SELF-DETERMINED MOTIVATION IN CARDIAC REHABILITATION

AUTONOMY SUPPORT, SELF-DETERMINED MOTIVATION, AND EXERCISE

ADHERENCE IN CARDIAC REHABILITATION

By

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Abstract

Despite the known benefits of regular exercise for cardiac patients (Jolliffe et al., 2001) and the delivery of cardiac rehabilitation programs to facilitate exercise participation in this population, exercise adherence remains a challenge for these individuals as evidenced by the reported decline in exercise participation over time (e.g., Moore et al., 2006). Investigating cardiac patients' motivation or willingness to engage in exercise may provide a better understanding of why some patients are better maintainers of exercise and others are not. Using self-determination theory (Deci & Ryan, 1985; 2002), the present study investigated changes in need satisfaction and self-determined motivation, as well as the role of perceived autonomy support relative to patient motivation, in the early months of participation in cardiac rehabilitation. It was hypothesized that need satisfaction and autonomous forms of behavioural regulation would increase over time, and that perceived autonomy support (ratings of exercise leaders' tendencies to acknowledge patients' perspectives, provide choices and contingent feedback, etc.) would positively predict changes in behavioural regulation, mediated by changes in psychological need satisfaction. Another aim of the study was to examine how autonomous forms of behavioural regulation related to cardiac patients' exercise intentions and self-managed exercise behaviour, and it was hypothesized that this relationship would be positive for both exercise intentions and behaviour. Fifty-three male participants (M_{age} = 62.83 ± 10.78) who were enrolled in a hospital-based cardiac rehabilitation program completed assessments of perceived autonomy support, need satisfaction and behavioural regulation at weeks 4, 8, and 12 of program participation. At week 14, participants' self-managed exercise behaviour and their exercise intentions to engage in independent exercise for the next 4 weeks were assessed. In general, participants' scores for all variables of interest were relatively high. Consistent with hypotheses, autonomy and relatedness need satisfaction, along with integrated and intrinsic regulation increased from week 4 to week 12 during cardiac rehabilitation. However, perceived autonomy support was not related to changes in need satisfaction or behavioural regulation, and thus, support for mediation was not obtained. Nonetheless, the high ratings of perceived autonomy support reflect the exercise leaders' natural tendency to use an autonomy supportive teaching style with patients. In addition, a positive relationship was found between autonomous forms of behavioural regulation (i.e., integrated and intrinsic) and exercise intentions, lending support to the SDT framework. The positive findings for need satisfaction, autonomous regulation, exercise intentions, and behaviour reflect a highly self-determined group of cardiac patients who are choosing to engage in self-managed exercise while still participating in the supervised cardiac rehabilitation program. These findings are promising in terms of regular exercise adoption in this population.

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Literature Review

Cardiovascular Disease

Cardiovascular disease is one of the leading causes of death among North Americans, accounting for 1 in 3 deaths each year, and is responsible for an estimated economic cost of over $18 million in hospital care, medication, physician visits, mortality, and disability (Heart and Stroke Foundation of Canada, 2003). Cardiovascular disease encompasses many conditions including congestive heart failure, stroke, peripheral artery disease, arrhythmias, and the most common type, coronary artery disease, a narrowing of the arteries that supply blood and oxygen to the heart that can manifest into a myocardial infarction. For individuals living with chronic heart disease, quality of life and psychological well-being are significantly affected. Compared with "healthy" individuals, people with heart disease commonly report poorer physical health, higher levels of anxiety and depression, and lower self-esteem (Heart and Stroke Foundation of Canada; Westin et al., 1997).

A number of risk factors for cardiovascular disease have been identified, including: age, gender, genetics, ethnicity, obesity, smoking, diabetes, psychological stress, hypertension, and physical inactivity (Stone & Arthur, 2005). Once diagnosed with cardiovascular disease, these risk factors will continue to affect disease progression if not managed appropriately. Disease management is attained by targeting modifiable risk factors, the majority of which can be managed through intervention and lifestyle changes. Given the documented burden of heart disease and the potential to modify known risk factors such as physical inactivity, the effective design and delivery of secondary and tertiary disease prevention programs such as cardiac rehabilitation is needed.

Benefits of Cardiac Rehabilitation

Cardiac rehabilitation has been defined by the Canadian Association of Cardiac Rehabilitation as "the enhancement and maintenance of cardiovascular health through individualized programs designed to optimize physical, psychological, social, vocational, and emotional status" (Stone & Arthur, 2005). With this objective in mind, cardiac rehabilitation programs provide a comprehensive approach to risk factor modification through risk factor stratification, education and counseling, and supervised exercise training.

A primary component of cardiac rehabilitation services is exercise-based due to sufficient evidence for the health benefit of regular exercise for cardiac patients (Jolliffe et al., 2001). Regular exercise not only improves cardiovascular efficiency, but it also has favourable effects on other heart disease risk factors such as high blood pressure, dyslipidemia, hyperglycemia, obesity, and depression (Bittner & Sanderson, 2006; Leon et al., 2005). As a result, participating in exercise-based cardiac rehabilitation has been shown to be associated with reduced morbidity and mortality, increased functional capacity and improved quality of life (Bittner & Sanderson; Pasquali, Alexander, & Peterson, 2001).

Exercise Adherence in Cardiac Rehabilitation

Following a cardiac event, a primary challenge for cardiac patients is to adopt regular exercise into their daily lifestyles. Cardiac rehabilitation programs provide a safe and effective means of developing an exercise routine for secondary prevention among cardiac patients, yet not all eligible patients enroll in cardiac rehabilitation (Daly et al., 2002) and for those who do participate, 50% are estimated to drop out within the first 3 months of the program (Moore & Durstine, 1997). Reasons for these trends that have been explored in the literature include such factors as low physician referral rates, unsuitable class times, and perceived benefits of cardiac rehabilitation (e.g., Beswick et al., 2005; Daly et al.).

One issue relating to exercise adherence for this population is that of patients who successfully adhere to a cardiac rehabilitation program, but then show a decline in exercise participation levels following program completion. Continued exercise is important for retaining the health benefits attained during cardiac rehabilitation (Brown, Taylor, Noorani, Stone, & Skidmore, 2003), and a goal of traditional cardiac rehabilitation programs is that through their exercise experience in the program, cardiac patients will be sufficiently motivated to continue exercising on their own. Unfortunately, data reflect a decline in exercise participation over time, and within the first year following cardiac rehabilitation up to 80% of patients fail to maintain regular exercise (Bock, Carmona-Barros, Esler, & Tilkemeier, 2003; Moore, Dolansky, Ruland, Pashkow, & Blackburn, 2003; Moore et al., 2006). Thus, exercise adherence in this population remains problematic and is a primary area of research interest for health psychologists.

Putting Theory to Good Use

Exercisers have reasons why they choose to participate in exercise, and these reasons or driving forces that lead them to act on the behaviour can be referred to as motivation. Considering the low exercise adherence rates in the cardiac rehabilitation population (Bock et al., 2003; Moore et al., 2003), cardiac patients' motivation may be an important determinant of exercise to examine. According to Brawley (1993), understanding determinants of exercise is best done through the use of a theoretical framework, because it describes the relationships between a set of variables proposed to affect cognition or behaviour from which hypotheses can be formed and study findings can be explained. Self-determination theory (Deci & Ryan, 1985; 2002) was selected for the present study for its use in examining motivation as a predictor of behaviour. Specifically, the quality of motivation in terms of the degree of self-determination that is felt towards engaging in a behaviour can be examined. The theory recognizes individuals' innate need to self-regulate and considers important socio-contextual conditions that can facilitate self-determined motivation and lead to behavioural maintenance. Thus, self-determination theory was considered useful for examining cardiac patients' motivation and its relation to self-managed exercise behaviour, while considering how the cardiac rehabilitation environment can support self-regulation among patients.

Self-Determination Theory

Self-determination theory (SDT) proposes that: (1) individuals have three innate psychological needs which coexist and must all be satisfied for optimal functioning (Deci

& Ryan, 2000; Ryan & Deci, 2000b), and (2) individuals possess a certain degree of self-determined or autonomous motivation to engage in a given behaviour (Ryan & Deci, 2000a, 2000b; see Figure 1). The three basic psychological needs posited by SDT are competence, autonomy, and relatedness (Baumeister & Leary, 1995; Ryan & Deci, 2000b; Sheldon, Elliott, Kim, & Kaser, 2001). The need for competence reflects one's desire to experience mastery and effectiveness in producing outcomes (White, 1959). Autonomy refers to the need for ownership over one's behaviour and the perceived freedom to choose what behaviours one engages in (deCharms, 1968). The need for relatedness reflects one's desire for a sense of attachment and security through social interaction (Baumeister & Leary).

Satisfaction of the three basic psychological needs leads to both cognitive and behavioural enrichment (e.g., self-determined motivation, enhanced well-being, increased persistence and performance; Ryan & Deci, 2000b). For health-related behaviours such as exercise, previous research using SDT has demonstrated that greater psychological need satisfaction is positively related to greater self-determined motivation to engage in exercise (e.g., Edmunds, Ntoumanis, & Duda, 2006; Standage, Duda, & Ntoumanis, 2003; Wilson, Rodgers, Blanchard, & Gessell, 2003).

When one engages in a behaviour for its inherent enjoyment, that person is said to be intrinsically motivated, which represents the most self-determined form of regulation. At the other end of the spectrum, one may be in a state of not intending to act, referred to as amotivation. Between amotivation and intrinsic motivation, reside four types of extrinsic motivation placed on a continuum that is based on the extent to which the regulation is autonomous or internalized with the person's sense of self. The least autonomous is external regulation, then introjected regulation, identified regulation, and integrated regulation (Ryan & Deci, 2000a; 2000b).

External regulation and introjected regulation are classified as "controlled" forms of extrinsic motivation. In the case of external regulation, the behaviour is performed to receive external rewards or to meet an external demand (e.g., being advised by a physician to engage in exercise). Behaviours that are introjected, are performed to receive internal rewards such as pride or to avoid internal punishments such as guilt. Quite often, individuals can be "autonomously extrinsically motivated" to engage in behaviours that are not found inherently enjoyable (Ryan & Deci, 2002). For example, exercise might be thought of as boring and considered a chore to some individuals, but they may still choose to exercise regardless, knowing that it is important for their health. These autonomous forms of extrinsic motivation are identified regulation and integrated regulation, and are experienced through processes known as internalization and integration (Ryan & Deci, 2002). Internalization requires the individual to grasp the meaning or relative importance behind a behaviour (Ryan & Deci, 2000a). By accepting the behaviour as personally important, one is regulating behaviour through identification. The process of integration refers to making the behaviour more congruent with other personally-held values and needs (Ryan & Deci, 2000a), hence the term integrated regulation. While integrated regulation is the most self-determined form of extrinsic motivation, it is considered extrinsic because the behaviour is still performed for instrumental reasons. For example, a person who accepts exercise as a part of her identity, but still chooses to exercise primarily to increase muscle tone and improve appearance is regulating her behaviour through integrated regulation.

	Extrinsic Motivation				
Amotivation	External Regulation	Introjected Regulation	Identified Regulation	Integrated Regulation	**Intrinsic Motivation**

Figure 1. The self-determination continuum (adapted from Ryan & Deci, 2002).

Self-Determined Motivation and Exercise Behaviour

According to Vallerand (1997), each motivational regulation is related to different cognitive and behavioural consequences. Amotivation and external regulation are said to have negative effects, whereas identified, integrated, and intrinsic regulations lead to increasingly more positive consequences as one moves along the continuum. Introjected regulation lies in between and can be associated with both positive and negative consequences (Vallerand & Ratelle, 2002).

In the exercise domain, identified and intrinsic regulations have been found to be strongly associated with self-reported exercise behaviour among individuals recruited from the community (Wilson et al., 2003). In an illustrative study, Thøgersen-Ntoumani and Ntoumanis (2006) found that individuals who reported to have been exercising regularly for longer than 6 months scored higher in intrinsic motivation, identified regulation and introjected regulation, and lower in extrinsic regulation and amotivation compared with those who reported to have been exercising less regularly. Reporting higher scores for autonomous forms of regulation have been found to also be linked to greater exercise intentions (Thøgersen-Ntoumani & Ntoumanis; Wilson & Rodgers, 2004).

According to SDT, psychological need satisfaction can also have a positive effect on behaviour through the mediated effects of self-determined motivation (Vallerand, 2000). This theorizing has been supported in previous research showing positive relationships between psychological need satisfaction and autonomous forms of motivation, which, in turn, were associated with exercise behaviour (e.g., Wilson et al., 2003; Wilson, Rodgers, Loitz, & Scime, 2006). One study within the exercise domain that tested for mediation partially supported the hypothesized effect of psychological need satisfaction on behaviour, showing that identified regulation partially mediated the effect of competence need satisfaction on strenuous exercise ($z = 2.56$, $p = .01$; Edmunds et al., 2006). In another study, Standage et al. (2003) demonstrated that secondary school students' perceptions of autonomy, competence, and relatedness positively predicted their intentions to engage in leisure-time exercise through self-determined motivation. These studies provide further support for the important role of self-determined motivation on exercise intentions and behaviour by demonstrating autonomous regulation as a mechanism through which psychological need satisfaction can be positively linked to intentions or behaviour.

Despite the majority of studies being cross-sectional in design, positive associations between autonomous forms of regulation (i.e., identified, intrinsic) and exercise intentions and behaviour are consistently apparent. Although identified regulation is considered an extrinsic form of behavioual regulation, it represents one of the more autonomous forms of extrinsic regulation that should be considered in conjunction with intrinsic regulation as an important predictor of exercise participation (Edmunds et al., 2006; Wilson, Mack, & Grattan, in press). One other autonomous form of extrinsic regulation that has not been examined until recently is integrated regulation. Studies of integrated regulation have provided further insight into the importance of autonomous extrinsic motivation in the exercise domain for predicting cognitive and behavioural outcomes (Edmunds, Ntoumanis, & Duda, 2007; 2008; Wilson, Rodgers, et al., 2006). However, longitudinal research is needed to further establish the independent effects of these autonomous behavioural regulation types on exercise behaviour.

The Role of Autonomy Support

According to Deci and Ryan (2000), individuals have an innate tendency to take control and become the source of their own behaviour, and psychological need satisfaction fosters these feelings of self-determined motivation by facilitating the processes of internalization and integration. Relatedness and competence both play a role in promoting internalization of behaviour (Deci & Ryan, 2000). With regards to relatedness, when deciding whether or not to engage in a given behaviour, those individuals to whom one feels closely related or connected influence one's decisions. Oftentimes, the behaviour in question is performed in order to gain social approval (Ryan & Deci, 2002). In terms of competence need satisfaction, the individual also needs to feel competent enough to perform the behaviour if he or she is to take ownership for it

(Ryan & Deci, 2002). Finally, satisfaction of the need for autonomy is necessary for fully internalizing and integrating behaviour (Deci & Ryan, 2000) because it represents the person's overall desire to feel volitional about their behaviour.

Complete internalization and integration are considered necessary for the individual to be a persistent self-regulator (Ryan & Deci, 2002). However, the social context can affect these processes depending on the extent to which psychological needs are or are not supported (Deci & Ryan, 2000). According to organismic integration theory, a sub-theory of SDT, the extent to which the social environment is autonomy supportive versus controlling will affect psychological need satisfaction, which then affects the degree of self-determined motivation one feels towards engaging in a given behaviour (Ryan & Deci, 2000b; Standage et al., 2003; Vallerand & Ratelle, 2002). In short, the social context can either facilitate or undermine self-determined motivation depending on the extent to which the environment is supportive of the three psychological needs.

Autonomy support refers to a "mode of communication and persuasion in which the persuader fully acknowledges and respects the selfhood of the persuadee" (Sheldon, Joiner, Pettit, & Williams, 2003). Autonomy support improves competence, autonomy, and relatedness need satisfaction when authority figures such as clinicians acknowledge patients' perspectives, offer choices and provide a rationale when choice is not available, support patients' decisions, and overall, minimize pressure or control (Sheldon et al., 2003; Williams, 2002). Moreover, informative and positive feedback that is presented in an autonomy-supportive way can lead to increases in need satisfaction, particularly competence need satisfaction (Deci, Koestner, & Ryan, 1999; Hein & Koka, 2007). In contrast, psychological need satisfaction is undermined by controlling environments that are characterized by rewards, punishments, imposed goals, and evaluation (Deci & Ryan, 1987). In health care settings, some clinicians use their authoritative position to pressure their patient into behaving a certain way, assuming that simply telling the patient what to do is enough to initiate a change in behaviour. However, to initiate change and more importantly, to maintain change, engagement in the behaviour should be volitional, not forced (Ryan & Deci, 2000a). By acknowledging patients' needs to autonomously self-regulate, the clinician can allow them to take an active role in their health-related decision-making and behaviour.

Perceived Autonomy Support in the Health Care and Exercise Domains

The significance of receiving autonomy support from health care providers has been examined in various health care settings. When clinicians are perceived as more autonomy supportive, patients report behavioural regulation that reflects greater autonomy (i.e., integrated, identified, intrinsic), leading to positive behavioural outcomes that include: greater adherence to prescribed medications (Williams, Rodin, Ryan, Grolnick, & Deci, 1998), better maintenance of diet and exercise in patients with chest pain (Williams, Gagné, Mushlin, & Deci, 2005), and better glycemic control in patients with diabetes (Williams, Freedman, & Deci, 1998).

The benefits of an autonomy supportive environment have also been demonstrated among individuals participating in a 6-month supervised weight loss program (Williams, Grow, Freedman, Ryan, & Deci, 1996). After having participated in the program for approximately 1-2 months, participants' perceptions of the autonomy support received from the program staff were assessed. Structural equation modeling revealed perceived autonomy support to be associated with autonomous reasons for continuing to participate in the weight loss program (e.g., "It's important to me personally to succeed in losing weight"). In turn, self-determined motivation positively predicted program attendance, weight loss during the program, and maintenance of weight loss two years later. Thus, the interpersonal nature of health-promotion programs can play an important role in determining participants' self-determined motivation and attainment of health-related goals.

Intervention studies designed to increase perceived autonomy support have shown autonomy support leads to more self-determined motivation and, as a consequence, successful behaviour change (Williams et al., 2006; Williams, McGregor, Zeldman, Freedman, & Deci, 2004). For example, the effects of physicians using autonomy supportive versus controlling styles for counseling patients for smoking cessation have been previously tested (Williams & Deci, 2001; Williams, Gagné, Ryan, & Deci, 2002). Counseling patients for smoking cessation in an autonomy-supportive way involved acknowledging the patients' perspectives and providing the relevant information regarding smoking cessation, while encouraging that patients make their own informed choices about quitting. Patients who received the autonomy supportive intervention showed greater active involvement during counseling sessions, more self-determined motivation, and greater success in quitting smoking, compared with patients who received counseling that involved a more controlling style.

In a more recent experimental study (Edmunds et al., 2008), female participants were exposed to either an SDT-based or "typical" instructional style while participating in a 10-week exercise program. Socio-contextual conditions of the exercise environment, including perceived autonomy support, were measured and tested as predictors of need satisfaction and behavioural regulation at three different time points during the program. Perceived autonomy support was found to predict identified and intrinsic regulation at each time point, with the magnitude of positive relationships between variables increasing over time. A comparison of the two exercise groups also revealed greater increases in competence ($\beta = 0.66, p < .01$) and relatedness ($\beta = 0.50, p < .05$) need satisfaction in the SDT-based intervention group compared to controls. This study demonstrates the positive consequences that receiving autonomy support can have for need satisfaction and autonomous forms of regulation in the exercise domain.

Although psychological need satisfaction is asserted to provide the link between autonomy support and self-determined motivation (Ryan & Deci, 2000b), few studies have examined the satisfaction of all three needs as mediators of the perceived autonomy support-motivation relationship. In one study of organized exercise classes, perceived autonomy support from exercise class leaders was positively correlated with all three psychological needs, but most strongly associated with the need for relatedness (Edmunds et al., 2006). Perceptions of autonomy support were also related to identified regulation and intrinsic motivation. Overall, the influence of perceived autonomy support on intrinsic motivation was found to be partially mediated by competence need satisfaction. In contrast, Standage et al. (2003) demonstrated that satisfaction of all three needs were mediators of the relationship between perceived autonomy support and the autonomous motivation felt by physical education students. Thus, the extent to which psychological need satisfaction mediates the relationship between autonomy support and autonomous behavioural regulation has been supported, but needs to be further examined.

Applicability of Self-Determination Theory in Cardiac Rehabilitation

Although SDT has been used to examine motivation and behaviour in numerous health care settings and exercise contexts, a review of the literature reveals limited research using SDT to study exercise behaviour in the cardiac rehabilitation population. Slovinec D'Angelo, Reid, and Pelletier (2007) examined how self-determined motivation relates to the initiation and maintenance phases of exercise in cardiac patients. The initiation phase was assessed by participants' intentions to exercise over the next 1-6 months. Whether participants reported having an exercise routine (e.g., exercising at the same time of day) and the extent to which they made specific exercise plans were used to identify individuals in the maintenance phase. Self-determined motivation was found to have direct associations with intentions ($\beta = .59, p < .001$) and planning ($\beta = .61, p < .001$). Although this study was cross-sectional in nature and did not examine actual exercise behaviour, the findings highlight the important role that self-determined motivation may play in predicting both short and long-term exercise among cardiac patients.

A recent study (Russell & Bray, 2008) examined self-determined motivation as a predictor of exercise behaviour 6 weeks following completion of cardiac rehabilitation. The relationship between psychological need satisfaction and self-determined motivation to exercise was also examined. Participants took part in a 6-week continuation of exercise-based rehabilitation at a university-based facility following discharge from a hospital-based outpatient cardiac rehabilitation program. Psychological need satisfaction and behavioural regulation were assessed at the completion of the supervised exercise program and self-reported home-based exercise was measured at 6-weeks follow-up. A relative autonomy index (RAI) was computed to assess the degree of self-determined motivation reported by participants. The satisfaction of the needs for autonomy and competence predicted self-determined motivation (Adjusted $R^2 = 16\%$). In addition, the relative degree of self-determined motivation to exercise that was reported at the end of the intervention program significantly predicted independent exercise 6 weeks later ($\beta = .33$, $p = .006$), explaining 9% of the variance in reported exercise. Thus, the utility of SDT to predict exercise motivation as well as home-based activity among cardiac patients following rehabilitation has been supported.

Given the low exercise adherence rates apparent among cardiac rehabilitation patients (Bock et al., 2003; Moore et al., 2003), it is necessary to focus on understanding modifiable factors that could increase the likelihood of patients remaining physically active. Autonomy supportive instructional styles on the part of kinesiologists may play an important part in cardiac patients' exercise-related need satisfaction, which in turn should affect patients' feelings towards exercise and their motivation to adopt exercise into their daily routine. A cardiac rehabilitation environment that is autonomy supportive would likely benefit patients trying to initiate and maintain behaviour change following a cardiac event.

Purpose

The purpose of the present study was to investigate the dynamics of motivational variables outlined by SDT, as well as the role of perceived autonomy support relative to patient motivation to exercise in the early months of participation in cardiac rehabilitation. Specifically, this study had three purposes. The first purpose was to examine the changes in psychological need satisfaction and behavioural regulation that occur over time from weeks 4-12 during hospital-based cardiac rehabilitation. The second purpose was to examine the relationship between perceived autonomy support and changes in behavioural regulation, and the potential mediating role that change in psychological need satisfaction plays in the autonomy support – behavioural regulation relationship. The final purpose was to examine the relationships between behavioural regulation and exercise intentions and independent exercise behaviour.

For the present study, only identified, integrated, and intrinsic regulation were examined. Although behavioural regulation instruments aim to assess multiple facets of behavioural regulation, these more autonomous regulations were hypothesized to be more sensitive to change over the course of cardiac rehabilitation, whereas amotivation, external regulation, and introjected regulation were expected to be low throughout. Previous research has demonstrated the positive associations between behavioural regulations that reflect greater autonomy and behaviour (e.g., Thøgersen-Ntoumani & Ntoumanis, 2006). Thus, the positive relationships between autonomous behavioural regulation types (i.e., identified, integrated, and intrinsic) and exercise intentions and behaviour were of primary interest.

Hypotheses

1a. (i) Perceived competence need satisfaction would increase from week 4 to week 12.

(ii) Perceived autonomy need satisfaction would increase from week 4 to week 12.

(iii) Perceived relatedness need satisfaction would increase from week 4 to week 12.

1b. (i) Identified regulation would improve from week 4 to week 12.

(ii) Integrated regulation would improve from week 4 to week 12.

(iii) Intrinsic regulation would improve from week 4 to week 12.

2a. Perceived autonomy support assessed at week 4 would positively predict change in identified regulation indirectly through changes in psychological need satisfaction.

2b. Perceived autonomy support assessed at week 4 would positively predict change in integrated regulation indirectly through changes in psychological need satisfaction.

2c. Perceived autonomy support assessed at week 4 would positively predict change in intrinsic regulation indirectly through changes in psychological need satisfaction.

3a. (i) Identified regulation measured at week 12 would be positively related to exercise intentions assessed at week 14.

(ii) Integrated regulation measured at week 12 would be positively related to exercise intentions assessed at week 14.

(iii) Intrinsic regulation measured at week 12 would be positively related to exercise intentions assessed at week 14.

3b. (i) Identified regulation measured at week 12 would be positively related to exercise behaviour assessed at week 14.

(ii) Integrated regulation measured at week 12 would be positively related to exercise behaviour assessed at week 14.

(iii) Intrinsic regulation measured at week 12 would be positively related to exercise behaviour assessed at week 14.

Method

Participants

Participants were enrolled in the Cardiac Health and Rehabilitation Centre (CHRC) cardiac rehabilitation program at the Hamilton General Hospital and had been referred to that program by their GP or cardiologist for supervised exercise. All participants met the following inclusion criteria: (a) documented evidence of a myocardial infarction, angioplasty, coronary artery bypass surgery, or identified as "at risk" for cardiovascular disease; (b) participation in the exercise-based rehabilitation program at the Hamilton General Hospital; (c) ability to read or speak English at a minimum grade 8 level. Only male participants were included due to conflict with another study involving only females being conducted at the same facility.

Of 116 eligible participants, 21 individuals dropped out of the cardiac rehabilitation program before the recruitment process for those individuals began. Reasons for dropout included experience of other medical issues, switching into another exercise program outside of the CHRC, or reasons unspecified. An additional 28 patients declined to participate in the study. Reasons for declining participation included not being interested and having busy schedules that did not allow for participation.

In total, 67 cardiac rehabilitation patients agreed to participate in the study. Of this total, 14 (21%) were lost to attrition. Six individuals left the study due to personal illness or injury, one left due to spousal illness, and one died before study completion. The remaining 6 study dropouts were also dropouts of the CHRC rehabilitation program and despite efforts to contact those individuals, their reasons for leaving the program could not be determined. Thus, the final sample size consisted of 53 participants. The sample had a mean age of 62.83 years (*SD* = 10.78; range = 44 to 87 years). Participants were primarily Caucasian and married, and 55% were retired (see Table 1).

Measures

Demographics. General descriptive characteristics of the participants such as age, ethnicity, marital status, work status, and cardiac event/diagnosis, were assessed. As recommended in the thesis proposal meeting, a brief questionnaire asked participants to rate their perceived social support for being physically active from various sources on a 7-point scale (1 = *no support* to 7 = *a great deal of support*). The sources of social support included in the questionnaire were: family physician, kinesiologist at the CHRC, spouse, other family member, friend, and "someone else (please indicate)" if there was someone not included in the list who participants felt provided them support for being physically active. Participants answered these items only if they were applicable to them. For example, if a participant was not married, the item for social support from a spouse did not apply and could not be answered. In addition, in-program attendance was estimated at each assessment time point by asking participants to recall over the past 4 weeks how many exercise sessions they had attended at the centre.

Perceived autonomy support. A shortened, 6-item version of the original 15-item Health Care Climate Questionnaire (HCCQ; Williams et al., 1996) was used to assess participants' perceptions of autonomy support provided by their exercise leaders. The use of the 6-item scale in place of the original 15-item version has been supported in previous research (Williams, McGregor, King, Nelson, & Glasgow, 2005). Participants responded to items in reference to their exercise sessions at the CHRC, concerning the degree of autonomy support for engaging in physical activity that participants perceived they were given from their exercise leaders. Example items include: "I feel that my exercise leader has provided me choices and options about my physical activity program in terms of improving how much physical activity I engage in"; "My exercise leader conveys confidence in my ability to make changes regarding how much physical activity I engage in"; "My exercise leader listens to how I would like to do things in terms of improving how much physical activity I engage in". Participants responded to each item on a 7-point scale (1 = *strongly disagree* to 7 = *strongly agree*). Individual item scores were averaged, with higher mean scores indicating higher levels of perceived autonomy support. The scale showed good internal consistency at all three assessment time points, with Cronbach's alpha values ranging from .95 to .98 (Tabachnick & Fidell, 2001; see Table 2).

Psychological need satisfaction. The Psychological Need Satisfaction in Exercise (PNSE) scale developed by Wilson, Rogers, Rodgers, and Wild (2006) was used in the present study, and employed 18 items that assessed the degree to which competence, autonomy and relatedness were satisfied. The items were rated on a 6-point Likert-type scale from 1 = *false* to 6 = *true*. Sample items are as follows: "I feel that I am able to meet the challenge of exercising" (competence need satisfaction), "I feel like I am the one who decides what exercises I do." (autonomy need satisfaction); "I feel close to my exercise companions who appreciate how difficult exercise can be" (relatedness need satisfaction). Need satisfaction was calculated as the mean of the six items that comprise each subscale of the PNSE questionnaire. The measure demonstrated good internal consistency for each subscale at each time point (autonomy, α = .88 to .90; competence, α = .92 to .94; relatedness, α = .96 to .97; Tabachnick & Fidell, 2001; see Table 2).

Behavioural regulation. The Exercise Self-Regulation Questionnaire (SRQ-E; http://www.psych.rochester.edu/SDT/measures/selfreg_exer.html. Retrieved July 6, 2007) that has been adapted from self-regulation questionnaires introduced by Ryan and Connell (1989), was used to assess the degree to which participants' motivation for participating in the exercise program was self-determined. The measure consisted of four subscales of behavioural regulation: external regulation, introjected regulation, identified regulation, and intrinsic regulation. An amotivation subscale was not included in this scale and was not considered relevant for this population because participants had already decided to participate in cardiac rehabilitation and therefore were assumed to have possessed some degree of motivation to begin with. As suggested by Wilson, Rodgers, et al. (2006), four additional items were added to the SRQ-E to include a fifth subscale representing integrated regulation. Following the stem, "There are a variety of reasons why people choose to exercise. Please indicate how true each of these reasons is for why you are currently participating in this exercise program," participants responded to each item on a 7–point Likert-type scale (1 = *not at all true* to 7 = *very true*). Example items for each regulation type include: "Because others would be angry at me if I did not" (external regulation), "Because I would feel bad about myself if I did not" (introjected regulation), "Because I feel like it's the best way to help myself" (identified regulation), "Because it is consistent with my life goals" (integrated regulation), "Because I enjoy exercising" (intrinsic regulation). Items for each subscale were averaged to calculate subscale scores. Cronbach's alpha for the SRQ-E subscales ranged from .76 (external regulation) to .92 (identified regulation). Refer to Table 2 for internal consistency ratings listed for all behavioural regulation scales included in the study.

Exercise intentions. Exercise intentions were assessed using three items based on recommendations by Courneya and McAuley (1993): (1) "I intend to exercise __ times per week during the next 4 weeks". (2) "I will try to exercise __ times per week during the next 4 weeks". (3) "My goal is to exercise __ times per week during the next 4 weeks". Intention scores were calculated by averaging the scores obtained for the three items. The scale showed good internal consistency (α = .97; see Table 2).

Self-reported exercise behaviour. Independent, self-managed exercise behaviour (i.e., outside of cardiac rehabilitation classes) was assessed using the 7-day Physical Activity Recall (PAR) questionnaire (Blair et al., 1985). The PAR has been previously validated against objective measures such as accelerometer data (Hayden-Wade, Coleman, Sallis, & Armstrong, 2003). Participants were asked to recall and estimate the frequency and duration of activities engaged in over the past seven days (e.g., walking, bicycling, resistance training) as well as the intensity at which they rated each activity (i.e., light, moderate, heavy).

Frequency of exercise was calculated by summing the number of days the participant reported doing exercise lasting 10 minutes or longer. Average time spent exercising in a given day was also calculated in minutes. Total weekly volume of exercise participation was obtained by multiplying the frequency with the average duration.

Based on recommendations for this population (Stone & Arthur, 2005) and the primary emphases in the CHRC program, aerobic exercise at the moderate to vigorous intensity levels were of primary interest. Total aerobic exercise encompassing all three intensity levels (i.e., light, moderate, vigorous) was also analyzed.

Procedure

Recruitment process. Kinesiologists employed at the CHRC were informed of the eligibility criteria and study procedures. The list of incoming patients was screened each week and if patients were deemed eligible to participate, a study information sheet was provided by one of the kinesiologists in the patient's second week of participating in the cardiac rehabilitation program. Potential participants were given a week's time to read the information sheet and express possible interest to one of the kinesiologists. Once given permission to approach the patient, the student investigator reviewed the information sheet and consent form with the patient during week 3 of his participation in the program. Upon agreement to participate in the study, the individual signed the consent form and received a copy of it, and the investigator retained the original signed form. Letters were then sent to the participant's cardiologist and family physician informing them of his participation in the study.

Scheduling. Upon receiving informed consent, an appointment was scheduled for the following week (week 4) at which time the first questionnaire package was to be completed either before or after the participant's exercise class at the CHRC. Subsequent appointments for the remaining data collection time points were scheduled one week in advance. All data collection took place at the CHRC.

Time 1 assessment (week 4 of program participation). At Time 1, participants completed the demographics and perceived social support questionnaires, along with an assessment of perceived autonomy support, psychological need satisfaction, and behavioural regulation. The 7-day PAR was also included at this time point. If participants had difficulty recalling the activities they had engaged in over the past 7 days, the researcher, upon booking subsequent appointments, reminded participants to log their exercise activity for the week leading up to the next meeting. Program attendance for the past 4 weeks was also noted. (See Figure 2 for data collection procedure.)

Time 2 assessment (week 8 of program participation). Measures for perceived autonomy support, psychological need satisfaction, behavioural regulation, program attendance, and the 7-day PAR were assessed at Time 2.

Time 3 assessment (week 12 of program participation). Time 3 assessment followed the same procedures as outlined for Time 2.

Time 4 assessment (week 14 of program participation). Exercise intentions and behaviour were assessed during participants' 14^{th} week of program participation. Participants were then debriefed and thanked for their participation in the study.

*PAS, PNSE, SRQ-E, program attendance and 7-day PAR; **Exercise intentions and 7-day PAR

Figure 2. Overview of data collection time points for cardiac rehabilitation program participants.

Results

Screening of Data

The data were initially screened for missing values. Items assessing perceived social support from various sources were missing some data. However, those items were only answered if they were applicable to the participant, and because those data were not a part of the primary investigation, the data were left alone. On the other hand, some items for the relatedness need satisfaction subscale at Time 1 were missing for four individuals who felt it was too early to assess their connectedness with fellow patients in some regards. Following recommendations by Tabachnick and Fidell (2001), mean scores representing each individual's scores for the completed items from the relatedness need satisfaction subscale were used to replace the missing item values. In addition, two participants declined to complete the Time 3 questionnaire, claiming that their answers had not changed since the last assessment, but agreed to finish their participation in the study by completing the Time 4 questionnaire. Time 2 data for those two individuals were carried forward to Time 3 to retain their cases in the analysis. Screening of exercise data revealed two participants missing their Time 1 PAR data. Upon being queried, those two individuals remarked they had difficulty remembering the activities they had engaged in over the last 7 days. As a conservative precaution, it was decided to leave out their exercise data. Hypotheses for the present study included only Time 4 exercise data. Therefore, these missing behavioural data at Time 1 were not a concern.

For all variables included in the hypotheses, the distribution of scores for each variable was screened for statistical outliers (± 3 SD from the mean). A few moderate outliers (≤ 4 SD from the mean) were identified, but were retained within the data set because scores were obtained from the intended sample population and considered representative of a heterogeneous population. The *z*-distribution scores for skewness and kurtosis using a conservative alpha level of .001 (Tabachnick & Fidell, 2001) were used to assess the normality of the scores for each of the variables. As shown in Table 3, scores for perceived autonomy support and competence need satisfaction were mildly skewed, whereas scores for identified regulation, and total cardio duration (average and total volume) were severely skewed and kurtotic. Standardized scores for these variables were in excess of 3.29 (p = .001, two-tailed test). Based on recommendations made by Tabachnick and Fidell, square root transformations were conducted for these variables to normalize their distributions. Scores for the three SDT variables were reflected prior to transformation because they were negatively-skewed. Thus, lower scores for those variables should be interpreted as representing higher scores. Due to the severity of skewness for identified regulation and total cardio exercise duration variables, scores remained skewed regardless of which transformation used (i.e., square root, log), and a decision was made to remove those variables from further analyses.

Descriptives

Demographic information for the sample is presented in Table 1. Perceived social support from the various sources was generally rated high, with the highest ratings for "kinesiologist" and "spouse". Other sources of social support that some participants added to the list were individuals at the workplace, such as a co-worker or supervisor, as well as neighbours. For the duration of the study, participants attended an average of 79.25% (*SD* = 12.45) of their supervised exercise sessions at the CHRC.

Table 1

Demographic Characteristics of Study Participants

Variable	*n (%)*	*Mean*	*SD*	*Range*
Age		62.83	10.78	44-87
CRP Attendance (%)		79.25	12.45	39-100
Social Support				
Physician	52	4.85	1.85	1-7
Kinesiologist	53	6.00	1.27	3-7
Spouse	46	5.91	1.46	2-7
Family	52	5.23	1.77	1-7
Friend	49	4.73	1.81	1-7
Other	10	5.90	0.99	4-7
Ethnicity				
Caucasian	51 (96%)			
Other	2 (4%)			
Marital Status				
Married	43 (81%)			
Separated, divorced	4 (7%)			
Single	3 (6%)			
Common-law	2 (4%)			
Widowed	1 (2%)			
Employment Status				
Employed	24 (45%)			
Retired	29 (55%)			
Diagnosis				
CABG	29 (55%)			
Angioplasty	16 (30%)			
Myocardial Infarction	14 (26%)			

Other	5 (9%)
Occupation	
Sales, service	18 (34%)
Trades, transport	12 (23%)
Education, government	6 (11%)
Other	12 (23%)
Not indicated	5 (9%)

Note. SD = standard deviation. CRP = cardiac rehabilitation program. CABG = coronary artery bypass graft. Scores for continuous variables are represented by means and standard deviations. Scores for categorical variables are represented by percentages.

Table 2

Internal Consistency Reliabilities (Cronbach's α) for Self-Determination Theory Variables and Exercise Intentions

Variable	Week 4	Week 8	Week 12	Week 14
Perceived autonomy support	.95	.98	.97	-
Autonomy need satisfaction	.88	.90	.89	-
Competence need satisfaction	.93	.94	.92	-
Relatedness need satisfaction	.97	.96	.97	-
External regulation	.76	.79	.78	-
Introjected regulation	.81	.85	.85	-
Identified regulation	.90	.92	.89	-
Integrated regulation	.82	.86	.88	-
Intrinsic regulation	.82	.84	.89	-
Exercise intentions	-	-	-	.97

Note. n = 53. Perceived autonomy support = 6 items; Autonomy need satisfaction = 6 items; Competence need satisfaction = 6 items; Relatedness need satisfaction = 6 items; External regulation = 4 items; Introjected regulation = 4 items; Identified regulation = 4 items; Integrated regulation = 4 items; Intrinsic regulation = 4 items; Exercise intentions = 3 items. All internal consistency reliabilities were acceptable (α > .70; Tabachnick & Fidell, 2001).

Table 3

Test for Significance of Skewness and Kurtosis

		Skewness		Kurtosis	
Variable	*M (SD)*	Statistic	*z*	Statistic	*z*
Time 1					
Perceived autonomy support	5.72 (1.18)	-1.09	3.34*	1.41	2.19
Autonomy need satisfaction	4.16 (1.30)	-0.67	2.06	-0.25	.39
Competence need satisfaction	4.98 (1.02)	-1.31	4.00*	0.88	1.37
Relatedness need satisfaction	4.37 (1.35)	-0.83	2.54	-0.10	.15
Identified regulation	6.55 (.71)	-2.01	6.15*	3.90	6.05*
Integrated regulation	5.43 (1.31)	-0.70	2.13	-0.38	.59
Intrinsic regulation	5.63 (1.15)	-0.79	2.41	0.12	.18
Time 2					
Autonomy need satisfaction	4.32 (1.15)	-.40	1.22	-.52	.80
Competence need satisfaction	5.02 (.94)	-1.22	3.72*	1.20	1.86
Relatedness need satisfaction	4.71 (1.12)	-.64	1.97	-.56	.87
Time 3					
Autonomy need	4.46 (1.15)	-0.55	1.67	-0.17	.26

satisfaction					
Competence need satisfaction	5.14 (.81)	-1.08	3.31*	1.51	2.35
Relatedness need satisfaction	4.81 (1.15)	-0.99	3.02	0.30	.47
Identified regulation	6.46 (.67)	-1.71	5.22*	2.85	4.42*
Integrated regulation	5.66 (1.28)	-0.96	2.92	0.30	.46
Intrinsic regulation	5.63 (1.15)	-0.70	2.13	0.04	.07
Time 4					
Exercise intentions	4.58 (1.47)	0.31	.94	-0.87	1.35
MV frequency	3.09 (2.07)	-0.20	.61	-1.07	1.66
MV average duration	23.61 (.29)	0.29	.90	-0.12	.18
MV total volume	134.96 (117.18)	1.07	3.28	1.60	2.49
Cardio frequency	3.85 (1.82)	-0.38	1.17	-0.28	.43
Cardio average duration	44.05 (30.68)	2.08	6.36*	6.59	10.23*
Cardio total volume	191.28 (178.32)	2.88	8.81*	12.21	18.96*

Note. $n = 53$. z = (statistic – 0)/standard error, where standard error for skewness = 0.327 and standard error for kurtosis = 0.644. MV = moderate vigorous intensity. Cardio includes exercise reported at light, moderate, and vigorous intensities. Frequency (days per week), duration (minutes), total volume (frequency x duration).

*significant at the .001 alpha level, two-tailed test.

Hypotheses 1a (i-iii): Perceived autonomy, competence, and relatedness need satisfaction would increase from week 4 to week 12.

Three separate paired samples *t*-tests were conducted to examine whether there was a significant change in perceived autonomy, competence, and relatedness need satisfaction from week 4 to week 12 of participation in the CHRC program. Hypotheses were partially supported with autonomy and relatedness need satisfaction showing significant improvements (see Table 4). The changes in autonomy and relatedness need satisfaction were represented by small effect sizes ($d = .24$ and $d = .35$, respectively; Cohen, 1992).

Hypotheses 1b (ii-iii): Integrated regulation and intrinsic regulation would improve from week 4 to week 12.

Paired samples *t*-tests were conducted separately for integrated regulation and intrinsic regulation, revealing significant improvements in both regulation types ($p < .05$) from week 4 to week 12 (see Table 5). Small effect sizes of $d = .21$ and $d = .18$ were evident for change in intrinsic regulation and integrated regulation, respectively (Cohen, 1992).

Table 4

Mean Score Changes in Psychological Need Satisfaction from Week 4 to Week 12

Variable	M_1	M_2	t	p	ES
Autonomy need satisfaction	4.16 (1.30)	4.46 (1.15)	2.06	.045	.24
Competence need satisfaction[a]	1.38 (0.33)	1.33 (0.29)	1.37	.176	.16
Relatedness need satisfaction	4.37 (1.35)	4.81 (1.15)	5.75	.000	.35

Note. M_1 = mean variable score assessed at Week 4. M_2 = mean variable score assessed at Week 12. Standard deviations are presented in parentheses. $n = 53$ at both time points. Means and standard deviations for perceived autonomy support and competence need satisfaction have undergone square-root transformation. ES = effect size, $(M_1 - M_2)/SD_{\text{pooled}}$, where SD_{pooled} = pooled standard deviation (Cohen, 1992).

[a]Scores for competence need satisfaction have been reflected and transformed. Lower scores should be interpreted as higher scores, and vice versa.

Table 5

Mean Score Changes in Integrated Regulation and Intrinsic Regulation from Week 4 to Week 12

Variable	M_1	M_2	t	p	ES
Integrated regulation	5.43 (1.31)	5.66 (1.28)	2.29	.026	.18
Intrinsic regulation	5.63 (1.15)	5.85 (0.98)	2.23	.030	.21

Note. M_1 = mean variable score assessed at Week 4. M_2 = mean variable score assessed at Week 12. Standard deviations are presented in parentheses. $n = 53$ at both time points. ES = effect size, $(M_1 - M_2)/SD_{\text{pooled}}$, where SD_{pooled} = pooled standard deviation (Cohen, 1992).

Hypothesis 2: Perceived autonomy support assessed at week 4 would positively predict change in a) integrated regulation, and b) intrinsic regulation, indirectly through changes in psychological need satisfaction.

For the following analysis, autonomy support assessed at Time 1 was the independent variable, and the residualized change scores for integrated regulation, and intrinsic regulation from Time 1 to Time 3 were the two separate dependent variables examined. Changes in competence, autonomy and relatedness need satisfaction from Time 1 to Time 2, represented by residualized change scores were examined as potential mediators.

To assess mediation, the product of coefficients method was followed (MacKinnon, Fairchild, & Fritz, 2007; MacKinnon, Taborga, & Morgan-Lopez, 2002; see Figure 3 for an example): (1) perceived autonomy support must be significantly related to the change scores for behavioural regulation types. Two separate bivariate regression analyses would be conducted to regress each of the change scores for integrated regulation and intrinsic regulation on perceived autonomy support. (2) perceived autonomy support must be significantly related to changes in psychological need satisfaction scores. Three separate bivariate regression analyses would be conducted to regress changes in competence, autonomy, and relatedness need satisfaction on perceived autonomy support (α_1, α_2, α_3, respectively). (3) changes in psychological need satisfaction scores must be significantly related to change scores for a) integrated regulation, b) intrinsic regulation (β_1, β_2, β_3, respectively), when the independent variable (perceived autonomy support) is included in the model. Based on the multiple mediator model outlined by MacKinnon et al. (2002), and on SDT stating that all three needs must be satisfied and are important for the processes of integration and internalization (Deci & Ryan, 2000), a decision was made to enter change scores for autonomy, competence and relatedness simultaneously into a multivariate regression analyses, predicting each of: a) integrated regulation, and b) intrinsic regulation. (4) a test of the mediated effect is conducted using product of coefficients. Three specific mediated effects ($\alpha_1\beta_1$, $\alpha_2\beta_2$, and $\alpha_3\beta_3$) and the total indirect effect (the sum of the three mediated effects $\alpha_1\beta_1$, $\alpha_2\beta_2$, and $\alpha_3\beta_3$) would be computed, as well as their standard errors (Sobel, 1986). The standard errors would then be used to compute confidence limits to test the significance of the mediated effect(s). If the confidence limit includes zero, then the mediated effect is not significant.

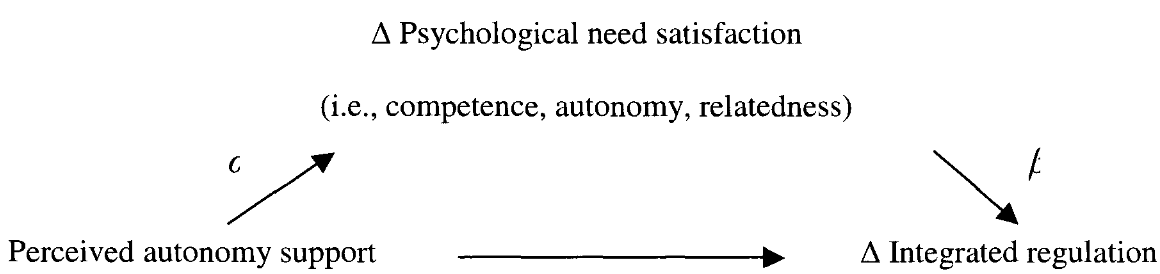

Figure 3. Example of the mediation model with change in integrated regulation as the dependent variable.

Prior to conducting the proposed mediation analysis, the first step taken was to calculate change scores for the three psychological needs and the two behavioural regulation types. As was assumed, correlations between Time 1 scores and raw change scores for each of these variables were found to be significant. Therefore, residualized change scores were computed by regressing Time 2 scores on Time 1 scores for each psychological need, and regressing Time 3 scores on Time 1 scores for integrated regulation and intrinsic regulation as recommended by Cohen, Cohen, West and Aiken (2003).

Examination of the correlation matrix (Table 6) showed that perceived autonomy support assessed at Time 1 had no relationship with change scores for any of the three psychological need satisfaction variables or the autonomous forms of behavioural regulation. Thus, criteria 1 and 2 outlined above were not met and the mediation analysis could not be continued. Further examination revealed no significant relationships between change scores for the three psychological needs and change in the two behavioural regulation types (criteria 3). Thus, this hypothesis was not supported.

Table 6

Correlations Among Perceived Autonomy Support at Week 4 and Residualized Change Scores of Psychological Need Satisfaction (Week 4 to 8) and Behavioural Regulation (Week 4 to 12)

	1	2	*3*	*4*	5	6
1. Perceived autonomy support (Time 1)	-	.06[a]	.23	.17[a]	-.03[a]	-.01[a]
2. Δ Autonomy need satisfaction		-	.50[a]**	.33*	-.03	-.05
3. Δ Competence need satisfaction			-	.38[a]**	.07[a]	.15[a]
4. Δ Relatedness need satisfaction				-	.04	-.10
5. Δ Integrated regulation					-	.69**
6. Δ Intrinsic regulation						-

Note. Δ = residualized change.

[a]Direction of correlation has been adjusted due to reflected scores for perceived autonomy support and competence need satisfaction.

*$p < .05$; **$p < .01$.

Hypothesis 3a: ii) Integrated regulation, iii) Intrinsic regulation measured at week 12 would be positively related to exercise intentions assessed at week 14.

As was hypothesized, both autonomous forms of behavioural regulation were positively correlated with participants' intentions to exercise on their own for the upcoming month (see Table 7).

Hypothesis 3b: ii) Integrated regulation, iii) Intrinsic regulation measured at week 12 would be positively related to exercise behaviour assessed at week 14.

Means and standard deviations for exercise reported at Time 4 (week 14) are presented in Table 7. Table 7 also shows the bivariate correlations between scores for the two forms of behavioural regulation (assessed at Time 3) and exercise data at the moderate to vigorous intensity as well as frequency of total reported exercise (assessed at Time 4). Contrary to hypotheses, no significant relationships were found between these variables.

Table 7

Relationships Among Autonomous Exercise Regulations, Intentions and Behaviour

	M (SD)	*1*	*2*	*3*	*4*	*5*	*6*	*7*
1. Integrated regulation		-	.81**	.35*	.07	-.11	.08	-.08
2. Intrinsic regulation			-	.30*	-.03	.06	.08	-.13
3. Exercise intentions	4.58 (1.47)			-	.33*	.22	.30*	.16
4. MV frequency	3.09 (2.07)				-	.63**	.82**	.66**
5. MV average duration	33.82 (23.61)					-	.83**	.32*
6. MV total volume	134.96 (117.18)						-	.56**
7. Cardio frequency	3.85 (1.82)							-

Note. MV = moderate vigorous intensity. Cardio includes exercise reported at light, moderate and vigorous intensities. Frequency (days per week), duration (minutes), total volume (frequency x duration).

$*p < .05$; $**p < .01$.

Discussion

The present study was designed to investigate the dynamics of motivational variables outlined by SDT in a cardiac rehabilitation setting. The role of perceived autonomy support relative to patient motivation was also assessed. The study first examined changes in psychological need satisfaction and behavioural regulation from week 4 of cardiac rehabilitation program participation to week 12. Next, a mediational model was proposed to examine changes in psychological need satisfaction as mediators of the effect of perceived autonomy support on changes in behavioural regulation. The study also aimed to test the relationship between the autonomous forms of behavioural regulation, patients' exercise intentions, and self-managed exercise behaviour. Consistent with hypotheses, findings from the study showed that need satisfaction and behavioural regulation increased during cardiac rehabilitation. Perceived autonomy support was not related to changes in need satisfaction or behavioural regulation. Therefore, no evidence for mediation was obtained. However, a positive relationship was found between behavioural regulations reflecting greater autonomy and intentions to exercise independently, lending support to the SDT framework. The following sections will explore the results in more detail and address study limitations and future directions for SDT research within this population.

Changes in Psychological Need Satisfaction and Behavioural Regulation During Cardiac Rehabilitation

According to SDT, the drive to seek challenges and meaningful connections with others, to experience interest and enjoyment, and to self-regulate and attain outcomes that are personally valued is innate, not learned (Deci & Vansteenkiste, 2004; Ryan, 1995; Ryan & Deci, 2002). As SDT proposes, the social context can either undermine these inherent tendencies, which can lead to negative outcomes, or support them and result in positive outcomes (Deci & Ryan, 2000; Ryan & Deci, 2002). In the present study, the data indicated these needs were largely satisfied at the outset of cardiac rehabilitation as indicated by high baseline (week 4) scores. However, the cardiac rehabilitation environment further supported these needs as indicated by the observed improvements in participants' perceived autonomy and relatedness need satisfaction from week 4 to week 12. Although autonomous forms of behavioural regulation were also high at baseline, integrated regulation and intrinsic regulation showed improvements over time as well. The increase in need satisfaction coupled with increases in behavioural regulation over time is consistent with the propositions of SDT (Ryan & Deci, 2000b; 2002).

One finding of interest was the increase in relatedness need satisfaction that was evident over time. This finding is consistent with previous research involving participation in structured exercise programs (Edmunds et al., 2008; Wilson et al., 2003). According to Baumeister and Leary (1995), shared negative experiences promote positive bonding. Participants in the present study were all in the rehabilitation program due to a cardiac event. Thus, placement in a new exercise class with other individuals facing similar experiences and challenges likely fostered the initiation of social interaction within the group. Over time, attachments were also likely to have been formed and strengthened as the group shared experience in cardiac rehabilitation together and witnessed the progress made by each other. Several researchers have already recognized this tendency of group cohesion and mutual acceptance to develop over time as individuals continue to adhere to an exercise program (Carron & Brawley, 2000; Christensen, Schmidt, Budtz-Jørgensen, & Avlund, 2006). By satisfying the desire to interact with fellow cardiac rehabilitation patients, it is conceivable that a sense of connectedness or cohesiveness ensued and relatedness need satisfaction increased as a result.

Autonomy need satisfaction also increased from week 4 to week 12 of cardiac rehabilitation. Autonomy refers to having a sense of choice and ownership over one's behaviour (deCharms, 1968). At week 4, participants' rehabilitative exercise prescriptions were still fairly new and they were closely monitored by their exercise leaders. By week 12, more choices regarding their exercise program were being offered for most of the patients (e.g., varying exercise time, use of additional cardio machines, the addition of a resistance training component, etc.). Nurturing these choices may have led to greater feelings of control over their exercise program, and consequently greater autonomy need satisfaction.

The evidence indicating improved need satisfaction over time also lends support to propositions made by Ryan (1993; 1995) that the needs for autonomy and relatedness are complementary in nature. Although the term autonomy is often confused with the concept of independence (Deci & Ryan, 2002), the two are not considered equivalent. For example, in supervised cardiac rehabilitation, patients may have considerable dependence on their exercise leaders for guidance on their exercise programs (Bray, Brawley & Millen, 2006), yet they can still feel autonomous towards exercising if the act of exercising is coherent with their values and it is self-endorsed (Ryan, 1993). This sense of autonomy can be facilitated through supportive attachments that provide positive feedback, a rationale for engaging in exercise, and opportunity for choice while respecting the patients' perspectives (Williams, 2002). The positive correlation between perceived autonomy support and autonomy need satisfaction at week 4 suggests that this need was being supported by the exercise leaders, and perhaps increased the possibility for change in autonomy need satisfaction over time (see Appendix A).

Receiving support from other patients to whom one feels related and participating with a group that shares similar values of exercise can promote autonomy as well, especially in the early stages of behaviour change (Ryan & Deci, 2002). A positive correlation between autonomy and relatedness need satisfaction was also evident at week 4 (see Appendix A). Considered together, these positive correlations and the observed increases in need satisfaction for both autonomy and relatedness suggest that complete self-reliance is not required to feel autonomous.

Contrary to what was hypothesized in the present study, competence need satisfaction showed no significant improvement from week 4 to week 12. Competence need satisfaction has been found in previous studies to increase over time amongst healthy individuals participating in supervised exercise classes of 10-12 weeks' duration (Edmunds et al., 2008, Wilson et al., 2003). However, in the present study, the mean score at week 4 for competence need satisfaction was 4.98 (SD = 1.02), with a maximum possible score of 6. Thus, there was little room for change in competence compared to the other two needs of autonomy and relatedness (at week 4, autonomy = 4.16, SD =

1.30; relatedness = 4.37, SD = 1.35). Satisfying the need for competence seems especially important early on following a cardiac event in order for a patient to have enough confidence to initiate an exercise rehabilitation program. Having been presented with this challenge from the beginning of the program, and through feedback provided by the exercise leaders, it is possible that competence improved during the first month prior to the start of data collection. Despite there being no observed improvements in competence need satisfaction, participants' scores revealed relatively high feelings of competence that were maintained over the three months of study participation.

In summary, cardiac rehabilitation patients' psychological needs were being satisfied at the onset of the study, with the needs for autonomy and relatedness showing evidence of being further supported over time during their early months in cardiac rehabilitation. Integrated and intrinsic regulation showed improvements during this time as well, suggesting that participants were experiencing more enjoyment from exercising, and were identifying with the behaviour to make exercise more congruent with other personally-held values (Ryan & Deci, 2000a). Thus, the cardiac rehabilitation environment supported patients' need satisfaction and promoted self-determined motivation.

The Effect of Autonomy Support on Motivational Variables

A primary focus of the present study was to examine how the social context in which cardiac patients participate can promote need satisfaction and autonomous regulation of behaviour. As such, perceived autonomy support was examined as a predictor of changes in psychological need satisfaction as well as changes in integrated and intrinsic regulation. An ongoing interaction between the patients and an autonomy supportive environment in the cardiac rehabilitation setting was hypothesized to lead to improvements in need satisfaction and self-regulation of behaviour over time. Based on SDT, a complex mediation model was proposed to examine changes in need satisfaction as a mediator of the relationship between perceived autonomy support and changes in autonomous forms of behavioural regulation. Contrary to hypotheses, perceived autonomy support was not found to be a significant predictor of change in any of the SDT variables examined, which failed to support mediation.

Although previous research has supported a positive association between perceived autonomy support and self-regulation for exercise (e.g., Edmunds et al., 2006; Wilson & Rodgers, 2004), most studies have been cross-sectional with very few having examined change in autonomous regulation as the outcome variable. In a recent experimental study, Edmunds and colleagues (2008) found individuals participating in an autonomy supportive exercise class reported no changes in autonomous regulation. In contrast, a study involving patients with diabetes showed autonomy support from health care providers accounted for improvements in autonomous reasons for following regular diet and exercise ($\beta = 0.15, p < .05$) over a 4-month period (Williams, Freedman, et al., 1998). However, by assessing behavioural regulation for the two behaviours together (diet and exercise) it could not be established whether autonomy support had an effect on diet, exercise, or both. As such, the effect of perceived autonomy support on changes in motivational variables remains unclear.

Several factors should be considered when interpreting the lack of association between perceived autonomy support and changes in need satisfaction. In the present study, the mean score for perceived autonomy support at the baseline assessment was notably high ($M = 5.72$, $SD = 1.18$). Although the scale for perceived autonomy support was designed to provide a continuum of scores ranging from 1 through 7, virtually all respondents reported ceiling-level scores for the amount of autonomy support they felt they were receiving from the exercise leaders. This narrow range of scores provided limited variance in perceived autonomy support, which in turn compromised testing its proposed relationship with other variables. Alternative methods such as the use of different measurement instruments or designs such as conducting an experimental study that manipulates the level of autonomy support provided in a cardiac rehabilitation setting to improve variance in the construct should be considered for future research.

Autonomy Support is Still Important in Cardiac Rehabilitation

According to several researchers (Deci & Ryan, 1987; Sheldon et al., 2003), the provision of social support using an autonomy supportive style should have positive effects on motivation and behaviour. Although a significant relationship between perceived autonomy support and changes in motivational variables was not found in the present study, the results do not mean a relationship between those variables does not exist. As noted above, ceiling effects and limited variability in autonomy support scores are factors limiting the detection of a relationship in the present data. Cardiac rehabilitation patients in the present study perceived the exercise leaders to be highly autonomy supportive. From my personal observations made in a cardiac rehabilitation setting, some ways in which autonomy support is manifested include: (1) Encouraging patients to exercise on their own after being oriented to the exercise program, knowing that the exercise leaders are close by if help is needed. (2) Providing relevant information regarding the benefits of exercise and realistic expectations of the program. (3) Providing informative and contingent feedback regarding progress. (4) Displaying an honest understanding of challenges faced by the patients and providing options on how to address their concerns. (5) Encouraging patients to ask questions and get involved with their health behaviour decisions.

There is evidence to suggest that health professionals can be successfully taught to be autonomy supportive with their patients (e.g., Edmunds et al., 2008; Reeve, 1998; Williams, 2002). Although they may not have been formally trained to be autonomy supportive, the exercise leaders at the cardiac rehabilitation centre involved in the present study demonstrated a natural tendency to be receptive to the individual needs of each patient and used an autonomy-supportive teaching style to guide them during the program. Regardless of the degree of autonomy support needed by each individual, everyone benefits when their self-regulation is supported (Sheldon et al., 2003). Thus, the use of autonomy support in health care programs such as cardiac rehabilitation should still be encouraged.

Additional Socio-Contextual Conditions

In the present study, perceived autonomy support was examined as a potentially important contextual condition of the social environment that can facilitate self-determination. However, autonomy support is just one of the socio-contextual factors posited by SDT to affect change in psychological need satisfaction and self-determined motivation. Structure and involvement are the other two contextual conditions considered important in the SDT framework that were not included in the present study (Deci & Ryan, 1991; Edmunds et al., 2008; Wilson et al., in press). In this case, structure could have involved the exercise leaders providing clear expectations of behaviour-outcome contingencies and relevant positive feedback, whereas involvement could refer to the exercise leaders expressing outward interest in the well-being of the patient (Deci & Ryan, 1991; Markland, 1999; Wilson et al., in press). Examining structure and involvement in conjunction with autonomy support would provide a more thorough examination of the socio-contextual conditions posited by SDT to be important for facilitating self-determination and should be a consideration for future research.

Predicting Exercise Intentions and Behaviour

As hypothesized, integrated regulation and intrinsic regulation were both found to be positively related to exercise intentions, which is consistent with previous research involving adult exercisers (Edmunds et al., 2007; Thøgerson-Ntoumani & Ntoumanis, 2006; Wilson & Rodgers, 2004). The present findings are also consistent with Slovenic D'Angelo et al.'s (2007) study involving cardiac rehabilitation patients, where a positive relationship between self-determined motivation and intentions to exercise regularly for the upcoming 1 to 6 months was reported. Thus, it appears that cardiac rehabilitation patients' willingness to engage in regular self-managed exercise, represented in the present study as number of days exercising per week, is reflective of the quality or degree of self-determined motivation that is felt towards exercise behaviour.

When self-managed exercise behaviour was examined in relation to integrated and intrinsic regulation, no significant correlations were found. These findings are in many ways not consistent with much of the previous research examining motivational determinants of exercise behaviour among adults. That is, past studies have reported identified and intrinsic regulation to positively predict leisure-time exercise behaviour (e.g., Edmunds et al., 2006; Wilson et al., 2003), and while only a couple of studies have included integrated regulation in their analysis, its positive association with total exercise behaviour has been documented as well (Edmunds et al., 2007; Wilson, Rodgers, et al., 2006). However, it is important to note that most of these studies were cross-sectional in design. When Hagger, Chatziserantis, and Harris (2006) employed a longitudinal design for their study involving university students, self-determined motivation was not found to have a direct relationship with exercise behaviour.

Although relationships between autonomous forms of behavioural regulation and exercise behaviour were expected to emerge, the time frame for behaviour was somewhat limited. Specifically, the exercise recall measure had participants recording activities they had engaged in only one week after assessing behavioural regulation. Williams (2002) has advised that changes in behavioural regulation may need to be maintained for extended periods of time before a relationship between behavioural regulation and behaviour becomes evident. A measure reflecting a longer-term of exercise behaviour would be useful to examine this hypothesis.

Overall, autonomous regulation was not found to predict cardiac patients' self-managed exercise behaviour, but did predict their exercise intentions. These intentions provided a future outlook on cardiac patients' willingness to engage in self-managed exercise for the upcoming month. Assessing exercise behaviour during this month and even longer-term would have been beneficial for describing the prospective relationship between behavioural regulation, exercise intentions, and exercise behaviour.

Study Limitations

Although the present findings are encouraging and lend some support for the SDT framework in cardiac rehabilitation, there are a number of limitations to acknowledge. Several limitations are associated with the sample employed in the study. For one, the sample size was relatively small and drawn from a convenience population at one hospital. In addition, the ceiling effect observed for identified regulation at the baseline assessment may indicate that only those cardiac patients who valued the importance of regular exercise were participating in cardiac rehabilitation and also were more likely to agree to participate in the study. These factors, along with the male-only composition of the sample, limit the generalizability of the study's findings.

A second limitation involves the use of self-report measures for a population consisting mainly of older adults, not to mention coronary artery bypass surgery patients who are known to report cognitive difficulties (Borowicz, Goldsborough, Selnes, & McKhann, 1996). With the use of the exercise recall measure, some participants expressed difficulty with remembering the activities they had engaged in over the past seven days. To aid with data collection, participants were prompted to log their exercise activity for the week leading up to the next meeting. However, this prompting of participants to record their exercise may have motivated them to do more exercise than usual, regardless of their degree of autonomous regulation. Furthermore, despite encouraging participants to make full use of the response scales provided for each item on the questionnaire instruments, cognitive biases may have emerged. The Likert-type scales used for measuring SDT variables may have presented a cognitive burden for the older adults (Isaksson, Santamäki-Fischer, Nygren, Lundman, & Åström, 2007). For example, too many response choices may have led participants to only use the extreme values for item responses. Such issues raise questions about the reliability and validity of the self-report data and should be considered when using self-report measures with the cardiac rehabilitation population.

A third limitation concerns starting data collection four weeks post-entry into the cardiac rehabilitation program. Although a rationale was provided for this aspect of the procedure (i.e., giving participants one month of interaction time with their exercise leaders before rating perceived autonomy support), no assessments were made within the first month of program participation during which time significant changes in several of the study variables may have occurred. Given that participants were reporting relatively high ratings for need satisfaction and autonomous forms of regulation at the baseline measurement point (i.e., week 4), it would be useful to assess these variables at the outset of participation in cardiac rehabilitation to observe whether changes occur during the first month or if patients enter the exercise program already feeling this way. Considering that retention rates are likely to show the most significant drop within the first month of starting an exercise program (Edmunds et al., 2007), these motivational variables may represent important program adherence factors that should be investigated in future studies.

Study Strengths

One strength of the present study is the use of SDT as a guiding theoretical framework for study design. The use of SDT in the cardiac rehabilitation population has been limited in past research, but has been shown to be effective in predicting behaviour in the general exercise and health care domains (Wilson et al., in press; Williams, 2002). What makes SDT unique from other social cognitive theories is its acknowledgement of one's inherent desire to take an active role in behaviour regulation. Recognizing and nurturing this natural drive to self-regulate would be especially useful for promoting adoption and long-term maintenance of health-related behaviours. Uniquely, SDT not only examines what cognitive variables, such as self-determined motivation, predict behaviour, but also *how* the social environment can nurture motivation to self-regulate, by considering important socio-contextual conditions (e.g., autonomy support). Within a cardiac rehabilitation setting that allows for regular interaction with exercise leaders and other patients, there exists the potential for establishing an environment supportive of patients' self-regulation, which could eventually lead to exercise adherence. The ability to test this potential through a comprehensive examination of SDT's contextual and motivational constructs made the use of SDT in the present study appealing.

Additional strengths of this study were its prospective nature and examination of changes in SDT variables, which previous research using SDT has paid little attention to. Measures developed to assess psychological need satisfaction and behavioural regulation share common methods of measurement (e.g., scale type, context-specific items) that, when administered at the same point in time, can lead to findings that are attributable to the method of measurement used instead of the actual constructs themselves, an issue referred to as common method variance (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Thus, the positive relationships between SDT variables reported in previous cross-sectional studies may be misleading. The present study used temporal separation to reduce common method biases, allowing for an examination of changes in need satisfaction and behavioural regulation, as well as theory-based correlates of change over time.

Implications for Self-Determination Theory

The observed improvements in need satisfaction and autonomous forms of behavioural regulation over time, along with the positive correlation between behavioural regulation and exercise intentions, lend some support to the SDT framework. Distinctively, the present study examined if perceived autonomy support was associated with subsequent changes in need satisfaction or integrated and intrinsic regulation. Unfortunately, no relationship was found when looking at changes in motivational variables. Potential methodological reasons for these findings were acknowledged previously, but it is also felt that the present study provided a fair test of the hypotheses within the established parameters, which raises questions about the validity of SDT itself.

Some conceptual issues related to SDT may not make this theory suitable for the cardiac rehabilitation population. For example, SDT posits that receiving autonomy support can improve overall self-determined motivation. However, what SDT does not specify is whether perceived autonomy support has different magnitudes of effect on the separate behavioural regulation types. For instance, greater levels of perceived autonomy support may be more effective in reducing scores for some forms of extrinsic regulation (i.e., external, introjected) to facilitate initial internalization. If this was the case, the ability for autonomy support to affect positive changes in the more autonomous behavioural regulation types would be limited. Secondly, if patients who choose to enroll in cardiac rehabilitation are likely to be participating for more autonomous rather than extrinsic reasons from the start of their program (recall that initial scores for identified, integrated, and intrinsic regulation were high in the present study), then changes in these autonomous forms of behavioural regulation as a function of perceived autonomy support would likely not be supported. The study's findings therefore reinforce Wilson et al.'s (in press) view for the need to resolve some conceptual issues related to SDT in exercise contexts.

Future Directions

The present study provided a prospective look at changes in motivational variables as a function of participation in cardiac rehabilitation. However, more research applying SDT in this population is needed to extend these findings. From previous discussion, it is clear that further research is needed to clarify some conceptual issues of SDT for its application to understanding exercise motivation and behaviour in cardiac rehabilitation. Furthermore, measurement instruments currently being used to assess need satisfaction and behavioural regulation were originally developed using younger populations. Reliable and valid measures developed for older adults are necessary, with validation of these measures in the cardiac rehabilitation context.

Although there was no significant relationship found between the behavioural regulations examined and exercise behaviour, a review of the behavioural data revealed appropriate levels of exercise frequency, duration and total weekly involvement being reported at the moderate-to-vigorous intensity level. Participants also reported relatively high intentions to continue participating in self-managed exercise ($M = 4.58$, $SD = 1.47$ days/week). The positive findings for exercise intentions and behaviour, together with the high scores observed for psychological need satisfaction and autonomous regulation, reflect a highly self-determined population showing evidence of successful integration of regular exercise into active lifestyles. These findings are positive and could potentially indicate how successful these cardiac patients may be in maintaining self-managed exercise following program completion. Nonetheless, cognitive factors underlying the decline in exercise adherence following completion of cardiac rehabilitation (Bock et al., 2003; Moore et al., 2003) remain inconclusive. A longitudinal assessment of self-managed exercise following completion of the cardiac rehabilitation program related to self-determined motivation would provide further answers regarding the utility of SDT in this population. The potential benefit of self-determined motivation on long-term exercise adherence for the cardiac rehabilitation population has been previously suggested (Slovenic D'Angelo et al., 2007; Russell & Bray, 2008), but more longitudinal research is needed.

Finally, high scores for perceived autonomy support found in the present study limited the ability to test its positive effect on changes in need satisfaction and behavioural regulation. These findings highlight the need for the manipulation of social contextual variables (i.e., autonomy support, structure, involvement) through experimental design. A comparison of two contexts (control group versus autonomy supportive) within cardiac rehabilitation would help gain a better understanding of the motivational benefits associated with exposure to an autonomy supportive environment.

Conclusion

The findings from the present study provide insight into cardiac patients' levels of self-determined motivation during the early months of participation in cardiac rehabilitation and the positive association between these self-determined motives and intentions to engage in self-managed exercise, lending support to SDT. The high scores for perceived autonomy support and psychological need satisfaction were indicative of a cardiac rehabilitation environment supporting healthy functioning (Ryan & Deci, 2002). Future research that addresses some measurement and conceptual issues of SDT and assesses the effects of cardiac patients' self-determined motivation on long-term exercise adherence is needed to lend additional support to the application of SDT in cardiac rehabilitation.

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Appendix A

Correlations Between Perceived Autonomy Support and Psychological Need Satisfaction at Week 4

	1	*2*	*3*	*4*
1. Perceived autonomy support	-	.50[a]**	.44**	.53[a]**
2. Autonomy need satisfaction		-	.26[a]	.53**
3. Competence need satisfaction			-	.45[a]**
4. Relatedness need Satisfaction				-

[a]Direction of correlation has been adjusted due to reflected scores for perceived autonomy support and competence need satisfaction.

$^{**}p < .01$.

Appendix B

B1: Demographic Questionnaire

B2: Sources of Social Support Questionnaire

Appendix B1

Cardiac Rehabilitation Program Questionnaire

Randomized three-digit identification number: _______

1. Gender (check ✓ one): ☐ Female ☐ Male

2. Age: _________ years.

3. Are you currently (check ✓ one):

☐ Married ☐ Separated ☐ Widowed ☐ Single ☐ Divorced ☐ Common-law ☐Other

4. Are you currently (check ✓ one): ☐ Working ☐ Retired

Occupation/Former occupation: ______________________________

5. Ethnicity (check ✓ one):

☐ White ☐ Chinese ☐ Black ☐ Filipino ☐ Latin American ☐Southeast Asian
☐South Asian ☐ West Asian ☐North American Indian, Metis, or Inuit ☐ Arab

☐ Other

6. Please describe your cardiac event (check ✓):

☐ Heart attack ☐ Angioplasty ☐ Coronary artery bypass surgery

☐ Other: ______________

Appendix B2

Sources of Support

Below is a list of people in your social environment who may provide you with support to be physically active. For each, please rate how much support you feel he/she provides for you being physically active.

1) family physician

1	2	3	4	5	6	7
no support						a great deal of support

2) kinesiologist (exercise leader) at the cardiac rehab centre

1	2	3	4	5	6	7
no support						a great deal of support

3) spouse

1	2	3	4	5	6	7
no support						a great deal of support

4) other family member

1	2	3	4	5	6	7
no support						a great deal of support

5) friend

1	2	3	4	5	6	7
no support						a great deal of support

6) someone else (please indicate): ______________________

1	2	3	4	5	6	7
no support						a great deal of support

Appendix C

Appendix C1

Health Care Climate Questionnaire

This questionnaire contains items that are related to your exercise sessions at the cardiac rehabilitation facility in which your exercising was discussed between you and your kinesiologist (exercise leader) in any way. Exercise leaders have different styles in dealing with patients and we would like to know more about how you have felt about your encounters with your exercise leader in any encounter when your exercising was discussed. Your responses will be kept confidential, so none of the exercise leaders will know about your responses. Think about the exercise leader that you have worked with the most when answering the following questions.

1. I feel that my exercise leader has provided me choices and options about being physically active.

1	2	3	4	5	6	7
strongly disagree			neutral			strongly agree

2. I feel that my exercise leader at the centre understands how I see things with respect to being physically active.

1	2	3	4	5	6	7
strongly disagree			neutral			strongly agree

3. My exercise leader conveys confidence in my ability to make changes regarding my being physically active.

1	2	3	4	5	6	7
strongly disagree			neutral			strongly agree

4. My exercise leader encourages me to ask questions about my being physically active.

1	2	3	4	5	6	7
strongly disagree			neutral			strongly agree

5. My exercise leader listens to how I would like to do things in terms of my being physically active.

1	2	3	4	5	6	7
strongly disagree			neutral			strongly agree

6. My exercise leader tries to understand how I see things in terms of my being physically active before suggesting any changes or new ways to do things.

1	2	3	4	5	6	7
strongly disagree			neutral			strongly agree

Appendix C2

Psychological Need Satisfaction in Exercise Scale

Using the scale below, please indicate to what extent each of the following statements is true for you by considering how you typically feel while you are exercising.

	False					True
1. I feel like I am in charge of my exercise program decisions.	1	2	3	4	5	6
2. I feel like I am capable of doing even the most challenging exercises.	1	2	3	4	5	6
3. I feel free to choose which exercises I participate in.	1	2	3	4	5	6
4. I feel attached to my exercise companions because they accept me for who I am.	1	2	3	4	5	6
5. I feel capable of completing exercises that are challenging to me.	1	2	3	4	5	6
6. I feel a sense of camaraderie with my exercise companions because we exercise for the same reasons.	1	2	3	4	5	6
7. I feel free to make my own exercise program decisions.	1	2	3	4	5	6
8. I feel confident in my ability to perform exercises that personally challenge me.	1	2	3	4	5	6
9. I feel like I have a say in choosing the exercises that I do.	1	2	3	4	5	6

	False					True
10. I feel close to my exercise companions who appreciate how difficult exercise can be.	1	2	3	4	5	6
11. I feel like I am the one who decides what exercises I do.	1	2	3	4	5	6
12. I feel like I share a common bond with people who are important to me when we exercise together.	1	2	3	4	5	6
13. I feel that I am able to complete exercises that are personally challenging.	1	2	3	4	5	6
14. I feel connected to the people who I interact with while we exercise together.	1	2	3	4	5	6
15. I feel confident that I can do even the most challenging exercises.	1	2	3	4	5	6
16. I feel free to exercise in my own way.	1	2	3	4	5	6
17. I feel like I get along well with other people who I interact with while we exercise together.	1	2	3	4	5	6
18. I feel good about the way I am able to complete challenging exercises.	1	2	3	4	5	6

Appendix C3

Self-Regulation in Exercise Questionnaire

There are a variety of reasons why people choose to be physically active. Please indicate how true each of these reasons is for why you are exercising.

1. I am exercising because I would feel bad about myself if I did not.

   1 2 3 4 5 6 7
   not at all true somewhat true very true

2. I am exercising because others would be angry at me if I did not.

   1 2 3 4 5 6 7
   not at all true somewhat true very true

3. I am exercising because I enjoy exercising.

   1 2 3 4 5 6 7
   not at all true somewhat true very true

4. I am exercising because it is consistent with my life goals.

   1 2 3 4 5 6 7
   not at all true somewhat true very true

5. I am exercising because I would feel like a failure if I did not.

   1 2 3 4 5 6 7
   not at all true somewhat true very true

6. I am exercising because I feel like it's the best way to help myself.

   1 2 3 4 5 6 7
   not at all true somewhat true very true

7. I am exercising because people would think I'm a weak person if I did not.

1	2	3	4	5	6	7
not at all true			somewhat true			very true

8. I am exercising because I feel like I have no choice about exercising; others make me do it.

1	2	3	4	5	6	7
not at all true			somewhat true			very true

9. I am exercising because it is a challenge to accomplish my goal.

1	2	3	4	5	6	7
not at all true			somewhat true			very true

10. I am exercising because I consider exercise to be a part of my identity.

1	2	3	4	5	6	7
not at all true			somewhat true			very true

11. I am exercising because I believe exercise helps me feel better.

1	2	3	4	5	6	7
not at all true			somewhat true			very true

12. I am exercising because it's fun.

1	2	3	4	5	6	7
not at all true			somewhat true			very true

13. I am exercising because I worry that I would get in trouble with others if I did not.

1 2 3 4 5 6 7
not at all true somewhat true very true

14. I am exercising because it feels important to me personally to accomplish this goal.

1 2 3 4 5 6 7
not at all true somewhat true very true

15. I am exercising because I consider exercise a fundamental part of who I am.

1 2 3 4 5 6 7
not at all true somewhat true very true

16. I am exercising because I feel guilty if I do not exercise regularly. .

1 2 3 4 5 6 7
not at all true somewhat true very true

17. I am exercising because I want others to acknowledge that I am doing what I have been told I should do. .

1 2 3 4 5 6 7
not at all true somewhat true very true

18. I am exercising because it is interesting to see my own improvement. .

1 2 3 4 5 6 7
not at all true somewhat true very true

19. I am exercising because feeling healthier is an important value for me. .

1 2 3 4 5 6 7
not at all true somewhat true very true

20. I am exercising because I consider exercise consistent with my values. .

1	2	3	4	5	6	7
not at all true			somewhat true			very true

Appendix C4

Exercise Intentions

Please indicate your intentions towards exercising **independently** during the next 4 weeks.

1) I intend to exercise independently _____ times **per week** during the next 4 weeks.

2) I will try to exercise independently _____ times **per week** during the next 4 weeks.

3) My goal is to exercise independently _____ times **per week** during the next 4 weeks.

Please circle a number to indicate how strongly you feel about these exercise intentions.

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Definitely will not do this				Might do this				Definitely will do this

Appendix C5

Program Attendance

Over the past 4 weeks, how many cardiac rehabilitation sessions have you attended?

____

7-Day Physical Activity Recall

Circle which days of the week you consider your weekend days: M T W T F S S

Which day of the week is today: M T W T F S S

Yesterday (Day 1) ______________________

Intensity	**Activity Description**		**Duration**
Light	Morning		
	Afternoon		
	Evening		
Moderate	Morning		
	Afternoon		
	Evening		
Hard	Morning		
	Afternoon		
	Evening		
Strength	Morning		
	Afternoon		
	Evening		
Flexibility	Morning		
	Afternoon		
	Evening		
Other	Morning		
	Afternoon		
	Evening		

Day 2 ____________________

Intensity	**Activity Description**		**Duration**
Light	Morning		
	Afternoon		
	Evening		
Moderate	Morning		
	Afternoon		
	Evening		
Hard	Morning		
	Afternoon		
	Evening		
Strength	Morning		
	Afternoon		
	Evening		
Flexibility	Morning		
	Afternoon		
	Evening		
Other	Morning		
	Afternoon		
	Evening		

***Repeated for days 3 to 7 (inclusive).**

Appendix D

7-Day Physical Activity Recall Script

Script for 7-Day Physical Activity Recall

"We are going to complete a 7-Day physical activity recall. Starting with yesterday, we work back seven days, recording any physical activity you might have done for each day. First, please tell me what two days you consider are your weekend days. Today is _____ (day of the week), so starting with yesterday, can you tell me if you took part in any physical activity. This includes any cardio, strength, or stretching activities; we are interested in the activities you did for the purpose of exercise."

If yes, will ask the following questions and record as necessary:

"What activity did you do?"
"How long did you spend doing it?"
"Was it in the morning, afternoon, or evening?"
"Would you consider the activity you did a light, moderate, or heavy intensity? Exercise of light intensity requires minimal effort (e.g., easy walking, bowling), exercise of moderate intensity is not exhausting (e.g., brisk walking, easy swimming), and exercise of heavy intensity gets your heart beating rapidly (e.g., fast bicycling, jogging)"
"Were there any other activities you participated in this day?"

example:

Moderate	Morning Afternoon Evening	*Walk*	*60 minutes*

If no,
"Let's move on to the previous day. Can you tell me if you took part in any physical activity this day?"

This method will continue until the activities for the past week (seven days) have been recalled.

"Thank you for your time."