	.63**
23						-	.71**	.53**
24							-	.70**
25								-

Please Note: 1= Baseline task efficacy, 2= baseline barrier efficacy, 3= baseline scheduling efficacy, 4= baseline goal-setting efficacy, 5= baseline relapse prevention efficacy, 6= month 3 task efficacy, 7= month 3 barrier efficacy, 8= month 3 scheduling efficacy, 9= month 3 goal-setting efficacy, 10- month 3 relapse prevention efficacy, 11= month 6 task efficacy, 12= month 6 barrier efficacy, 13= month 6 scheduling efficacy, 14= month 6 goal-setting efficacy, 15- month 6 relapse prevention efficacy, 16= month 9 task efficacy, 17= month 9 barrier efficacy, 18= month 9 scheduling efficacy, 19= month 9 goal-setting efficacy, 20- month 9 relapse prevention efficacy, 21= week 1 light intensity activity, 22= month 1 light intensity activity, 23= month 3 light intensity activity, 24= month 6 light intensity activity, and 25= month 9 light intensity activity.

Table 7

Inter-correlations for the efficacy variables and moderate intensity activity.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	-	.59**	.56**	.51**	.47**	.60**	.27**	.40**	.43**	.43**	.70**	.50**	.36**	.32**	.30**	.66**	.50**	.51**	.45**	.45**	.24*	.24*	.24*	.29**	.20
2		-	.68**	.62**	.66**	.45**	.40**	.53**	.56**	.55**	.52**	.74**	.45**	.46**	.41**	.36**	.52**	.38**	.43**	.34**	.26**	.22*	.19	.28**	.20
3			-	.78**	.75**	.52**	.23*	.58**	.51**	.53**	.63**	.56**	.47**	.44**	.43**	.42**	.35**	.52**	.49**	.50**	.20*	.19	.20*	.35**	.13
4				-	.82**	.53**	.29**	.56**	.60**	.59**	.50**	.56**	.45**	.50**	.46**	.33**	.38**	.49**	.51**	.50**	.16	.14	.19	.36**	.17
5					-	.53**	.29**	.59**	.60**	.65**	.54**	.62**	.47**	.49**	.52**	.40**	.52**	.64**	.61**	.65**	.17	.16	.20*	.33**	.22*
6						-	.51**	.70**	.69**	.67**	.90**	.58**	.35**	.50**	.38**	.71**	.50**	.50**	.50**	.48**	.23*	.14	.19	.25*	.16
7							-	.37**	.44**	.34**	.42**	.37**	.08	.24*	.09	.27*	.19	-.05	.06	-.06	.06	-.03	.02	.07	.02
8								-	.90**	.92**	.67**	.74**	.75**	.71**	.70**	.45**	.57**	.61**	.54**	.58**	.18	.11	.17	.25*	.13
9									-	.94**	.61**	.75**	.69**	.75**	.72**	.47**	.62**	.58**	.62**	.56**	.21*	.12	.20*	.25*	.19
10										-	.60**	.74**	.73**	.73**	.79**	.41**	.62**	.62**	.60**	.63**	.19	.12	.17	.26*	.17
11											-	.65**	.47**	.57**	.44**	.69**	.53**	.48**	.45**	.48**	.22*	.19	.28**	.32**	.23*
12												-	.71**	.75**	.70**	.47**	.67**	.45**	.48**	.46**	.23*	.14	.29**	.33**	.31**
13													-	.81**	.88**	.44**	.55**	.65**	.53**	.58**	.11	.01	.20	.24*	.24*
14														-	.82**	.29*	.48**	.42**	.43**	.43**	.07	-.04	.19	.22*	.27*
15															-	.33**	.53**	.57**	.50**	.53**	.07	.05	.14	.20	.20
16																-	.66**	.70**	.61**	.59**	.31*	.32*	.38**	.38**	.31*
17																	-	.81**	.82**	.76**	.21	.27*	.36**	.39**	.35**

18	-	.86**	.88**	.29*	.38**	.36**	.41**	.31*																		
19		-	.88**	.24	.29*	.31*	.35**	.31*																		
20			-	.25*	.25*	.32*	.35**	.28*																		
21				-	.77**	.73**	.64**	.56**																		
22					-	.77**	.66**	.60**																		
23						-	.76**	.70**																		
24							-	.76**																		
25								-																		

Please Note: 1= Baseline task efficacy, 2= baseline barrier efficacy, 3= baseline scheduling efficacy, 4= baseline goal-setting efficacy, 5= baseline relapse prevention efficacy, 6= month 3 task efficacy, 7= month 3 barrier efficacy, 8= month 3 scheduling efficacy, 9= month 3 goal-setting efficacy, 10- month 3 relapse prevention efficacy, 11= month 6 task efficacy, 12= month 6 barrier efficacy, 13= month 6 scheduling efficacy, 14= month 6 goal-setting efficacy, 15- month 6 relapse prevention efficacy, 16= month 9 task efficacy, 17= month 9 barrier efficacy, 18= month 9 scheduling efficacy, 19= month 9 goal-setting efficacy, 20- month 9 relapse prevention efficacy, 21= week 1 moderate intensity activity, 22= month 1 moderate intensity activity, 23= month 3 moderate intensity activity, 24= month 6 moderate intensity activity, and 25= month 9 moderate intensity activity.

Table 8

Inter-correlations for the efficacy variables and vigorous intensity activity.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	-	.59**	.56**	.51**	.47**	.60**	.27**	.40**	.43**	.43**	.70**	.50**	.36**	.32**	.30**	.66**	.50**	.51**	.45**	.45**	.07	-.02	.03	.09	.04
2		-	.68**	.62**	.66**	.45**	.40**	.53**	.56**	.55**	.52**	.74**	.45**	.46**	.41**	.36**	.52**	.38**	.43**	.36**	.10	.05	.06	.12	.00
3			-	.78**	.75**	.52**	.23*	.58**	.51**	.53**	.63**	.56**	.47**	.44**	.43**	.42**	.35**	.52**	.48**	.50**	.16	.10	.13	.19	.00
4				-	.82**	.53**	.29**	.56**	.60**	.59**	.50**	.56**	.45**	.50**	.46**	.33**	.38**	.49**	.51**	.50**	.07	.06	.07	.12	.08
5					-	.53**	.29**	.59**	.60**	.65**	.54**	.62**	.47**	.49**	.52**	.40**	.53**	.64**	.61**	.65**	.14	.07	.14	.14	.09
6						-	.51**	.70**	.69**	.67**	.90**	.58**	.35**	.50**	.38**	.71**	.50**	.50**	.50**	.48**	.10	.07	.06	.11	.12
7							-	.37**	.44**	.34**	.42**	.37**	.08	.24*	.09	.27*	.18	-.05	.06	-.06	.07	.09	.06	.08	.07
8								-	.90**	.92**	.67**	.74**	.75**	.71**	.70**	.45**	.57**	.61**	.54**	.58**	.18	.21*	.22*	.26**	.12
9									-	.94**	.61**	.75**	.69**	.75**	.72**	.47**	.62**	.58**	.62**	.56**	.13	.16	.17	.21*	.10
10										-	.60**	.74**	.73**	.73**	.79**	.41**	.62**	.62**	.60**	.63**	.14	.16	.16	.21*	.14
11											-	.65**	.47**	.57**	.44**	.69**	.53**	.47**	.45**	.48**	.15	.08	.13	.16	.20
12												-	.71**	.75**	.70**	.47**	.67**	.45**	.48**	.46**	.20	.17	.16	.20	.26*
13													-	.81**	.88**	.44**	.55**	.65**	.53**	.58**	.15	.18	.24*	.26*	.26*
14														-	.82**	.29*	.48**	.42**	.43**	.43**	.09	.15	.20	.22*	.19
15															-	.33**	.53**	.57**	.50**	.53**	.08	.13	.21	.18	.18
16																-	.66**	.71**	.61**	.59**	.15	.08	.09	.16	.13

17	-	.81**	.82**	.76**	.15	.10	.09	.13	.08
18		-	.86**	.88**	.18	.04	.20	.17	.10
19			-	.88**	.15	.03	.14	.13	.06
20				-	.16	.04	.13	.17	.05
21					-	.81**	.69**	.65**	.52**
22						-	.74**	.67**	.42**
23							-	.79**	.46**
24								-	.53**
25									-

Please Note: 1= Baseline task efficacy, 2= baseline barrier efficacy, 3= baseline scheduling efficacy, 4= baseline goal-setting efficacy, 5= baseline relapse prevention efficacy, 6= month 3 task efficacy, 7= month 3 barrier efficacy, 8= month 3 scheduling efficacy, 9= month 3 goal-setting efficacy, 10- month 3 relapse prevention efficacy, 11= month 6 task efficacy, 12= month 6 barrier efficacy, 13= month 6 scheduling efficacy, 14= month 6 goal-setting efficacy, 15- month 6 relapse prevention efficacy, 16= month 9 task efficacy, 17= month 9 barrier efficacy, 18= month 9 scheduling efficacy, 19= month 9 goal-setting efficacy, 20- month 9 relapse prevention efficacy, 21= week 1 sedentary activity, 22= month 1 sedentary activity, 23= month 3 sedentary activity, 24= month 6 sedentary activity, and 25= month 9 sedentary activity.

Table 9

Hierarchical regression analysis for predicting Month 6 AEE

	B	t	R	R^2	R^2 Change
	Predicting Month 6 AEE				
Step 1			.28*	.08*	.08*
Month 6 Task Efficacy	.27*				
Step 2			.30	.09	.01
Month 6 Task Efficacy	.11				
Month 3 Task Efficacy	.07				
Month 3 Scheduling Efficacy	.18				
Month 3 Relapse Prevention	-.04				
Step 3			.34	.12	.03
Month 6 Task Efficacy	.12	.43			
Month 3 Task Efficacy	-.06	-.21			
Month 3 Scheduling Efficacy	.11	.32			
Month 3 Relapse Prevention	-.06	-.19			
Baseline Task Efficacy	.09	.49			
Baseline Barrier Efficacy	-.04	-.22			
Baseline Scheduling Efficacy	.11	.43			
Baseline Goal-Setting Efficacy	.16	.72			
Baseline Relapse Prevention Efficacy	-.03	-.13			

**$p < .001$; *$p < .05$

Table 10

Hierarchical regression analysis for predicting Month 9 Sedentary Behaviour

	B	t	R	R^2	R^2 Change
	Predicting Month 9 Sedentary Behaviour				
Step 1			.33*	.11*	.11*
Month 6 Scheduling Efficacy	-.03				
Month 6 Goal-Setting Efficacy	.21				
Month 6 Relapse Prevention	.16				
Step 2			.33	.11	.001
Month 6 Scheduling Efficacy	-.03	-.11			
Month 6 Goal-Setting Efficacy	.19	.94			
Month 6 Relapse Prevention	.15	.57			
Month 3 Goal-Setting Efficacy	.04	.23			

$^{**}p < .001$; $^{*}p < .05$

Table 11

Hierarchical regression analysis for predicting Month 6 Light Intensity Activity

	B	t	R	R^2	R^2 Change
	Predicting Month 6 Light Intensity Activity				
Step 1			.30*	.09*	.09*
Baseline Scheduling Efficacy	-.05	-.30			
Baseline Goal-Setting Efficacy	.12	.66			
Baseline 6 Relapse Prevention	.24	1.30			

$^{**}p < .001$; $^{*}p < .05$

Table 12

Hierarchical regression analysis for predicting Month 9 Light Intensity Activity

	B	t	R	R^2	R^2 Change
	Predicting Month 9 Light Intensity Activity				
Step 1			.34	.12	.12
Month 9 Barrier Efficacy	.08				
Month 9 Scheduling Efficacy	.27				
Month 9 Goal-Setting Efficacy	.01				
Step 2			.34	.12	.003
Month 9 Barrier Efficacy	.08	.34			
Month 9 Scheduling Efficacy	.24	.84			
Month 9 Goal-Setting Efficacy	-.02	-.06			
Baseline Relapse Prevention Efficacy	.08	.45			

$^{**}p < .001$; $^{*}p < .05$

Moderate Intensity Activity. For predicting moderate *intensity* activity at week 1, baseline task, barrier, scheduling efficacy intervention explained 7.0% of the response variance (see Table 13).

For the prediction of month 1 moderate *intensity* activity, baseline task, and barrier efficacy explained 7.0% of response variance (see Table 14).

Hierarchical regression results for the prediction of month 3 moderate *intensity* activity are presented in Table 15. Results showed that month 3 goal-setting efficacy explained 4% of month 3 moderate intensity activity. After controlling month 3 goal-setting efficacy (step 1), the introduction of baseline task, scheduling, and relapse prevention efficacy (step 2) did not make a significant contribution to the prediction of

month moderate *intensity* activity (F change (3, 100) = 1.08, p = .36). Results showed that baseline task, scheduling, and relapse prevention efficacy increased the R^2 by 3%. None of the variables made a significant and unique contribution to the prediction of month 3 moderate intensity activity.

Hierarchical regression results for the prediction of month 6 moderate *intensity* activity are presented in Table 16. Results showed that month 6 task, barrier, scheduling and goal-setting efficacy explained 14% of month 6 moderate *intensity* activity. After controlling month 6 task, barrier, scheduling, and goal-setting efficacy (step 1), the introduction of month 3 task, scheduling, goal-setting and relapse prevention efficacy (step 2) did not make a significant contribution to the prediction of month 6 moderate *intensity* activity (F change (4, 76) = .13, p = .97). Results showed that month 3 task, scheduling, goal-setting and relapse prevention efficacy increased the R^2 by .06%. After controlling month 6 task, barrier, scheduling and goal-setting efficacy (step 1), and month 3 task, scheduling, goal-setting and relapse prevention efficacy (step 2), the introduction of baseline task, barrier, scheduling, goal-setting, and relapse prevention (step 3) did not make a significant contribution to the prediction of month 6 moderate *intensity* activity (F change (5, 71) = .56, p = .73). Results showed that baseline task, barrier, scheduling, goal-setting and relapse prevention efficacy increased the R^2 by 3%. None of the variables made a significant and unique contribution to the prediction of month 6 moderate *intensity* activity.

Hierarchical regression results for the prediction of month 9 moderate *intensity* activity are presented in Table 17. Results showed that month 9 task, barrier, scheduling, goal-setting and relapse prevention efficacy explained 14% of month 9

moderate *intensity* activity. After controlling month 9 task, barrier, scheduling, goal-setting and relapse prevention efficacy (step 1), the introduction of month 6 task, barrier, scheduling, and goal-setting efficacy (step 2) did not make a significant contribution to the prediction of month 9 moderate *intensity* activity (F change 43, 51) = 1.00, $p = .42$). Results showed that month 6 task, barrier scheduling, and goal-setting efficacy increased the R^2 by 6%. After controlling month 9 task, barrier, scheduling, goal-setting and relapse prevention efficacy (step 1), and month 6 task, barrier, scheduling, and goal-setting efficacy (step 2), the introduction of baseline relapse prevention (step 3) did not make a significant contribution to the prediction of month 9 moderate *intensity* activity (F change (1, 50) = .03, $p = .87$. Results showed that baseline relapse prevention efficacy increased the R^2 by 0%. None of the variables made a significant and unique contribution to the prediction of month 9 moderate intensity activity.

Table 13

Hierarchical regression analysis for predicting Week 1 Moderate Intensity Activity

	B	t	R	R^2	R^2 Change
	Predicting Week 1 Moderate Intensity Activity				
Step 1			.27*	.07*	.07*
Baseline Task Efficacy	.11	.86			
Baseline Barrier Efficacy	.12	1.38			
Baseline Scheduling Efficacy	-.01	-.03			

**$p < .001$; *$p < .05$

Table 14

Hierarchical regression analysis for predicting Month 1 Moderate Intensity Activity

	B	t	R	R^2	R^2 Change
	Predicting Month 1 Moderate Intensity Activity				
Step 1			.26*	.07*	.07*
Baseline Task Efficacy	.18	1.51			
Baseline Barrier Efficacy	.11	.89			

**$p < .001$; *$p < .05$

Table 15

Hierarchical regression analysis for predicting Month 3 Moderate Intensity Activity

	B	t	R	R^2	R^2 Change
	Predicting Month 3 Moderate Intensity Activity				
Step 1			.20*	.04*	.04*
Month 3 Goal-Setting Efficacy	.20*				
Step 2			.26	.07	.03
Month 3 Goal-Setting Efficacy	.08	.67			
Baseline Task Efficacy	.16	1.28			
Baseline Scheduling Efficacy	.03	.16			
Baseline Relapse Goal-Setting Efficacy	.06	.35			

**$p < .001$; *$p < .05$

Table 16

Hierarchical regression analysis for predicting Month 6 Moderate Intensity Activity

	B	t	R	R^2	R^2 Change
	Predicting Month 6 Moderate Intensity Activity				
Step 1			.37*	.14*	.14*
Month 6 Task Efficacy	.20				
Month 6 Barrier Efficacy	.26				
Month 6 Scheduling Efficacy	.09				
Month 6 Goal-Setting Efficacy	-.18				
Step 2			.38	.14	.006
Month 6 Task Efficacy	.12				
Month 6 Barrier Efficacy	.24				
Month 6 Scheduling Efficacy	.14				
Month 6 Goal-Setting Efficacy	-.22				
Month 3 Task Efficacy	.11				
Month 3 Scheduling Efficacy	-.09				
Month 3 Goal-Setting Efficacy	.14				
Month 3 Relapse Prevention	-.02				
Step 3			.42	.17	.03
Month 6 Task Efficacy	.10	.33			
Month 6 Barrier Efficacy	.29	1.18			
Month 6	.05	.20			

Scheduling Efficacy		
Month 6 Goal-Setting Efficacy	-.14	-.57
Month 3 Task Efficacy	-.04	-.13
Month 3 Scheduling Efficacy	-.15	-.41
Month 3 Goal-Setting Efficacy	.07	.18
Month 3 Relapse Prevention	.02	.05
Baseline Task Efficacy	.09	.48
Baseline Barrier Efficacy	-.13	-.60
Baseline Scheduling Efficacy	.19	.73
Baseline Goal-Setting Efficacy	.10	.44
Baseline Relapse Prevention Efficacy	.002	.009

$^{**}p < .001$; $^{*}p < .05$

Table 17

Hierarchical regression analysis for predicting Month 9 Moderate Intensity Activity

	B	t	R	R^2	R^2 Change
	Predicting Month 9 Moderate Intensity Activity				
Step 1			.37	.14*	.14*
Month 9 Task Efficacy	.16				
Month 9 Barrier Efficacy	.23				
Month 9 Scheduling Efficacy	-.05				
Month 9 Goal-Setting Efficacy	.11				

Month 9 Relapse Prevention Efficacy	-.04				
Step 2			.45	.20	.06
Month 9 Task Efficacy	.32				
Month 9 Barrier Efficacy	.01				
Month 9 Scheduling Efficacy	-.12				
Month 9 Goal-Setting Efficacy	.13				
Month 9 Relapse Prevention Efficacy	-.00				
Month 6 Task Efficacy	-.29				
Month 6 Barrier Efficacy	.23				
Month 6 Scheduling Efficacy	.10				
Month 6 Goal-Setting Efficacy	.12				
Step 3			.45	.20	.00
Month 9 Task Efficacy	.33	1.34			
Month 9 Barrier Efficacy	.03	.09			
Month 9 Scheduling Efficacy	-.15	-.30			
Month 9 Goal-Setting Efficacy	.12	.34			
Month 9 Relapse Prevention Efficacy	-.01	-.02			
Month 6 Task Efficacy	-.30	-1.29			
Month 6 Barrier Efficacy	.22	.71			

Month 6 Scheduling Efficacy	.11	.30
Month 6 Goal-Setting Efficacy	.11	.36
Baseline Relapse Prevention Efficacy	.03	.17

$^{**}p < .001$; $^{*}p < .05$

Vigorous Intensity Activity. No proceeding efficacy variables were associated with vigorous physical activity at week 1, and month 1.

For the prediction of month 3 vigorous intensity activity, month 3 scheduling explained 5.0% of the response variance (see Table 18).

Hierarchical regression results for the prediction of month 6 vigorous *intensity* activity are presented in Table 19. Results showed that month 6 scheduling and goal-setting efficacy explained 6% of month 6 vigorous *intensity* activity. After controlling for month 6 scheduling and goal-setting efficacy (step 1), the introduction of month 3 scheduling, goal-setting and relapse prevention efficacy (step 2) did not make a significant contribution to the prediction of month 6 vigorous *intensity* activity (F change (3, 79) = .95, p = .42). Results showed that month 3 scheduling, goal-setting and relapse prevention efficacy increased the R^2 by 3%. None of the variables made a significant and unique contribution to the prediction of month 6 vigorous *intensity* activity.

Finally, for the prediction of month 9 vigorous *intensity* activity, month 6 barrier and scheduling efficacy explained 8.0% of the response variance (see Table 20).

Table 18

Hierarchical regression analysis for predicting Month 3 Vigorous Intensity Activity

	B	t	R	R^2	R^2 Change
	Predicting Month 3 Vigorous Intensity Activity				
Step 1			.22*	.05*	.05*
Month 3 Scheduling Efficacy	.22	2.24			

**$p < .001$; *$p < .05$

Table 19

Hierarchical regression analysis for predicting Month 6 Vigorous Intensity Activity

	B	t	R	R^2	R^2 Change
	Predicting Month 6 Vigorous Intensity Activity				
Step 1			.26	.06	.06
Month 6 Scheduling Efficacy	.24				
Month 6 Goal-Setting Efficacy	.03				
Step 2			.31	.10	.03
Month 6 Scheduling Efficacy	.16	.76			
Month 6 Goal-Setting Efficacy	-.01	-.05			
Month 3 Scheduling Efficacy	.44	1.57			
Month 3 Relapse Goal-Setting Efficacy	.09	.28			
Month 3 Relapse Prevention Efficacy	-.39	-1.08			

**$p < .001$; *$p < .05$

Table 20

Hierarchical regression analysis for predicting Month 9 Vigorous Intensity Activity

	B	t	R	R^2	R^2 Change
	Predicting Month 9 Vigorous Intensity Activity				
Step 1			.28*	.08*	.08*
Month 6 Barrier Efficacy	.16	1.06			
Month 6 Scheduling Efficacy	.15	.98			

$^{**}p < .001$; $^{*}p < .05$

Discussion

The first objective of the present study was to examine the effect of an efficacy intervention on task and self-regulatory (i.e., barrier, scheduling, goal-setting and relapse prevention) efficacy in relatives undertaking a 9-month home-based physical activity program. With regards to this objective, it was hypothesized that the efficacy intervention would have higher levels of task and self-regulatory efficacy compared to the attention control condition. This hypothesis was not supported as there were no efficacy differences between treatment groups. This finding may have several explanations. First, both groups were highly active over the 9 months of assessment, which in turn likely affected their efficacy cognitions in a similar manner. Thus, regardless of group, in order to continue to exercise regularly individuals must overcome barriers, schedule exercise sessions, set goals and address relapse prevention issues. Third, the efficacy measures may not have been sensitive enough to detect changes given the 10% increments of the scales used. This is a plausible explanation as participants may have rounded up or down making it difficult to detect changes in

efficacy scores. Fourth, although email interventions have been shown to be an effective delivery method (e.g., Gollings & Paxton, 2006), it did not prove to be the most effective delivery method in the current study as efficacy levels declined regardless of treatment condition. Thus, a different mode of delivery may yield more positive results. Particularly, an internet intervention may have been more effective as it has been shown to improve a number of health outcomes (e.g., exercise behaviour— Wantland, Portillo, Holzemer, Slaughter, & Mcghee, 2004), and it can be tailored to the user's needs, and provide instantaneous feedback (Fotheringham & Owen, 2000).

Results also showed that regardless of treatment condition, all efficacy variables decreased over the 9-month physical activity program. This is in contrast to the efficacy patterns shown by participants in the 12-week structured and supervised program. During that phase of the program, only scheduling efficacy declined. Task and barrier efficacy increased and goal-setting and relapse prevention efficacy remained stable. These findings, taken together, suggest that efficacious beliefs are more challenging to maintain and possibly improve during a home-based physical activity program than a structured and supervised exercise program. The goal of long-term home-based physical activity interventions appears to attenuate the decline of these self-efficacious cognitions.

Another objective of the current study was to examine the effect of an efficacy intervention on objective free-living physical activity behaviour (i.e., AEE, sedentary behaviour, light, moderate and vigorous *intensity* activity). Specifically, it was hypothesized that relatives receiving the efficacy intervention would have higher AEE, spend less time (i.e., minutes) in sedentary behaviour and light activity, and more time

in moderate and vigorous *intensity* activity when compared to the attention control condition. This hypothesis was not supported, as there were no differences between groups on their physical activity behaviour. Although not statistically significant, the results revealed that the efficacy intervention group had higher AEE at all time points. The eta square statistic (.04) indicated small effects (Cohen, 1992) and that a significant finding would likely have occurred with a larger sample. In short, the study was likely underpowered to show a significant effect for AEE.

For time spent in the predetermined *intensity* cut-off point, our results showed that those in the intervention condition spent less time in sedentary and light *intensity* activity. Contrary, the attention control group, in general, spent more time in moderate and vigorous *intensity* activity. However, it should be noted that the groups spent very little time in vigorous *intensity* activity and the values are representative of only a few participants who participated in vigorous *intensity* activity.

Although significant differences between groups were not found, it should be noted that results demonstrate that both groups engaged in levels of free-living energy expenditure that exceed recommended guidelines for colon cancer protection (Lee, 2003), as well as for other health benefits (Warbutron, Nicol, & Bredin, 2006*ab*). This is of particular importance as empirical-based evidence showing that physical activity can be enhanced and more importantly maintained in those "at risk" of colon cancer is essential before longitudinal prospective studies can be conducted that evaluate the protective benefits of physical activity.

The final objective was to explore the ability of proceeding efficacy variables to predict objective physical activity in a 9-month home-based physical activity program.

It was hypothesized that the task and self-regulatory efficacy variables would predict objective physical activity behaviour (i.e., AEE, sedentary behaviour, light, moderate and vigorous *intensity* activity). With respect to AEE, results showed that proceeding efficacy variables were only able to predict AEE at 6 months and explained 12% of the response variance. The fact that efficacy was associated with AEE at only one of the four assessment time point is perplexing. The means and variances for these two variables suggest that the non-significant findings at week 1, months 1, 3, and 9 cannot be accounted by restrictions in range (cf. McNemar, 1969).

With respect to weekly time spent at different levels of physical activity *intensity*, results revealed that month 6 goal-setting and relapse prevention efficacy contributed the most to the prediction of month 9 sedentary behaviour. Baseline relapse prevention efficacy contributed the most to the prediction of month 6 light *intensity* activity, while month 9 scheduling efficacy contributed the most the prediction of month 9 light *intensity* activity. These findings, taken in concert, demonstrate that self-regulatory cognitions are important for the maintenance of light *intensity* physical activity in the later stages of a home-based physical activity program.

Results also showed that the efficacy variables predicted a reasonable amount of variance (range 7 to 20%) of moderate *intensity* activity. The only variables to show an association were task and barrier efficacy. Specifically, baseline task efficacy was related to all assessment points except month 6 and month 9. Additionally, baseline barrier efficacy was associated with week 1, while month 6 barrier efficacy was related to month 6 and month 9 moderate *intensity* activity. Overall, these prediction results

demonstrate that both task and barrier efficacy offer meaningful insight into the prediction of moderate *intensity* activity.

Finally, the efficacy variables predicted 5% to 10% of vigorous *intensity* activity. Specifically, scheduling efficacy at various time points was able to predict month 3, 6 and 9 vigorous *intensity* activity. Additionally, month 3 relapse prevention contributed the most to the prediction of month 6 vigorous intensity activity, while month 6 barrier efficacy contributed the most to the prediction of month 9 vigorous *intensity* activity. It should be noted that it is unfortunate that the efficacy intervention was not able to effectively manipulate task and self-regulatory efficacy as these variables were found to be predictors of time spent at different intensity levels of physical activity.

These findings raise the question of why do efficacious beliefs predict moderate *intensity* activity more consistently than sedentary, light and vigorous? A possible explanation for this result is that systematic reporting errors and biases have been found to be related to characteristics of the activities being reported (Durante & Ainsworth, 1996). Particularly, research has established that sedentary and light *intensity* physical activity have been less accurately recalled (Matthews, 2002), while moderate to vigorous *intensity* physical activity can be recalled with reasonable accuracy (Jacobs, Ainsworth, Hartman, & Leon, 1993). In the present study the majority of time was spent in sedentary to light physical activity—activity that likely would have been difficult to recall from an efficacious perspective. For vigorous *intensity* activity, a small proportion of time was spent by participants in this category (less than 1%).

Hence there was likely not enough variability in this measure to show an association with efficacy.

The present study had several methodological strengths. This is the first research trial to explore the following issues in a population of relatives of colon cancer patients participating in a 9-month home-based physical activity program: (a) testing the utility of an efficacy intervention on both task and self-regulatory (i.e., barrier, scheduling, goal-setting and relapse prevention) efficacy, (b) examining the temporal patterns of these efficacious beliefs, (c) testing the utility of an efficacy intervention influence on objectively physical activity behaviour (i.e., AEE, sedentary, light, moderate, vigorous), (d) examining the prediction of objectively measured physical activity behaviour using both task and self-regulatory efficacy. Another strength was the prospective/ longitudinal study design, which allowed for the examination of the relationship between efficacy and physical activity behaviour. A further strength was that the study employed a randomized control design.

The main limitation of the current study is that the primary investigator who measured the key outcomes was not blinded to group allocation as she was responsible for administering the efficacy and attention control interventions. Additionally, the results are not generalizable beyond first- and second-degree relatives of colon cancer patients. Another limitation which was briefly mentioned is the issue of statistical power. Larger group numbers would have likely changed non-significant physical activity (i.e., AEE) and sedentary behavior findings to significant ones. Additionally, the sample of males in the study was considerably smaller than the sample of females, thus a larger sample of males would have allowed us to examine our data across gender.

Finally, the sample was comprised of mostly first-degree relatives of colon cancer patients making it unfeasible to examine our data across familial history.

In conclusion, the results of the present study demonstrate the importance of exploring both task and self-regulatory efficacy when examining health behaviour change (e.g., exercise behaviour) and maintenance (Bandura, 1995, 2004; Rodgers et al., 2002). Specifically, the present study revealed that the efficacy intervention was unsuccessful in preventing decreases in efficacious beliefs during a home-based physical activity program. The intervention was also modest in its ability to assist relatives of colon cancer patients adopt and maintain their physical activity behaviour (i.e., AEE) in a home-based physical activity program. Finally, baseline task and self-regulatory efficacy variables were shown to predict objective measured physical activity behaviour (i.e., AEE, sedentary behaviour, light, moderate and vigorous *intensity* physical activity behaviour) throughout the 9-month home-based physical activity program.

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Summary, Implications, and Future Directions

The initiation, adoption, and maintenance of an exercise or physical activity program can be a complex and challenging endeavour. Bandura (1995) further argues that the management of regular exercise and physical activity necessitates self-regulatory efficacy. Given that self-regulatory skills are integral to health behaviour change, the components comprising self-regulatory efficacy have been explored in the physical activity and exercise domain. Although self-regulatory efficacy encompasses multiple self-regulatory skills (i.e., barrier, scheduling, goal-setting, and relapse prevention), the majority of research thus far has examined barrier and scheduling efficacy (e.g., DuCharme & Brawley, 1995; Rodgers et al., 2002).

In the present dissertation, three interrelated research studies were performed to provide insight into the initiation, adoption, and maintenance of physical activity behaviour in first- and second-degree relatives of colon cancer patients. Moreover, these studies represent an attempt to advance the literature comprising Protection Motivation Theory (Rogers, 1975; 1983; Rogers & Prentice-Dunn, 1997) and self-efficacy in the exercise and physical activity domain.

The purpose of Study 1 (McGowan & Prapavessis, 2009) was to investigate the effectiveness of a Protection Motivation Theory intervention in its ability to modify beliefs towards: (a) colon cancer and exercise, and (b) exercise intentions among physically inactive relatives of colon cancer patients. A secondary objective was to explore the predictive ability of the four Protection Motivation Theory variables in the prediction of exercise intention. Results suggest that colon cancer information is a meaningful source of exercise motivation for relatives of colon cancer patients. In

particular, relative to the attention control group, participants in the intervention group reported stronger perceptions regarding their vulnerability in the development of colon cancer and reported greater perceptions of coping resources (i.e., response efficacy and self-efficacy) to reduce this threat. Furthermore, participants in the intervention group reported stronger intentions to exercise compared to the attention control group. Additionally, results indicated that the strongest predictors of exercise intentions were response efficacy and self-efficacy.

Study 2 (McGowan, Prapavessis, Podolinsky, Gray, & Elkayam, 2009a) exposed participants from Study 1 to a 12 week structured and supervised exercise program and explored four issues: (a) the utility of an efficacy intervention on levels of task and self-regulatory (i.e., barrier, scheduling, goal-setting and relapse prevention) efficacy, (b) the temporal pattern of these efficacious beliefs, (c) the influence of an efficacy intervention on objectively measured exercise adherence (i.e., *frequency*, *intensity*, and *duration*), and (d) the prediction of exercise adherence based upon proceeding efficacy beliefs. Results demonstrated that treatment groups did not differ on their reported efficacy beliefs. Further, the efficacious beliefs demonstrated different temporal patterns. Specifically, task and barrier efficacy increased, goal setting and relapse prevention efficacy remained stable, while scheduling efficacy decreased. The efficacy intervention group exercised for longer *duration* in the early phase of the program (i.e., 0-4 weeks) than the attention control group; however no significant group differences emerged with regard to exercise *frequency* and *intensity*. Differential loss was demonstrated between groups at weeks 4, 8, and 12, suggesting that the efficacy intervention had a reasonable effect on reducing dropout rates. Finally, the variables of

task and scheduling efficacy provided meaningful and significant prediction to the exercise adherence measures (i.e., *frequency*, *intensity*, and *duration*). Specifically, scheduling efficacy was the strongest predictor for exercise *frequency*, while task efficacy significantly predicted exercise *duration* and *intensity*.

Finally, participants from Study 2 moved into a home and community based physical activity program (Study 3- McGowan, Prapavessis, Podolinsky, Gray, & Elkayam, 2009b). The purpose was to examine the: (a) effects of an efficacy intervention on task, and self-regulatory (i.e., barrier, scheduling, goal-setting and relapse prevention) efficacy (b) temporal pattern of these efficacious beliefs, (c) effects of an efficacy intervention on objective physical activity behaviour (i.e., AEE, sedentary behaviour, light, moderate and vigorous *intensity* activity), and (d) ability of the proceeding efficacy variables to predict objectively measured physical activity behaviour. Results suggested that the efficacy intervention was not successful in the manipulation of efficacy levels, as these did not differ between groups. Further, all efficacy variables decreased over the course of the 9-month home-based program. No differences emerged between the groups with regards to their physical activity behaviour. Although not statistically significant, results indicated that the efficacy intervention group exhibited more AEE and less sedentary behaviour at all time points compared to the attention control condition. Results further demonstrated that proceeding efficacy variables predicted AEE only at the Month 6 time-point. Finally, results revealed that participants in both groups surpassed the ACSM/CDC (2009) physical activity guidelines one year following enrollment in this study. This noteworthy finding suggests that relatives of colon cancer patients are capable of

engaging in free-living energy expenditure that actually exceeds the guidelines recommended for colon cancer prevention (Lee, 2003), and other health benefits (Warbutron, Nicol, & Bredin, 2006). Indeed, further research is warranted to offer support for our findings that physical activity can be both enhanced and maintained among individuals "at risk" of colon cancer. Subsequently, longitudinal prospective studies need be conducted to evaluate and delineate the protective factors and benefits of physical activity in this population.

Despite the limitations noted in each of the three studies, this dissertation research has made some noteworthy contributions to the existing exercise and health psychology literature. Further, these studies provide guidance for future research avenues. The Protection Motivation Theory (Rogers, 1975; 1983; Rogers & Prentice-Dunn, 1997) literature was advanced by the demonstration that a single-exposure media intervention grounded in a Protection Motivation Theory framework modified (changed) exercise and colon cancer beliefs and exercise intentions. This is indeed a valuable contribution, as the intention to exercise is the first step required for an individual to undertake a physical activity program (Estabrooks & Gyurcsik, 2003). There are a number of substantial research avenues stemming from the findings of Study 1. Future research should focus on bridging the intention-behaviour (e.g., exercise and physical activity) gap through implementation intentions. Research has suggested that intention goals do not trigger behaviour directly, but may lead to specific intention plans that prompt behaviour (Taylor, Pham, Rivkin, & Armor, 1998). Milne, Orbell, and Sheeran (2002) found that a Protection Motivation Theory intervention only changed exercise behaviour when combined with an implementation intention

intervention. A recommendation for future research is to consider tailoring messages to an individual's style of processing health information (e.g., Salovey & Williams-Piehota, 2004). It is likely that matched messages will be more effective at promoting exercise and physical activity motivation compared to mismatched messages. It is possible that the messages presented in Study 1 were not matched to all participants' processing styles.

Studies 2 and 3 reflect an attempt to extend the self-efficacy and exercise and physical activity research by: (a) expanding the operationalization of self-regulatory efficacy by assessing multiple self-regulatory skills, and (b) examining the ability of self-regulatory efficacy to predict objective measures of exercise adherence (i.e., *frequency*, *intensity*, and *duration*), and physical activity behaviour (i.e., AEE). The results provide practical and clinical implications for exercise interventionists. In particular, Study 2 and Study 3 highlight the need to manipulate task and self-regulatory efficacy, as they were both predictors of exercise and physical activity behaviour. Although the efficacy intervention in the current studies was not effective in the manipulation of task and self-regulatory efficacy, other researchers have been successful (e.g., Cramp & Brawley, 2009; Rejeski et al., 2003; Woodgate & Brawley, 2008; Woodgate, 2005) with less motivated and efficacious individuals. Thus, future intervention research is needed to determine the most effective means by which self-efficacy can be strengthened in structured and home-based physical activity programs.

Clearly, the impact of self-efficacy interventions on exercise adherence and physical activity behaviour could be extended to other populations that could significantly benefit from increased levels of activity. For example, similar research

programs could be undertaken with breast and colon cancer patients, obese persons, and individuals suffering from diabetes mellitus. This research direction is of particular importance. Theoretically, individuals with greater self-efficacy should be more likely to adjust and adapt exercise regimens in the face of challenging situations (Maddux & Lewis, 1995), in addition to maintaining exercise to attain health benefits. Hence, future research into self-efficacy and its relation to physical activity could have significant implications to the disease prevention and treatment among clinical populations.

As recommended by Maddux and Lewis (1995) future interventions should continue to include more than one source of efficacy, as they should be more effective at increasing an individual's efficacious beliefs. Additionally, future research should focus on understanding how self-regulatory efficacy is being used in both diseased and non-diseased populations. The current studies represent an important step forward in this line of research.

Based on the results presented in this dissertation, there is considerable evidence supporting the critical role that self-regulatory efficacy plays in exercise adherence and physical activity behaviour. These studies are presented with the intent that this program of research will provide a foundation for the development of interventions designed to increase physical activity behaviour. Further research into this interesting area and its clinical and practical implications are underscored.

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Appendix A

Stage of Exercise Readiness Questionnaire

Study 1

STAGE OF EXERCISE READINESS

Please place a tick (√) next to the statement that best applies to yourself.

☐ I do *not* currently exercise and am *not* seriously thinking about changing in the next 6 months.

☐ I do *not* currently exercise *but* I am seriously thinking about changing in the next 6 months.

☐ I exercise sometimes but *not* regularly (less than 2 times each week for at least 30 minutes each time).

☐ I have started to exercise regularly (at least 3 or more times each week for at least 30 minutes each time) in the last 6 months.

☐ I exercise regularly (at least 3 or more times each week for at least 30 minutes each time) and have done so for *longer* than 6 months.

Appendix B

Beliefs towards Exercise and Colon Cancer Questionnaire

Study 1

Exercise and Colon Cancer Study

Erin McGowan and Dr. Harry Prapavessis
The University of Western Ontario

Instructions

The questionnaire asks about your perceptions and so there is no right or wrong answers. All we ask is that you provide honest responses. All responses are completely confidential and will never be used in any way that could link them to you. It is important to complete all questions so that we can include your responses in our analyses. If you have any questions about completing the questionnaire, please ask the research assistant.

ıe following questions ask you about your perceptions of colon cancer, physical exercise, and
e potential link between the two. Please complete each question using the scales that are
ovided.

Personally, I feel vulnerable to developing colon cancer at some point in my life.

	2	3	4	5	6	7
rongly isagree	Moderately Disagree	Slightly Disagree		Slightly Agree	Moderately Agree	Strongly Agree

I feel that my chance of developing colon cancer at some point in my life is:

1	2	3	4	5	6	7
‹tremely Low	Quite Low	Fairly Low		Fairly High	Quite High	Extremely High

I think it is likely that I will develop colon cancer at some point in my life.

1	2	3	4	5	6	7
rongly isagree	Moderately Disagree	Slightly Disagree		Slightly Agree	Moderately Agree	Strongly Agree

Compared to the average person, I feel that my chance of developing colon cancer is:

1	2	3	4	5	6	7
Much Lower	Lower	Slightly Lower	About the Same	Slightly Higher	Higher	Much Higher

I feel colon cancer would be a very serious illness for me to develop.

1	2	3	4	5	6	7
rongly isagree	Moderately Disagree	Slightly Disagree		Slightly Agree	Moderately Agree	Strongly Agree

. If you developed colon cancer, how much would it interfere with you leading a normal ife?

1	2	3	4	5	6	7
Jot at all			Moderately			Very Much

. I feel that if I were to develop colon cancer, it would seriously affect me for the rest of my ife.

1	2	3	4	5	6	7
trongly Disagree	Moderately Disagree	Slightly Disagree		Slightly Agree	Moderately Agree	Strongly Agree

. The thought of getting colon cancer scares me.

1	2	3	4	5	6	7
trongly Disagree	Moderately Disagree	Slightly Disagree		Slightly Agree	Moderately Agree	Strongly Agree

. I feel that physical exercise would help me to personally reduce my risk of colon cancer.

1	2	3	4	5	6	7
trongly Disagree	Moderately Disagree	Slightly Disagree		Slightly Agree	Moderately Agree	Strongly Agree

0. How effective do you feel physical exercise would be for reducing your risk of colon ancer?

1	2	3	4	5	6	7
Jot at all ffective		Slightly Effective		Moderately Effective		Extremely Effective

1. I think physical exercise is one of the most important risk factors for colon cancer that I ould change.

1	2	3	4	5	6	7

ongly sagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

. I feel that the evidence linking physical exercise to colon cancer reduction is very ong.

1	2	3	4	5	6	7
ongly sagree	Moderately Disagree	Slightly Disagree		Slightly Agree	Moderately Agree	Strongly Agree

. For me to do the types and amount of physical exercise necessary to reduce my risk of lon cancer would be:

1	2	3	4	5	6	7
tremely asy			Moderately Easy/Difficult			Extremely Difficult

. If I wanted to I could easily do the types and amount of physical exercise necessary to duce my risk of colon cancer.

1	2	3	4	5	6	7
rongly isagree	Moderately Disagree	Slightly Disagree		Slightly Agree	Moderately Agree	Strongly Agree

. How much control do you have over doing the types and amount of physical exercise cessary to reduce your risk of colon cancer?

1	2	3	4	5	6	7
ery Little ontrol			Moderate Control			Complete Control

. How confident are you that you are capable of doing the types and amount of physical tercise necessary to reduce your risk of colon cancer?

1	2	3	4	5	6	7
Not at all Confident			Moderately Confident			Completely Confident

.7. Would you be interested in finding out more about reducing your risk of colon cancer hrough physical exercise?

1	2	3	4	5	6	7
Not at all nterested			Moderately Interested			Very Interested

.8. How likely is it that colon cancer prevention would motivate you to exercise?

1	2	3	4	5	6	7
Extremely Unlikely	Quite Unlikely	Slightly Unlikely		Slightly Likely	Quite Likely	Extremely Likely

19. Would you seriously consider starting an exercise program designed to reduce your risk of colon cancer?

1	2	3	4	5	6	7
Not at all			Perhaps			Very Seriously

20. Do you plan to start an exercise program to reduce your risk of colon cancer in the near future?

1	2	3	4	5	6	7
Definitely Not			Maybe			Definitely

Appendix C

Letter of Information/ Consent Form

Studies 1, 2 and 3

Western

Letter of Information

Initiating and Maintaining Exercise in First and Second-Degree Relatives of Colon Cancer Patients: A Matter of Self-Regulation

Purpose and Study Information:

You are invited to participate in a study that examines the effectiveness of an intervention strategy that seeks to enhance physical activity behaviour in first-degree relatives of colon cancer patients. The overall research program consists of three sequential phases that will each address the following exercise compliance issues: PHASE I increasing exercise motivation and intention; PHASE II increasing exercise initiation and adoption during an 12-week structured and supervised exercise program; and PHASE III successfully maintaining exercise compliance during a 9-month home-based program. If you agree to participate, you will be asked to participate in all three of the study's phases. Each participant will be randomly assigned to one of two groups; the intervention group or the attention control group.

Phase 1:

The first phase of the study will involve completing some baseline questionnaires (i.e., demographic questionnaire, beliefs towards colon cancer and exercise and par-q). One week later, you will watch a DVD that will present health information. Following watching the DVD, you will be asked to complete several questionnaires designed to assess your beliefs toward colon cancer and exercise, and exercise intentions.

Phase II:

Phase II of the study will involve attending a 12-week structured and supervised exercise program at the Exercise and Health Psychology Lab at UWO. The exercise program will consist of supervised sessions including both walking and stationary cycling and will last approximately 60-minutes, with 10-15 minutes of light aerobic warm-up and gentle stretching before and after exercise. The intensity of exercise training will be graduated based upon participants' cardiorespiratory fitness and will be available up to seven times per week. Fitness testing will be conducted at week 1, 6 and at the end of the phase at week 12. Again questionnaires will be administered at week 1, 4, 8 and 12 to assess psychological variables related to exercise. Additionally, at week 1 and at week 12 you will be asked to take part in a body scan to assess your total body composition. You will be scanned using the dual energy x-ray absorptiometry (iDEXA). The iDEXA is used to determine bone mineral density, body fat and lean mass percentages through low dose radiation. The amount of radiation used during an iDEXA scan is extremely small and is about the same as the average amount of background radiation that we experience daily. Thus, no complications are expected with the iDEXA procedure. You should not participant in this study if you are pregnant or think that you may be pregnant due to the radiation exposure from the iDEXA scan.

Phase III:

The third and final phase will consist of making the transition into a 9-month home exercise maintenance program, where you will be expected to exercise a minimum of three times per week at your preferred community setting (e.g. a local gym or outdoors). You will be asked to complete the same questionnaires, as in phase II at 3, 6 and 9 months and you will also be asked to complete another fitness test at 9 months to assess your cardiorespiratory fitness. Throughout the study, exercise behaviour will be assessed using self-report measures (i.e. questionnaires) and through activity sensors (i.e. heart rate monitors and accelerometers). Additionally, another body scan will be conducted at the end of the research study. Finally, at the end of the study, a representative sample of participants from the intervention condition will be asked to participate in one of four focus groups, in which they will be asked to describe their reactions to the various aspects of the program to provide valuable data regarding the effectiveness of the intervention.

Confidentiality and Voluntary Participation

Your participation in this study is completely confidential. The information that we collect from you will only be for the use of the study investigators. By participating in this three-phase research study you are agreeing that your results may be used for scientific purposes, including publication in scientific and health journals. The results of the study will be reported without identifying you personally, so your anonymity will be maintained. Your participation in this study is also completely voluntary. You may refuse to answer any questions, or withdraw from the study at any time without consequence. If you chose to withdraw from the study you may be approached to identify why you have withdrawn. This information is valuable for future research and will give the researchers information on ways to improve the study. Also, if you choose to withdraw you will be approached to see if you are interested in rejoining the study at the onset of the next phase. Please also be aware that the information that has been collected prior to your withdrawal may still be used for research purposes. There are few anticipated risks associated with your participation in this study.

This letter is for you to keep. If you have any concerns, please feel free to contact one of the researchers below. You may request the general findings of this research study from the researchers after the study is complete. If you have any questions about the conduct of this study, or your rights as a participant, you may contact the Director, Office of Research Ethics, The University of Western Ontario, 519-661-3036.

Erin McGowan, BSc., MSc. Kinesiology
PhD Exercise & Health Psychology Candidate
School of Kinesiology
University of Western Ontario
Ontario

Dr. Harry Prapavessis
Professor
School of Kinesiology
University of Western

Informed Consent

Initiating and maintaining exercise in first-degree relatives of colon cancer: A matter of Self-Regulation

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

Consenting Signature:

Participant's Signature: _____ Date: _____

Participant's Printed Name: _____

Signature of Person:

Obtaining Informed Consent: _____ Date: _____

Printed Name of Person Obtaining Informed Consent: _____

Appendix D

Demographic Questionnaire

Studies 1, 2 and 3

DEMOGRAPHIC INFORMATION

Please answer the following questions. Remember, there are no right or wrong answers, so please try to answer each question as honestly as possible.

Part A:

Full Name: _____

Telephone Number (Home, Business or Cell): _____

Email Address: _____

□ Male □ Female

Age: _____ Date of Birth (M/D/Y): _____

Height (in): _____ Weight (lbs): _____

Education Level:
□ Did not complete High School
□ High School
□ College
□ University- Bachelor Degree
□ University- Graduate Degree
□ University- PhD

Occupation: _____

Ethnicity:
□ Caucasian
□ African American
□ Native American
□ Hispanic
□ Other: (please specify): _____

Cancer History:
What is your association to the person with colon cancer: _____

Are you part of the colon cancer registry? □ yes □ no

Appendix E

Task and Self-Regulatory Efficacy Questionnaires

Studies 2 and 3

TASK SELF-EFFICACY SCALE

Please indicate below how confident you are that you can successfully carry out each of the activities below using the following scale.

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
No Confidence At all Somewhat Confident Completely Confident

For example if you have complete confidence that you can walk for 10 minutes at a moderately fast pace, you would circle 100%. However, if you are not very confident that you can walk 20 minutes without stopping, you would circle a number closer to the zero end of the scale.

NOTE: Effort indicates perceived exertion during continuous exercise.

EASY EFFORT– there is minimal shortness of breath or discomfort experienced. You are able to talk easily while exercising.
MODERATE EFFORT– is a harder effort, in which you will experience some shortness of breath and tolerable muscular discomfort. You will be able to talk in between breaths. You will experience some sweating.
HARD EFFORT– at this pace you will definitely experience shortness of breath, muscular discomfort and sweating. You will be able to say individual words but not hold a conversation.

I Believe That I Can Exercise...

1. For 20 **minutes** at an **easy effort** without stopping . _____
2. For 30 **minutes** at an **easy effort** without stopping. _____
3. For 40 **minutes** at an **easy effort** without stopping. _____
4. For 50 **minutes** at an **easy effort** without stopping. _____
5. For 20 **minutes** at a **moderate effort** without stopping. _____
6. For 30 **minutes** at a **moderate effort** without stopping. _____
7. For 40 **minutes** at a **moderate effort** without stopping. _____
8. For 50 **minutes** at a **moderate effort** without stopping. _____
9. For 20 **minutes** at a **hard effort** without stopping. _____
10. For 30 **minutes** at a **hard effort** without stopping. _____
11. For 40 **minutes** at a **hard effort** without stopping. _____
12. For 50 **minutes** at a **hard effort** without stopping. _____

BARRIER EFFICACY SCALE

Using the scale below, please indicate how confident you are that you could exercise in the event that any of the following circumstances were to occur.

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
No Confidence At all Somewhat Confident Completely Confident

For example if you have complete confidence that you can exercise, even if you are bored by the activity, you should circle 100%. However, if you are absolutely sure that you could not exercise if you failed to make or continue to make progress you would circle 0% (No confidence at all).

I believe that I can exercise 3 times per week if:

1. The weather is very bad (hot, humid, rainy, snow, cold). _____
2. I was bored by the program or activity. _____
3. I was on holiday. _____
4. I felt pain or discomfort. _____
5. I had to exercise alone. _____
6. Exercise was not enjoyable or fun. _____
7. It became difficult to get to the exercise location. _____
8. I didn't like the particular activity that I was involved in. _____
9. My work/study schedule conflicted with my exercise. _____
10. I felt self-conscious about my appearance. _____
11. I was not offered encouragement. _____
12. I was under personal stress of some kind. _____

SELF-REGULATORY QUESTIONNAIRES

Please indicate how confident you are that you can complete each of the following behaviours regularly <u>using the scale below</u>.

Place the appropriate number from the scale (0-100) on the line following the statement.

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Not at all confident					Somewhat confident					completely confident

SCHEDULING SELF-EFFICACY

1. Attend exercise sessions three times per week for the next 12 weeks no matter what. _____
2. Plan for the attendance of my exercise sessions in my daily activities. _____
3. Arrange my schedule to exercise regularly no matter what over the next 12 weeks. _____
4. Maintain a definite plan to restart exercise if I should miss several sessions or weeks of sessions during the next 12 weeks. _____
5. Make up times when I missed my regular exercise session. _____
6. Make sure that I do not miss more than one week of exercise due to other obligations during the next 12 weeks. _____
7. Organize time and responsibilities around each exercise session during the next 12 weeks no matter what. _____

GOAL SETTING SELF-EFFICACY

1. Set realistic goals for maintaining my exercise. _____
2. Set realistic goals for increasing my exercise. _____
3. Develop plans to reach my exercise goals. _____
4. Follow through with my exercise goals, even though it may be difficult at times. _____

The following items concern your ability to deal with lapses in your exercise regimen. Please rate how confident you are to do the following over the next 12 weeks.

Place the appropriate number from the scale (0-100) on the line following the statement.

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Not at all confident					Somewhat confident					completely confident

RELAPSE PREVENTION SELF-EFFICACY

1. Anticipate problems that might interfere with my exercise schedule. _____
2. Develop solutions to cope with potential barriers that interfere with my exercise schedule._____
3. Resume regular exercise when it is interrupted and I miss exercise for a few days. _____
4. Resume regular exercise when it is interrupted and I miss exercise for a few weeks. _____
5. Identify key factors that trigger lapses in my exercise program. _____
6. Learn to accept lapses in my exercise program as normal. _____
7. Learn to view lapses in my exercise program as challenges to overcome rather than failures. _____

Appendix F

Exercise Prescription

Study 2

Exercise Guidelines

Intensity of Exercise:

Target Heart Rate Zone- From The Karvonen Formula (see next page)

Week	Minimum	Maximum
Weeks 1 to 2	40% of HR Reserve HR _____	55% of HR Reserve HR _____
Weeks 3 to 4	50% of HR Reserve HR _____	65% of HR Reserve HR _____
Weeks 5 to 12	60% of HR Reserve HR _____	75% of HR Reserve HR _____

Minutes in Target HR Zone

Week	Minimum	Maximum
Weeks 1 to 2	15 Minutes in Target HR zone	35 Minutes in Target HR zone
Weeks 3 to 4	25 Minutes in Target HR zone	45 Minutes in Target HR zone
Weeks 5 to 12	35 Minutes in Target HR zone	55 Minutes in Target HR zone

Duration of Exercise:

Week	Minimum	Maximum
Weeks 1 to 2	20 Minutes of Exercise	40 Minutes of Exercise
Weeks 3 to 4	30 Minutes of Exercise	50 Minutes of Exercise
Weeks 5 to 12	40 Minutes of Exercise	60 Minutes of Exercise

Appendix G

Classroom/ Intervention Material for Efficacy and Attention Control Groups

Study 2

Study 2- Exercise: Efficacy Intervention

Session	Content
Session 1: Week 1	Benefits of Exercise Short-Term Benefits Long-Term Benefits Understanding your Body's Response to Exercise Exercise- Starting out on the Right Foot Warm-Up, Cool-Down and Stretching Frequency of Exercise Duration of Exercise Exercise Intensity Target Heart Rate My Exercise Logbook
Session 2: Week 2	Imaging Success Imagery Scenario Personal Imagery Exercise The Buddy System What is the Buddy System? What are the Benefits of Using The Buddy System? Group Activity- Buddy Selection Vicarious Experience Interviews- How to Increase Confidence Towards Exercising Rewarding Yourself My Exercise Logbook
Session 3: Week 3	Mastery Experiences Exercise Scheduling Exercise Barriers Coping with Stress Vicarious Experiences Role Playing Scenarios

	Imagery Experience Imaging Successfully Handling Situations Buddy System: Helping you Maintain The Behaviour Rewards Activity: Exercise Maintenance My Exercise Logbook
ssion 4: Week 4	Mastery Experiences Exercise Lapses Vicarious Experiences Role Playing Scenarios Imaging Success Imagery Scenario Buddy System- Helping Overcome Slips Rewarding Yourself for Overcoming Lapses and Relapses My Exercise Logbook
ssion 5: Week 6	Mastery Experiences Your Body's Continued Reaction to Exercise Reviewing Past Logbook Entries Imaging Success Personal Imagery Experience My Exercise Logbook
ssion 6: Week 8	Mastery Experiences Exercise Scheduling Overcoming Exercise Barriers Coping with Stress Effectively Buddy System My Exercise Logbook

ssion 7: Week 10	Vicarious Experiences Role Playing Scenarios Buddy System Rewarding Yourself My Exercise Logbook
ssion 8: Week 11	Mastery Experiences- Making the Transition Target Heart Rate Activity- Finding your Heart Rate Intensity of Common Activities Exercise Scheduling Exercise Barriers Great I-D-E-A Activity Imaging Success Imagery Scenario Vicarious Experiences Role Playing Scenario Buddy System Rewards- Successful Transition My Exercise Logbook
ssion 9: Week 12	Mastery Experiences Coping with the Stress of Making the Transition Scheduling Activities Preparing for a Lapse in Your Home-Based Physical Activity Program Benefits of Social Support My Exercise Logbook

Study 2- Nutrition: Attention Control Intervention

Session	Content
ssions 1 & 2: Weeks 1 & 2	Energy Sources Carbohydrates Proteins Fats Vitamins and Minerals Water Group Activity- Identifying Energy Sources and Nutrients in Common Foods My Nutrition Logbook
ssions 3 & 4: Weeks 3 & 4	Eating Well with Canada's Food Guide The Four Food Groups Understanding Serving Sizes Key Nutrients in the Food Groups Healthy Eating Tips Group Activity- Planning Meals and Snacks According to Canada's Food Guide My Nutrition Logbook
ssion 5: Week 6	Eating Well with Canada's Food Guide Review Canada's Food Guide to Healthy Eating Card Tips to Help you Follow the Food Guide Group Activity- Developing Personal Strategies My Nutrition Logbook
ssion 6 & 7: Weeks 8 & 10	How to Read Food Labels Group Activity- Reading Food Labels

	My Nutrition Logbook
ession 8: Week 11	10 Tips to Make Healthier Shopping Easier Helpful Tips for Grocery Shopping Group Activity- Shopping Cart My Nutrition Logbook
ession 9: Week 12	Healthy Cooking Tips Recipe Modifications Group Activity- Healthy Cooking My Nutrition Logbook

Appendix H

Efficacy Intervention and Nutrition Intervention (Attention Control) Email Material

Study 3

Study 3- Exercise: Efficacy Intervention (Email Material)

Email Delivery	Content
Month 1 Week 1	Knowing you Exercise Environment Exercising on your Own: The Basics- Doing The Behaviour Successfully Testing your Knowledge Activity
Month 1 Week 2	Making Physical Activity and Exercise a Lifestyle Habit Decreasing your Sedentary Behaviour Activity- How to Add More Activity your Life
Month 1 Week 3	Exercising Scheduling Exercise Barriers Coping With the Stress of Exercising in a Home-Based Program Testing your Knowledge Activity
Month 1 Week 4	Developing a Solid Support System to Help you Maintain your Exercise Behaviour Rewarding your Success Activity- Rewards for Success
Month 2 Week 1	Exercise Lapses Imaging Success Activity- Overcoming a Lapse in the Home-Based Program
Month 2 Week 3	Preventing Exercise Lapses and Relapses Rewarding Yourself for Overcoming Relapses and Relapses Activity- Rewards

Month 3 Week 1	Your Body's Continued Reaction to Exercise Reviewing Past Logbook Entries Activity- Positive Accomplishments
Month 4 Week 1	Goal-Setting Principles Activity- Goal-Setting Activity
Month 5 Week 1	Exercise Scheduling Testing Your Knowledge Activity
Month 6 Week 1	Exercise Barriers Strategies to Overcome Lack or Loss of Motivation Testing Your Knowledge Activity
Month 7 Week 1	Reviewing Past Successes in the Home-Based Activity Activity- Imaging Future Success
Month 8 Week 1	Continuing to Reward Your Exercise Behaviour Activity- Reward
Month 9 Week 1	Review Material Exercise Scheduling Exercise Barriers Exercise Lapses and Relapses Goal-Setting Rewards

Study 3- Nutrition: Attention Control Intervention (Email Material)

Email Delivery	Content
Month 1 Week 1	Tips to Healthy Eating Testing Your Knowledge Activity
Month 1 Week 2	Cooking Methods Testing Your Knowledge Activity
Month 1 Week 3	Adjusting Your Recipes Testing Your Knowledge Activity
Month 1 Week 4	Healthy Snacking Testing Your Knowledge Activity
Month 2 Week 1	Trans Fats Testing Your Knowledge Activity
Month 2 Week 3	Trans Fats- The List- Part 1 Testing Your Knowledge Activity
Month 3 Week 1	Trans Fats- The List- Part 2 Testing Your Knowledge Activity
Month 4 Week 1	Eating in an Imperfect World Activity- Your Healthy Eating Strategies
Month 5 Week 1	Ways to Eat Healthy For Less- Part 1 Activity- Your Healthy Eating For Less Strategies
Month 6 Week 1	Ways to Eat Healthy For Less- Part 2 Activity- Your Healthy Eating For Less Strategies

	Testing Your Knowledge Activity
Month 7 Week 1	100 Calorie Snacks: 20 Choices Activity- Your 100 Calorie Snack Choices
Month 8 Week 1	Antioxidants 101 Testing Your Knowledge Activity
Month 9 Week 1	Overcoming Barriers to Healthy Eating

Appendix I

The University of Western Ontario Research Ethics Approval Notice

Studies 1, 2 and 3

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. H. Prapavessis

Review Number: 12009E **Revision Number:** 4

Review Date: September 25, 2009 **Review Level:** Expedited

Protocol Title: Initiating and maintaining exercise in first degree relatives of colon cancer: A matter of Self-Regulation.
(Phase I - III)

Department and Institution: Kinesiology, University of Western Ontario

Sponsor:

Ethics Approval Date: September 25, 2009 **Expiry Date:** February 28, 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	☐ Elizabeth Wambolt	☑ Grace Kelly	☐ Denise Grafton

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

cc: ORE File
LHRI

Entrance Scholarship
(Ottawa University)
Value: $1,000
1998-1999

SECTION III
Grants, Publications, Works in Progress, & Presentations

REFEREED PUBLICATIONS:

McGowan, E., Prapavessis, H., & Wesch, N (2008). Self-Presentational Concerns and Competitive Anxiety. *Journal of Sport & Exercise Psychology, 30* (3), 383-400.

Foley, L., Prapavessis, H., Maddison, R., Burke, S., **McGowan, E.**, & Gillanders, L. (2008). Predicting Physical Activity Intention and Behavior in School-Aged Children. *Pediatric Exercise Science, 20*, 342-356.

ARTICLES UNDER REVIEW:

McGowan, E., & Prapavessis, H. (under review). Colon cancer information as a source of exercise motivation in first- and second-degree relatives of colon cancer patients. *International Journal of Behavioral Medicine.*

Gregg, M., Hall, C., **McGowan, E.,** & Hall, N. (under review). The Relationship between Imagery Ability and Imagery Use among Athletes. Submitted to *Psychology of Sport and Exercise.*

CONFERENCE PRESENTATIONS AND POSTERS:

McGowan, E., Prapavessis, H., Podolinsky, N., Gray, C., & Elkayam, J. (2009). An Examination of the Influence of Energy Expenditure on Body Composition. Paper presented at SCAPPS, Toronto, Ontario.

McGowan, E., Prapavessis, H., Podolinsky, N., Gray, C., & Elkayam, J. (2009). Examining the Relationships between Self-Efficacy and Objective Measures of Physical Activity Behavior in First- and Second-Degree Relatives of Colon Cancer Patients. Poster presented at the 11th World Congress of Psycho-Oncology, Vienna, Austria.

McGowan, E., Prapavessis, H., Podolinsky, N., Gray, C., & Elkayam, J. (2009). The Utility of a Self-Efficacy Intervention on Objective Measures of Exercise Behavior in First- and Second-Degree Relatives of Colon Cancer Patients. Paper presented at the 11th World Congress of Psycho-Oncology, Vienna, Austria.

McGowan, E., Prapavessis, H., Podolinsky, N., Gray, C., & Elkayam, J. (2009). Examining the Relationships between Self-Efficacy and Exercise Adherence in First- and Second-Degree Relatives of Colon Cancer Patients. Poster presented at the International Society for Behavioral Nutrition and Physical Activity, Lisbon, Portugal.

Elkayam, J., Prapavessis, H., Jung, M., **McGowan, E.,** & Wilson, J. (2009). The effects of a media literacy intervention on body dissatisfaction: Watching and exercising to a fitness video. Poster presented at the International Society for Behavioral Nutrition and Physical Activity, Lisbon, Portugal.

Gray, C., **McGowan, E.,** Pearson, E., Hall, C., Prapavessis, H., Shapcott, K., Gorczynski, P., Newnham-Kanas, C., & Wikman, J. (2009). Do behavioural regulations drive physical activity behaviour in "action" stage exercisers? Poster presented at the North American Society for Psychology of Sport and Physical Activity, Austin, Texas, USA.

McGowan, E., & Prapavessis, H. (2008). Does Colon Cancer Information Act as a Source of Exercise Motivation for First- and Second- Degree Relatives of Colon Cancer Patients? Paper presented at the 10th International Congress of Behavioral Medicine, Tokyo, Japan.

McGowan, E., Pearson, E., Hall, Craig, C., Prapavessis, Shapcott, K., Gorczynski, P., Newnham-Kanas, C., & Wikman, J. (2008). Paper presented at the North American Society for Psychology of Sport and Physical Activity, Niagara Falls, Canada.

Gray, C., Prapavessis, H., **McGowan, E.,** Podolinsky, N., & Holland, C. (2008). Perfectionism and Eating Attitudes among Elite Athletes. Poster presented at the 10th International Congress of Behavioral Medicine, Tokyo, Japan.

McGowan, E., & Prapavessis, H. (2008). Does Colon Cancer Information Act as a Source of Exercise Motivation For First- and Second- Degree Relatives of Colon Cancer Patients? Oncology Research and Education Day, London, Ontario.

Gregg, M., Hall, C., **McGowan, E.,** & Hall., N. (2007). The Relationship Between Imagery Ability and Imagery Use Among Athletes. Paper presented at the 12th European Congress of Sport Psychology, Athens, Greece.

Prapavessis, H., Foley, L. S., Burke, S. M., **McGowan, E.,** Maddison, R., & Gillanders, L. (2007). Predicting Physical Activity Behaviors in School-Aged Children. Paper presented at the 12th European Congress of Sport Psychology, Athens, Greece.

Foley, L., Prapavessis, H., Burke, S., **McGowan, E.**, Maddison, R., & Gillanders, L. (2007). Physical activity behaviors in school-aged children. Poster presented at the North American Society for Psychology of Sport and Physical Activity, San Diego, California.

Gorczynski, P., **McGowan, E.**, Shapcott, K., Newnham-Kanas, C., Hall, C., & Prapavessis, H. (2007). Examining Self-Determined Motives, Needs Satisfaction, and Self-Regulation in 'Action' Stage Exercisers. Paper presented at Eastern Canadian Sport & Exercise Psychology Symposium, Kingston, Ontario.

McGowan, E., Prapavessis, H., & Wesch, N. (2006). Validation of the self-presentation in sport questionnaire (SPSQ). Paper presented at the Canadian Society for Psychomotor Learning and Sport Psychology, Halifax, Nova Scotia.

McGowan, E., Prapavessis, H., & Wesch, N (2006). The Role of Self-Presentation in Competitive Sport Anxiety. Paper presented at the Canadian Society of Psychomotor Learning and Sport Psychology, Halifax, Nova Scotia.

SECTION IV
Related Work Experience

2008- Present	Exercise and Health Psychology Laboratory Faculty of Health Sciences, University of Western Ontario, London ON *Supervisor:* Harry Prapavessis, Ph.D.
Winter 2008	*Graduate Teaching Assistant:* Advanced Topics in Exercise Psychology, Department of Kinesiology, The University of Western Ontario
Fall 2007	*Graduate Teaching Assistant:* Research Design, Department of Kinesiology, The University of Western Ontario
Winter 2007	*Graduate Teaching Assistant:* Research Design, Department of Kinesiology, The University of Western Ontario
Fall 2006	*Graduate Teaching Assistant:* Advanced Topics in Exercise Psychology, Department of Kinesiology, The University of Western Ontario
Winter 2006	*Graduate Teaching Assistant:* Research Design, Department of Kinesiology, The University of Western Ontario
Winter 2005	*Graduate Teaching Assistant:* Personal Stress Management,

	Department of Kinesiology, Memorial University of Newfoundland
Summer 2005	Social Psychology of Sport, Physical Activity and Recreation, Department of Kinesiology, Memorial University of Newfoundland
Summer 2005	Performance Enhancement, Department of Kinesiology, Memorial University of Newfoundland
Fall 2005	*Graduate Teaching Assistant:* Introduction to Sport and Exercise Psychology, The University of Western Ontario
Summer 2004	Social Psychology of Sport, Physical Activity and Recreation, Department of Kinesiology, Memorial University of Newfoundland
Fall 2004	Performance Enhancement, Department of Kinesiology, Memorial University of Newfoundland
Fall 2004	*Graduate Teaching Assistant:* Personal Stress Management, Department of Kinesiology, Memorial University of Newfoundland
Winter 2003	*Graduate Teaching Assistant:* Performance Enhancement, Department of Kinesiology, Memorial University of Newfoundland
Summer 2003	Social Psychology of Sport, Physical Activity and Recreation, Department of Kinesiology, Memorial University of Newfoundland
Fall 2003	Performance Enhancement, Department of Kinesiology, Memorial University of Newfoundland
Fall 2002	*Graduate Teaching Assistant:* Performance Enhancement, Department of Kinesiology, Memorial University of Newfoundland

SECTION V
Services & Societies

Society of Graduate Students Kinesiology Representative: 2006-2007.

Graduate Teaching Assistant Union Representative: 2008-2009.

MEMBERSHIP IN ACADEMIC SOCIETIES:

International Psycho-Oncology Society (2009).

International Society for Behavioral Nutrition and Physical Activity (2009).

Society of Behavioral Medicine (2009).

The North American Society for Psychology of Sport and Physical Activity (2008).

Canadian Society for Psychomotor Learning and Sport Psychology (2006- 2007 & 2009).