Sources of Perceived Support from Friends in Exercise: An application of self-determination theory

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Submitted in partial fulfillment
of the degree of Master of Arts, Applied Health Sciences
(Health and Physical Education)

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Abstract

Background: This study examined three social factors (i.e., *autonomy support*, *structure*, and *involvement*) and their relationship with the motivational processes proposed by Vallerand (1997). This study explored sources of support for exercise participation.

Methods: Participants (N = 425) completed self-reported instruments which assessed variables outlined within Vallerand's (1997) HMIEM.

Results: Structural equation modeling analyses predicting the cognitive/affective and exercise behaviour accounted for 23 percent of variance in positive affect, 10 percent of variance in negative affect, 38 percent of variance in physical self-concept, and 4 percent of variance in exercise behaviour. Exploratory analyses revealed that friends, romantic partners, and educators to be consistent sources for providing autonomy support, structure, and involvement.

Summary: This study is among the first to examine perceived sources of *autonomy support*, *structure*, and *involvement* from friends in the exercise context and suggest such perceptions may contribute to motivating exercise behaviour in post-secondary students.

Acknowledgements

I would like to thank my family for supporting my decision to attend graduate school and for encouraging me to continue when I had my doubts. It was your hard work and dedication that have provided me with the opportunity to succeed in achieving a Master's degree. Although you could not help with homework or understand what I was doing at school, driving me to school and making my lunches were more than enough. Thank you!

I would also like to thank Dr. Philip Wilson for taking me in as his graduate student and for guiding me along the way. Without his guidance and encouragement, I would have lost my way and given up. In addition, I want to thank my advisory committee members for providing positive feedback and constructive criticism with regards to my thesis. I would also like to thank Meghan LeBlanc, Kimberly Grattan, Katie Gunnell, and Kristen Oster for being wonderful lab mates and making life as a graduate student fun and exciting. Last but not least, I would like to acknowledge SSHRC and OGS for their financial support throughout my graduate study here at Brock University.

Table of Contents

Tables

Figures

Operational Definitions

The following terms/concepts will be used throughout this document assuming the definitions provided.

Amotivation: The state of lacking an intention to act (Ryan & Deci, 2000).

Autonomy: The degree to which the individual feels that his or her actions are self-chosen (Deci & Ryan, 2002).

Autonomy support: Provision of choice, pressure to engage in the behaviour is minimized, and individuals are encouraged to initiate actions themselves (Mageau & Vallerand, 2003).

Competence: Feelings of effectiveness in environments that are challenging (White, 1959; Ryan & Deci, 2000).

Exercise: Form of leisure-time physical activity that is usually performed repeatedly over an extended period of time with a specific external objective such as the improvement of fitness, physical performance, or health (Bouchard, Blair, & Haskell, 2007).

External regulation: Behaviours performed to satisfy an external demand or obtain an externally imposed reward contingency (Ryan & Deci, 2000).

Extrinsic motivation: An activity done in order to attain separable outcomes (Ryan & Deci, 2000).

Identified regulation: An autonomous form of extrinsic motivation where the person has identified with the personal importance of a behaviour and thus accepted its regulation as his or her own (Ryan & Deci, 2000).

Integrated regulation: A type of extrinsic motivation when full assimilation of identified regulations to the self, has occurred, which means they have been evaluated and brought into congruence with one's other values and needs (Ryan & Deci, 2000).

Internalization: The process by which an external regulation is transformed into a more-self-determined, internally endorsed regulation (Deci & Ryan, 1985).

Intrinsic motivation: The act of doing of an activity for its inherent satisfactions rather than for some separable consequence (Ryan & Deci, 2000).

Introjected regulation: A type of extrinsic motivation that is still quite controlling because people perform such actions with the feeling of pressure in order to avoid guilt or anxiety or to attain ego-enhancements or pride (Ryan & Deci, 2000).

Involvement: The extent to which individuals perceive that significant others relevant to the behaviour are genuinely interested in them and their welling being (Mageau & Vallerand, 2003).

Motivation: Being moved to do something (Ryan & Deci, 2000)

Negative affect: The experiential component of all valenced (i.e., 'bad') responses, including emotions and moods (Ekkekakis & Petruzzello, 2000).

Physical Activity: Any bodily movement produced by the skeletal muscles that results in a substantial increase over resting energy expenditure (Bouchard, Blair, & Haskell, 2007).

Physical self-concept: Feelings a person holds about his or her physical self (Marsh, 1996; Marsh, Richards, Johnson, Roche, & Tremayne, 1994)

Positive affect: The experiential component of all valenced (i.e., 'good') responses, including emotions and moods (Ekkekakis & Petruzzello, 2000).

Relatedness: Feelings of closeness and belongingness with others (Baumeister & Leary, 1995).

Structure: The degree to which the relationships between the behaviour and salient outcomes are understandable, expectations are clear, and positive feedback is provided (Mageau & Vallerand, 2003).

Chapter 1 – Introduction

Engaging in daily physical activity has been shown to have beneficial effects on one's psyche and physiology (Bouchard, Blair, & Haskell, 2007). Unfortunately, the majority of Canadians do not engage in sufficient levels of physical activity to attain these benefits and it is estimated that approximately half of Canada's population is inactive (Gilmour, 2007). Given the burden of sedentary lifestyles on health care cost, it is pertinent for public health professionals to further their understanding of the determinants of physical activity participation (Katzmarzyk, Gledhill, & Shepherd, 2000). One key variable that may help further our understanding of physical activity participation is motivation.

Vallerand (1997) proposed a model depicting a motivational process where he identified social factors as the initial stage of the process. Based on previous studies by Tobin (2003) and Edmunds and colleagues (2008), *autonomy support*, *structure*, and *involvement* were social factors that fostered psychological need fulfillment, which in turn, had an effect on people's motivation. Although, there appears to be a lack of research concerning all three social supports with regards to the motivational process proposed by Vallerand (1997) in the exercise domain.

Given that few studies have examined Vallerand's (1997) HMIEM within the exercise context with respect to *autonomy support*, *structure*, and *involvement*, a primary purpose of this study was to examine the motivational process in an exercise setting. As a secondary purpose, this study examined and identified relevant sources of support that provide environments of autonomy support, structure, and involvement in the exercise domain.

Chapter 2 – Literature Review

Research has shown that physical activity is effective in preventing and managing several different chronic diseases (Bouchard, Blair, & Haskell, 2007). For instance, physical activity has been prescribed as a condition management and preventative approach to treatment for certain chronic ailments such as cardiovascular diseases, diabetes mellitus, and certain types of cancer (Bouchard et al., 2007). It has also been reported that people who are fit and physically active have a 50 percent reduction in risk associated with hypokinetic disease compared to non-active individuals (Ekkekakis, Backhouse, Gray, & Lind, 2008). Epidemiological and economic-based studies have supported the importance of getting or remaining physically active. In Canada, for example, it is estimated that the burden of sedentary living result in both direct and indirect health care costs and can reduce life expectancy perhaps by as much as 3 years (Katzmarzyk, 2006). These data provide strong evidence for the importance of regular physical activity. Moreover, these physical benefits can be attained through exercise of light-to- moderate intensity on most days of the week (Bouchard et al., 2007). Collectively, it appears that the evidence in favour of the physiological effects attributable to regular physical activity is irrefutable.

In addition to the physiological benefits associated with regular and sustained physical activity, it appears that active individuals can accrue psychological benefits as well. For instance, physical activity has been shown to improve one's health by countering anxiety and stress through the release of pleasure chemicals called endorphins in the brain (Thoren, Floras, Hoffman, & Seals, 1990). Population-based health studies have confirmed the association between participation in regular physical activity and reduced incidence of psychological maladies including depression, stress, anxiety, vulnerability, psychosomatic disorders, and chronic anxiety (Acevedo & Ekkekakis, 2006). Subsequent research has also supported the important role of regular physical activity in terms of promoting well-being as opposed to simply ameliorating ill-health markers. For example, emerging lines of research have indicated that regular physical activity is positively associated with enjoyment (Rogers, Greive, Shanmugham,

Dawson, & Courneya, 2005), vitality (Ryan & Frederick, 1997), physical self-worth and global self-esteem (Fox, 1997). Although the available evidence is not without criticism, it appears that people willing to engage in regular and sustained physical activity can experience many benefits that promote psychological health and overall well-being.

Physical activity in Canada and university students.

According to results from the most recent iteration of the Canadian Community Health Survey (CCHS; 2005), the physical activity levels of adults (defined as people aged 20 years or older) who are considered to be moderately active or more (an energy expenditure of 1.5 Kilocalories per day [KKD] or higher; 1.5 KKD is roughly equivalent to one half hour of walking every day) is approximately 49 percent. In other words, more then half of Canada's adult population are still inactive and fail to engage in sufficient regular physical activity behaviour for optimal physiological or psychological health. Based on current data from the CCHS, the majority of active adults were men and this trend was evident across all age-cohorts. Moreover, it appears that young men (20 – 24 years) are more active then young women. The CCHS data also suggests that the adult population is most active between the ages of 20-24 years (61%) and least active after 65 years old (43%). Overall, this pattern suggests that most Canadians are more active than 20 years ago (Cameron, Craig, & Paolin, 2005). However, according to the Canadian Fitness and Lifestyle Research Institute's (CFLRI), most Canadians do not meet the recommended public health guidelines with respect to accumulating one hour of physical activity daily.

In most recent physical activity and sport survey, regional and provincial data further illustrates the demography of physical activity levels in Canada. Nationwide population-health data suggests a physically inactive nation with majority of the provinces and territories displaying physically active rates for inhabitants below 50 percent, with the exceptions of Ontario (50%), Alberta (52%), and British Columbia (57%). However, several interesting trends do appear in CCHS (2005) results. For instance, it appears that Eastern provinces (40% - 46%) have less of

their population being at least moderately active when compared to Ontario (50%), Western (46% - 57%), and Northern provinces (49%). British Columbia, Alberta, and Ontario are the only provinces reporting 50 percent or more of the population engaging in at least moderate amounts of physical activity. Physical inactive rates are highest in Prince Edward Island (60%) followed by Newfoundland (58%) and then New Brunswick (56%). Taken together, while these data suggest some variability in the patterns of physical activity throughout Canada, the overall trend appears to be that the majority of Canadians are not physically active enough to reduce public health burden. In addition to the low level of physical activity participation reported in Canadian adults, Canadian university students' physical activity levels are just as poor.

Previous research examining exercise behaviour in university students has reported less than optimal participation rates when regular exercise was defined as activities performed at a moderate intensity, four or more times per week, accumulating at least 30 minutes per exercise session (Rhodes, Blanchard, Matheson, & Coble, 2006; Rhodes & Blanchard, 2006). For example, Rhodes and Blanchard (2006) found that university students, from an introductory psychology class, were reporting engagement in fewer moderate intensity activity sessions (M = 2.23; SD = 1.71) compared to minimum of 4 times a week to be considered as regular exerciser. In a subsequent study by Jones, Sinclair, Rhodes, and Courneya (2004), regular exercise was defined as involvement in physical activities of vigorous intensity, three or more times per week, for at least 30 minutes each exercise session. Specifically, Jones et al. (2004) indicated that university students in there study did not engage in vigorous intensity activity (ranged from 2.0-2.4) on three or more occasions per week. Collectively, irrespective of the definition of regular exercise, university students appear to be not meeting the physical activity recommendations for regular exercise. Therefore, understanding the determinants of physical activity participation has become a priority for public health professionals (Biddle, Fox, & Boutcher, 2000; Bouchard et al., 2007; Katzmarzyk, Gledhill, & Shepherd, 2000).

Determinants of physical activity

While a number of inter-and intra-personal variables have been linked with regular physical activity (Biddle et al., 2000; Bouchard et al., 2007), demographic variables appear to be most consistently linked with patterns of physical activity participation (Bouchard et al., 2007). Recent evidence from the CCHS (2005) suggests that gender, income, and age in particular represent the demographic variables showing the greatest variability with regards to physical activity behaviour. The most recent iteration of the CCHS (2005) and Gilmour (2007) noted that (a) males tend to be more physically active than females; (b) younger Canadians (aged 20 – 24 years) report being more physically active than older Canadians (65 years or older); (c) Canadians that have higher income (greater than $15,000) and higher education (secondary and above) levels are more physically active than Canadians who make less then $15,000 annually and have less education. Additional support for the importance of these demographic considerations was further substantiated in a recent study indicating that physical activity levels of Canadians living with Type I and II diabetes could be predicted from age, income levels and to a lesser extent gender (Plotnikoff, Taylor, Wilson, Courneya, Sigal, Birkett, Raine, & Svenson, 2006).

In addition to the prominent influence of demographic considerations on physical activity patterns, a number of barriers have been reported in population-health studies that impede regular physical activity behaviour (Cameron et al., 2005). In the workplace, for example, susceptibility to stress, various obligations, and inherent attributes of work often serve as overwhelming obstacles to physical activity (CCHS, 2005). More than one third of working Canadians report the constant tight deadlines at work are an important barrier impeding their physical activity, and 42 percent report that lack of time due to work is an important barrier (CCHS, 2005). In addition to the barriers associated with the workplace, the more general barriers to physical activity reported by Canadian adults include lack of time, insufficient motivation, perceived financial costs, and social barriers such as an inability to locate someone to be active with or a suitable location to encourage physical activity (Cameron et al., 2005). Not surprisingly, these common

barriers reported by Canadian adults have a greater effect across gender, income and education levels, and differ by age cohorts (Cameron et al., 2005).

Despite the importance of demographic variables and common barriers to physical activity participation, health professionals often support intervention attempts designed to increase or change physical activity behaviour. This focus on physical activity as an integral portion of health has lead experts to call for more theory driven research to help understand physical activity behaviour and design more useful intervention strategies (Biddle et al., 2000; Bouchard et al., 2007). Several theories of human motivation using social cognitive approaches have been popular in the physical activity literature including Social Cognitive Theory (Bandura, 1997), the Theory of Planned Behaviour (Ajzen, 2002), and the Transtheoretical Model (Prochaska & DiClemente, 1982). One organismic theory that is gaining popularity in terms of understanding various forms of physical activity is Self-Determination Theory (SDT; Deci & Ryan, 1985; 2002).

Self-Determination Theory

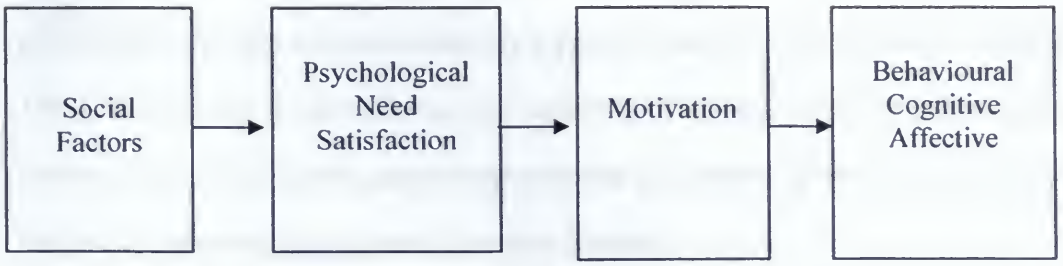
SDT is a broad theory of motivation and personality concerned with the human development and functioning within social contexts (Deci & Ryan, 2002). SDT is comprised of four mini-theories that overlap considerably to aid our understanding of human behavior and social functioning (Deci & Ryan, 2002). These mini-theories are *causality orientation theory* (COT), *cognitive evaluation theory* (CET), *organismic integration theory* (OIT), and *basic psychological needs* (BPN). COT describes individual differences in people's tendencies toward behaving volitionally and toward approaching environments in ways that support their own self-determination (Deci & Ryan, 2002). CET describes the factors that facilitate or undermine the development of intrinsic motivation (Deci & Ryan, 1985), whereas, OIT addresses the concept of internalization especially with respect to the development of extrinsic motivation (Deci & Ryan, 2002). Finally, BPN subtheory proposes that human's all have basic psychological need to feel competent, autonomous, and related, and when doing so function effectively and report enhanced

sense of well-being. The degree to which each of these psychological needs are satisfied will motivate an individual differently to pursue or disinvest from health behaviour such as physical activity. *Autonomy* refers to the degree to which the individuals feels that his or her actions are self-chosen (deCharms, 1968) whereas *relatedness* refers to feelings of closeness and belongingness with others (Deci & Ryan, 2002; Baumeister & Leary, 1995). *Competence* refers to feelings of effectiveness in environments that are challenging (White, 1959; Ryan & Deci, 2000).

While the four mini-theories comprising SDT have been employed extensively in the general psychology literature, few studies have examined all 4 mini-theories in one single investigation (Wilson, Mack, & Grattan, in press). One possible reason for this concerns the level of complexity inherent within each sub-theory of SDT and the difficulty in making clear links between elements of each sub-theory proposed by Deci and Ryan (2002). Toward this end, a conceptual model derived mainly from SDT has been proposed by Vallerand (1997) has been useful in terms of organizing and testing variables integral to each of SDT's sub-theories. Vallerand (1997) proposed the Hierarchical Model of Intrinsic/Extrinsic Motivation (HMIEM, 1997) as a framework for understanding and testing a sequence of processes inherent in motivated behaviour (see Figure 1).

According to Vallerand's (1997) HMIEM, motivation exists at three levels of generality (i.e. global, contextual, and situational). Motivation at the global level refers to "a general motivational orientation to interact with the environment in an intrinsic, extrinsic, or amotivated way" (Vallerand, 1997 p. 61). Motivation at the contextual level is "an individual's usual motivational orientation toward a specific context or a set of specific related activities, whereas motivation at the situation level refers to the motivation individuals experience when engaging in a specific activity at a given moment in time" (Vallerand, 1997 p. 61). Furthermore, Vallerand's

Figure 1. Summary of Vallerand's (1997) Hierarchical Model of Intrinsic and Extrinsic Motivation



Note. Vallerand's (1997) Model depicts three levels of generality. For the purpose of this study the contextual level of generality was examined since exercise is situated in the contextual level.

model (1997, see Figure 1) identifies social factors (e.g., autonomy support) as the initial stage of the motivational sequence followed by psychological mediators (i.e., autonomy, competence, and relatedness), motivational regulations, and ending with relevant behavioural and cognitive/affective outcomes. In other words, social factors will affect the psychological mediators which in turn affect one's motivation to regulate particular affective, cognitive, and behavioural consequences. Vallerand (1997) notes that the proposed sequence occurs at each level of generality.

Vallerand's (1997) HMIEM is a useful model because it displays the pathways and the direction of motivational processes integral to behavioural investment and concomitant experiences in contexts such as physical activity. Based on postulates embedded within Vallerand's (1997) HMIEM, a number of studies have investigated motivation processes in domain or social contexts of applied interest where Ryan (1995) asserts SDT may prove useful for shaping policy and understanding behavioural investment. Research in the education domain, for example, has tested Vallerand's (1997) HMIEM with students and shown some support for the model such that that social context exerted a positive influence on perceived school competence and autonomy, which in turn, lead to self-determined motivation that was able to predict academic achievement 8-months later (Guay & Vallerand, 1997). In a subsequent study by Vallerand, Guay, and Fortier (1997) that examined a motivational model for high school dropout, it was noted that students who dropout of school have lower intrinsic motivation and

lower perception of competence and autonomy. Moreover, dropout students were more likely to perceive their teachers to be less autonomy supportive than persistence students (Vallerand et al., 1997). Collectively, these studies provide support for Vallerand's HMIEM and imply that social factors (especially *autonomy support*) represent one key element of motivational processes influencing behavioural investment in student activities.

Social contexts play an important role in motivation according to Deci and Ryan (2002) within the framework of SDT. Specifically, social contexts that provide opportunities to fulfill basic psychological needs will nourish motivational development whereas social contexts that impair or forestall psychological need fulfillment hinder internalization and motivation (Deci & Ryan, 2002). According to SDT, social contexts can provide a basis for *structure*, *autonomy support*, and *involvement*. *Structure* concerns the degree to which the relationships between the behaviour and salient outcomes are understandable, expectations are clear, and positive feedback is provided (Mageau & Vallerand, 2003). *Autonomy support* is characterized by the provision of choice, pressure to engage in the behaviour is minimized, and individuals are encouraged to initiate actions themselves (Mageau & Vallerand, 2003). *Involvement* describes the extent to which individuals perceive that significant others relevant to the behaviour are genuinely interested in them and their well-being (Mageau & Vallerand, 2003).

Autonomy Support: Why is it important?

One critical element of the interaction experienced in the social environment that affects motivation is perceived *autonomy support* (Deci & Ryan, 2002; Vallerand, 1997). *Autonomy support* is conceptualized as a method of providing environmental support that will satisfy the three basic psychological needs of autonomy, competence, and relatedness (Deci & Ryan, 2003). According to Williams, Cox, Kouides, and Deci (1999), *autonomy support* refers to "an interpersonal style in which authority figures such as physicians take others' perspectives into account when providing relevant information, offer choice and minimize pressure, and encourage others to accept more responsibility for their own behaviors" (p. 961). Social environments that

support autonomy encourage individuals to initiate (or sustain) their own behaviours, minimize pressure for compliance, and acknowledge various perspectives. Important conceptual distinctions exist between perceived *autonomy support* and other components of the social context deemed critical for understanding motivation according to Deci and Ryan (2002). *Structure* differs from *autonomy support* because *structure* typically requires the authority to provide feedback, support client's self-efficacy, and help client develop appropriate goals (Deci & Ryan, 2002; Mageau & Vallerand, 2003). Whereas, *involvement* differs from *autonomy support* because *involvement* requires the authority to express empathy, explore client's concerns, and to demonstrate understanding (Deci & Ryan, 2002; Mageau & Vallerand, 2003).

Previous research has examined the perception of children, students, and athletes' with reference to the level and impact attributable to perceived *autonomy support* from others, in education, and athletic domains. For instance, environments characterized as supportive of autonomy led to better child performance in educational tasks (Grolnick, Gurland, DeCourcey, & Jacob, 2002; Joussement, Koestner, Lekes, & Houlfort, 2004) and suggested cultivating environments to support choice and agency as a beneficial alternative to the common use of rewards. Moreover, university students who perceived the classroom as being autonomy supportive tended to have higher perceived competence, increased interest, higher grade-focused performance goals during the course, and lower anxiety (Black & Deci, 2000). Vanstennkiste and colleagues noted social interactions perceived as autonomy supportive promoted synergy that was beneficial for motivating learning, performance, and persistence (Vanstennkiste, Simons, Soenens, & Lens, 2004). According to Chirkov and Ryan (2001), classrooms that promoted *autonomy support* positively affected students' academic self-regulation and were associated with more integrated and intrinsic motivation in school. Overall, the available evidence seems to suggest that children and students respond positively, in terms of, their motivation, performance, persistence, and level of interest within environments characterized by autonomy supportiveness.

Previous research noted the influential role that parents, coaches, and teachers have with respect to offering support for personal autonomy across life domains. The general observation across research suggests that authority figures (i.e., parents, coaches, and teachers) played a dominant role as providers of *autonomy support*. According to Assor, Kaplan, and Roth (2002), teachers who provided choice, avoided intrusion, or tolerate criticism created a space that allowed students to realize their personal goals and interest. Furthermore, Chirkov and Ryan (2001) found that greater parental *autonomy support* predicted greater adolescent well-being with both teacher and parental sources of *autonomy support* affect student and child's motivation towards school. In addition, Vansteenkiste et al. (2004) found that adolescents, who were approached in an autonomy supportive way, rather than being pressured in a subtle way, enhanced their conceptual learning in academic contexts.

Complimenting the educational research supporting the relevance and importance of autonomy supportive environments has been emerging studies for the importance of this concept in health care settings (Williams, 2002). Observational studies have indicated that patients who perceived their physician as more autonomy supportive are optimally motivated to pursue their treatment, adhere better to their treatment regimen over time, and appear capable of surmounting challenging barriers to improving their health (Williams, 2002; Sheldon, Williams, & Joiner, 2003). Randomized controlled trials have confirmed the importance of physicians' interactional styles with autonomy supportive approaches promoting better health outcomes in contexts including smoking cessation (Williams, McGregor, Sharp, Levesque, Kouides, Ryan, & Deci, 2006) and weight management (Williams, Grow, Freedman, Deci, & Ryan, 1996). Additional studies have corroborated the evidence produced by Williams and colleagues. For example, a recent study of intravenous drug users found that patients suffered lower relapse (evidenced by fewer missed appointments) if they perceived the clinical staff as being autonomy supportive (Zeldman, Ryan, & Fiscella, 2004). In summary, it seems that important health benefits may be most likely attained when important others such as physicians and health-care providers interact

with clients/patients in a manner that supports autonomy rather than seeks to coerce or control individual behaviour.

Autonomy support and physical activity contexts

Physical activity research embracing SDT as a guiding framework has been slow to examine the importance of *autonomy support* in comparison to other mini-theories forwarded by Deci and Ryan (1985; 2002). The major focus of SDT-related research in sport, exercise and physical education contexts has been on the motivation-consequence relationship specified within Organismic Integration Theory (see Hagger & Chatzisarantis, 2007, for a review). Recent advances in instrument development have encouraged additional focus on Basic Psychological Need Theory within the physical activity literature (Wilson & Rodgers, 2007) yet the evidence in this area is not without controversy. Few studies have explored the importance of personality orientations within physical activity settings based on SDT (Rose, Markland, & Parfitt, 2001). Moreover, few studies have fully explored the propositions set forth by Vallerand's (1997) HMIEM in sport, exercise, or physical education to date (Vallerand, 2007).

Research in physical activity contexts has generally supported the proposition that individuals are more likely to internalize the regulation of physical activity behaviour if social interactions are perceived as more autonomy supportive than coercive. For instance, a study of competitive swimmers found that greater levels of self-determined motivation was linked with coaching staff who encouraged athletes in an autonomy supportive rather than coercive fashion (Pelletier, Fortier, Vallerand, & Briere, 2001). Other studies have reported similar results with respect to physical education (PE) teachers within and outside PE contexts (Ntoumanis, 2005). For instance, Ntoumanis (2005) found that PE teachers who interacted with students in an autonomy supportive manner promoted greater psychological need satisfaction in PE, which in turn predicted self-determined motivation for PE behaviours. Moreover, students were more likely to participate in optional PE courses in the following school year if they felt self-

determined about engaging in PE (Ntoumanis, 2005) suggesting that *autonomy support* may cultivate motives that facilitate enduring patterns of behaviour in PE.

Research with respect to *autonomy support* in the exercise contexts other then PE and sport has been sparse in comparison, but the available evidence has also suggested the importance of social contexts on psychological need fulfillment, forms of motivational regulation, and behaviour. For instance, one early study by Wilson and Rodgers (2004) noted that perceived *autonomy support* from friends was positively associated with more internalized extrinsic motives and intrinsic regulation for exercise. In a subsequent study by Edmunds, Ntoumanis, and Duda (2006), perceptions of *autonomy support* from the exercise instructor predicted level of psychological need satisfaction, which in turn, was related to more self-determined motivational regulation in exercise initiates referred to activity programs by their physician. Brickell, Chatzisarntis, and Pretty (2006) also found that perceived *autonomy support* predicted autonomous and core autonomous intention. In other words, perceived *autonomy support* predicted the extent to which an individual would maintain exercise intentions for intrinsically motivated reasons (Brickell et al., 2006). Collectively, these initial studies imply that *autonomy support* promotes important outcomes in terms of motivational orientation and behavioural investment in physical activity contexts that are in line with both SDT (Deci & Ryan, 2002) and HMIEM (Vallerand, 1997).

Structure, and Involvement in Exercise: Current evidence.

The bulk of the available evidence concerning social factors influencing motivated exercise behaviour concerns the role of *autonomy support* (Hagger & Chatzisarntis, 2007). Substantially less empirical attention has been attended to the role of *involvement* and *structure* independent of and/or in conjunction with *autonomy support* within exercise domain (Tobin, 2003). Tobin (2003) has suggested that the provision of *structure* is most likely to satisfy the psychological need for competence, whereas engagement in an involved fashion will likely effect motivational and behavioural change by fulfilling relatedness needs. Extrapolating from Tobin's

(2003) argument, it seems logical to suggest that the need for autonomy is most likely to be heavily influenced by environments characterized as autonomy supportive.

Tobin (2003) was the first to test the differential role of *autonomy support*, *structure*, and *involvement* in exercise settings with specific reference to their role in facilitating behavioural change. Tobin (2003) conducted a multi-phase investigation to initially develop and test the construct validity of an instrument designed to capture in *autonomy support*, *structure*, and *involvement* within exercise settings. Focusing on individuals referred to exercise by a physician based upon multiple health risk factors (e.g., presence of cardiac disease risk factors, obesity, etc.), Tobin's (2003) first study rendered partial support for the assessment of concepts contained with the Perceived Environmental Supportiveness Questionnaire (PESQ) by establishing discriminant and structure validity of PESQ scores. Following the deletion of problematic PESQ items on empirical grounds, Tobin (2003, study 1) reports strong relationships between PESQ factors (phi-coefficients ranged from 0.79 to 0.95, all p's < .01). In the subsequent studies (study 2 and 3), Tobin (2003) provided additional structural validity evidence via factor analysis of PESQ item responses, and extended the construct validity evidence using need satisfaction, behavioural regulation and exercise behaviour as criterion. In brief, Tobin (2003) reported support with cross-sectional data for the influence of global environmental support on global need satisfaction (β =0.60, $p < .01$) whereby the global factor was comprised of manifest indicators of *autonomy support* ($\chi = 0.78$, $p < .01$), *structure* ($\chi = 0.97$, $p < .01$), and involvement ($\chi = 0.99$, $p < .01$) accounting for 39 percent of the need fulfillment variance. Interestingly, none of the PESQ factors predicted exercise behaviour or maintenance and were not predictive of post-scheme autonomous motivation assessed approximately 18 weeks after measuring environmental support. Collectively, Tobin's (2003) work suggest that (a) concepts integral to environmental support posited within Deci and Ryan's (2002) SDT framework can be measured in exercise contexts, and (b) preliminary evidence links need support with need fulfillment at the point in time for exercisers.

Only one subsequent investigation has attempted to examine the role of *autonomy support*, *structure*, and *involvement* in an exercise setting. Using an intervention-based design, Edmunds and colleagues examined the effects of an SDT-based instructional style on PESQ concepts, as well as, need fulfillment, motives, and behavioural and cognitive/affective consequences of exercise participation (Edmunds, Ntoumanis, & Duda, 2008). The results of sophisticated hierarchical linear modeling analyses indicated a number of findings with reference to PESQ and SDT. First, it appears that the SDT-based intervention was successful in terms of increasing all PESQ concepts across time. Second, neither ethnicity nor age predicted PESQ concepts. Third, and perhaps most interestingly, none of the PESQ concepts predicted need satisfaction at baseline or over time in exercisers. Fourth, *structure* made a positive contribution to the prediction of integrated regulation at study onset ($\beta = 0.63$; $p < .05$) while the effect of *autonomy support* became increasingly positive on both identified and intrinsic regulation across the 10-week exercise class. Finally, perceived *autonomy support* ($\beta = 0.30$; $p < .05$), *structure* ($\beta = 0.49$; $p < .05$), and *involvement* ($\beta = 0.36$; $p < .05$) predicted behavioural intentions at study onset but became non-significant across the 10-week study period.

Collectively, the results of both Tobin (2003) and Edmunds et al. (2008) suggest that both *structure* and *involvement* may have important insights into the motivational dynamics of exercise participation when considered alongside *autonomy support*. Both studies however noted concerns regarding the role of these concepts in exercise motivation. For example, Tobin's (2003) research reports varied item deletion with reference to PESQ items across studies suggesting additional construct validation research would be useful. Edmunds et al. (2008) report no relationship between need support, assessed by Tobin's (PESQ) items, and the satisfaction of competence, autonomy, and relatedness needs, which need support are theorized to underpin (Mageau & Vallerand, 2003); Tobin, 2003). Considering the importance of exercise promotion as a vehicle for physical activity participation, and the role of environmental supports with both

Vallerand's (1997) HMIEM and SDT (Deci & Ryan, 2002), additional alteration to the concepts of *autonomy support*, *structure*, and *involvement* in exerciser seems justified at this junction.

Purposes of the present study

Previous research has examined the importance of *autonomy support* in various contexts including the clinical setting (Williams, 2002), the education setting (Grolnick & Ryan, 1989; Standage, Duda, & Ntoumanis, 2003), and the sport setting (Pelletier et al., 2001; Sarrazin, Vallerand, Guillet, Pelletier, & Cury, 2002). However, there tends to be minimal research examining perception of *autonomy support* in conjunction with *structure* and *involvement* in university students, with respect to persistence behaviour and motivation in the exercise setting (Wilson & Rodgers, 2004). Moreover, no study to date has explored the relevant sources of *autonomy support*, *structure*, and *involvement* provided by specific important others in exercise contexts that may play a role in influencing persistence behaviour. Addressing these gaps in the literature represents the main objective of the present investigation.

The primary purpose of this study was to test the sequence of motivational processes embedded in Vallerand's (1997) Hierarchical Model of Intrinsic and Extrinsic Motivation in the domain of structured exercise. The secondary purpose of this study was to identify important others who represent sources of environmental support for exercise. A final purpose of this investigation is to explore and test the impact of gender on motivational process and sources of perceived environmental support for exercise.

Study Hypotheses

To address the primary and secondary purposes of this study, a number of hypotheses were examined and tested. Each hypothesis was based on conceptual arguments (Deci & Ryan, 2002; Vallerand, 1997) or previous SDT-studies examining issues of support for exercise (Edmunds et al., 2008; Pelletier et al., 2001; Sarrazin et al., 2002; Tobin, 2003; Wilson & Rodgers, 2004). Using these studies as a foundation, the following four hypotheses were tested in this study.

Hypothesis 1: Greater perceived support from important others in exercise would be associated with greater psychological need satisfaction. This hypothesis was drawn from conceptual arguments made by Deci and Ryan (2002), as well as, Vallerand's (1997) HMIEM. Furthermore, previous studies have reported a positive association between feelings of *autonomy support* and need fulfillment in youth sport athletes (Sarrazin et al., 2002). Based on arguments forwarded by Tobin (2003) and Mageau and Vallerand (2003), it was anticipated that (a) *autonomy support* would be the dominant correlate/predictor of perceived autonomy, (b) *structure* would be the dominant correlate/predictor of perceived competence, and (c) *involvement* would be the dominant correlate/predictor of perceived relatedness.

Hypothesis 2: Greater perception of psychological need satisfaction would be related to more self-determine than controlled motives. This hypothesis was drawn from conceptual arguments made by Deci and Ryan (2002). Previous studies have reported positive associations between psychological need satisfaction and self-determined exercise regulation (Edmunds, Ntoumanis, & Duda, 2007; Wilson, Rodgers, Blanchard, & Gessell, 2003).

Hypothesis 3: Third, it was hypothesized that motives that are more self-determined than controlled in nature would be positively associated with higher physical self-concept, more frequent exercise behaviour, and more positive (less negative) affect. This hypothesis was drawn from previous works by Wilson and colleagues where they have noted more self-determined motivation was an important predictor of exercise behaviour (Wilson, Rodgers, Fraser, & Murray, 2004) and associated with higher physical self-esteem (Wilson & Rodgers, 2002) in regular exercisers drawn from the university community.

Hypothesis 4: Fourth, it was hypothesized that gender would have no influence on these relationships with reference to the social factors, need satisfaction, motivation, consequence model postulated by Vallerand (1997). This hypothesis was drawn from conceptual arguments by Deci and Ryan (2002). Specifically, motivational processes that reside on the satisfaction of

basic psychological needs are theorized to be invariant across groups such as gender (Deci & Ryan, 2002).

No specific hypotheses were advanced regarding the influence or variety of sources of *autonomy support*, *structure*, or *involvement* from important others within exercise since this part of the investigation was largely exploratory in nature.

Chapter 3 - Methods

Participants

Based on current data from the CCHS (2005), adults between the ages of 20 – 24 years old are more physically active than any other age group in Canada. For the purpose of this study, the target population was university students, enrolled in an undergraduate program, at a university and college located in the Niagara Region (see sample characteristics reported in Result Section). There are two reasons why university students were the designated sample. First, most university students will likely represent the most active age cohort (20 – 24 years) as listed by the CCHS (2005), which makes them ideal for identifying factors promoting physically active behaviours. Second, university students, especially first year students, are undergoing a transitional period which places them at an increased risk for decreasing their physical activity participation (Bray, Clayton, Kwan, Arbour, & Chohan, 2007; Bray & Kwan, 2006). Therefore, determining factors that may underpin motivated behaviour in this age cohort may be useful for understanding why this segment of the population is more active than others. In terms of sample size, the estimated sample size to achieve a medium effect ($\beta = 0.15$) at $p = 0.01$ (two-tailed) would be 147 participants (Cohen, 1992). However, to account for equal representation across gender the sample size is doubled, therefore, a total of 294 participants will be needed for this study (Cohen, 1992).

Participants were recruited using the following criteria as guidelines which served to help with data collection: (a) age 17 or older; (b) be currently exercising on a regular basis; (c) be willing to commit to the length of the study; (d) indicate being engaged in regular exercise for at least the past 6 months; and (e) be currently enrolled as a student at Brock University or Niagara College. It should be noted that participants were not removed on any single inclusion/exclusion criteria (i.e., reporting zero on the GLTEQ)

Instruments

Psychological Need Satisfaction in Exercise Scale (PNSE; Wilson, Rogers, Rodgers, & Wild, 2006). The PNSE is an 18-item instrument developed within the SDT framework to measure psychological need satisfaction in exercise contexts (Wilson et al, 2006). A stem statement (i.e., "The following statements represent different feelings people have when they exercise. Please answer the following questions by considering how you typically feel while you are exercising.") was developed that encourages participants to respond to each item in terms of how they usually felt while exercising. Participants' responses were made on a scale anchored at the extremes by 1 (false) and 6 (true). One previously published study has provided support for the structural and convergent validity of PNSE scores (Wilson et al., 2006).

Behavioural Regulation in Exercise Questionnaire (BREQ-2). The BREQ-2 is a 19-item self-report instrument developed to assess exercise regulations consistent with SDT (Deci & Ryan, 2002). The BREQ-2 is an extension of the Behavioural Regulation in Exercise Questionnaire (BREQ; Mullan, Markland, & Ingledew, 1997), which contains four subscales that measure *external* ("I exercise because other people say I should"; 4 items), *introjected* ("I feel guilty when I don't exercise"; 3 items), *identified* ("I value the benefits of exercise"; 4 items), and *intrinsic* regulation ("I enjoy my exercise sessions"; 4 items) of exercise behaviour. The BREQ-2 includes an additional subscale that assesses *amotivation* ("I don't see the point in exercising"; 4 items). The BREQ-2 asks participants to respond to each item, following the stem "Why do you exercise?" on a 5-point likert-type scale anchored by (0) "not true for me" and (4) "very true for me." Previous studies by Markland and Tobin (2004) have supported the structural validity of the BREQ-2 scores. One study has supported the predictive validity of BREQ-2 scores in terms of accounting for variance in effort expended, behaviour, and intention to continue exercising in Canadian university students (Wilson et al., 2004).

Godin Leisure Time Exercise Questionnaire (GLTEQ; Godin & Shepherd, 1985). The GLTEQ is a 3-item self-report measure assessing the frequency of mild, moderate, and strenuous exercise done for at least 15 minutes per session during a typical week. An overall exercise

behaviour score (expressed in metabolic equivalent units or METS) can be calculated by averaging the weighted product of each question as follows: [strenuous x 9] + [moderate x 5] + [mild x 3]. According to Jacobs, Ainsworth, Hartman, and Leon (1993), the GLTEQ is easy to understand, stable, and correlates positively with exercise behaviour suggesting some convergent validity of GLTEQ scores. Previous studies with university students have reported no particular concern with using this instrument in the sample targeted for this investigation (Wilson, Rodgers, Murray, Longley, & Muon, 2006; Wilson et al., 2004).

Physical Self-Concept. Physical self-concept was assessed using the physical self-concept subscale of the *Physical Self-Description Questionnaire* (PSDQ-PSC; Marsh et al., 1994). This instrument provides a global evaluation of the degree or level of positive feelings a person holds about his or her physical self (Marsh, 1996; Marsh et al., 1994). Psychometric support for PSDQ-PSC scores have been provided through extensive factor analytic and multitrait-multimethod procedures (Marsh, 1996; Marsh et al., 1994). A stem statement (i.e., "These questions describe how people feel about themselves physically. Please circle the number next to each question that best describes how you feel about yourself physically.") was developed that encourages participants responses to six items (sample item: "I feel good about the way I look and what I can do physically") on a 5-point Likert scale ranging from 1 (false) to 5 (true).

Positive Affect Negative Affect Scale (PANAS; MacKinnon, Jorm, Christensen, Korten, Jacomb, & Rodgers, 1999). The short form of the PANAS consists of 10-items which provide an assessment of positive and negative affect. Participants indicate to what extent they feel the positive (i.e., inspired, alert, excited, enthusiastic, and determined) and negative (i.e. afraid, upset, nervous, scared, and distressed) affects following the stem "Please indicate to what extent you typically feel this way when you exercise". A 5 point Likert scale ranging from 1 (very slightly or not at all) to 5 (extremely) anchors responses to each of the 10 PANAS items. One study by Mackinnon et al (1999) has supported the internal consistency reliability and structural validity of the 10-items PANAS scores. A separate study has linked greater psychological need satisfaction

in exercise with more self-reported positive than negative affect felt while exercising (Wilson et al., 2006).

Social Contextual Characteristics. Perceived environmental support was assessed using two different instruments. Perception of *autonomy support* from friends was assessed using the 6-item Health Care Climate Questionnaire (HCCQ). Participants responded to each item, on a 7 point Likert scale ranging from 1(strongly disagree) to 7 (strongly agree), following the stem, "friends have different styles in dealing with people, and we would like to know more about how you have felt about your encounters with you friends about exercise." One study by Williams et al., (2002) has supported the internal consistency reliability of the 6-item HCCQ displaying a reliability coefficient of 0.81. Perceptions of *structure* and *involvement* concepts were assessed by using the Perceived Environmental Supportiveness Scale (PESQ; Tobin, 2003). Sixteen items within the PESQ tapped into the concept of *structure* (9 items) and *involvement* (7 items). Participants responded to each item, on a 5 point Likert scale ranging from 0 (Not true) to 4 (Very true), following the stem, "the following questions ask about the interactions you have with your friends about exercise." Tobin (2003) has demonstrated that these subscales (i.e., *structure* and *involvement*) were internally reliable (cronbach α ranging from 0.78 to 0.79). In a subsequent study by Edmunds et al., (2008), internal consistency reliability indices ranged from 0.84 to 0.89 for *structure* and 0.92 to 0.96 for *involvement*.

Given that the sample consists of university and college students, friends/peers was the obvious choice of source that would likely have some degree of inputs in their exercise behaviour. In a study by Mack and colleagues (2007) examining the effects of friends on social physique anxiety in adolescents, perceived pressure from peers with regards to changing or altering their physique reported greater level of social physique anxiety. Moreover, Smith (2003) have suggested that researchers should spend more time in better understanding peer relationship and how it is associated with physical activity motivation. Nonetheless, there appears to be no obvious reasons why friends should not be chosen as the target source.

Study Design

This study used a non-experimental, cross-sectional design such that the participants were asked to complete and provide data at only one point in time (Trochim, 2001). Participants did not receive academic credit or remuneration of any form for their involvement in this study. All data were collected via a secure internet site where participants accessed the questionnaire from a specified web link (www.surveymonkey.com). This method of data collection is beneficial because it maintains participants' anonymity and reduces any perception of coercion towards the participant (Dillman, 2006). According to Dillman (2006), implementation procedures using secure internet sources reduce participant burden and likely have a much more favourable influence on participant response rates.

Participants were approached using multiple methods of recruitment (i.e., posters, flyers, verbal presentations, "snowball" sampling) to reduce coverage error and obtain the projected sample size required for this investigation. Following the study advertisement, each participant received a series of e-mail contacts from the study investigator to provide them the opportunity to be involved in the study (see sample e-mail scripts in Appendix D). A modification to Dillman's (2006) Tailored Design was employed within each contact e-mail whereby (a) the initial e-mail explained the study purpose and invited participation, (b) the second e-mail reminded potential participants of the study and the importance of their involvement, and (c) the third and final e-mail reminded potential participants of the nature of the study and solicited their involvement. Each e-mail contained a web link to a secure server that houses the questionnaires being used in this investigation (see Appendix A).

Data Analysis

Data analysis proceeded in sequential stages. First, preliminary data analyses (i.e., frequency distribution curves, descriptive statistics) screened for missing data, abnormalities within the data set, and to ensure that data was entered correctly. Second, a series of instrument-specific measurement models were tested using confirmatory factor analysis (CFA) to determine

the viability of participant responses in this sample with reference to structural validity issues. Third, descriptive statistics was computed to determine the general patterns within the data, with respect to normality (i.e., histograms), central tendency (i.e., mean, mode, and median), skewness, kurtosis, and variance. At this stage of the analyses, estimates of internal consistency reliability (Coefficient α; Cronbach, 1951) and bivariate correlations (Pearson *r*) were computed between all study variables. The third stage of the analysis concerned specifying and testing conceptual models drawn from Vallerand's (1997) HMIEM to assess the role of social factors in motivating exercise participation. The fourth stage of the analysis tested the gender-invariance of a trimmed model drawn from Vallerand's (1997) HMIEM. The final stage of the analysis concerned identifying sources of *autonomy support*, *structure*, and *involvement* for exercisers and testing for gender differences in the total number and source of support.

Confirmatory factor analyses were conducted using AMOS (Arbuckle, 1997) to examine several measurement models to determine their ability to predict specifically chosen criterion variables. Conventional standards were specified for all CFA models while setting the loading of the manifest item to 1.0 to define each latent factor's scale. Moreover, acceptable global model fit was evaluated by examining the χ^2, comparative fit index (CFI), incremental fit index (IFI), root mean square error of approximation (RMSEA), standardized root mean square residual (SRMSR) as recommended by West, Finch, and Curran (1995). Following guidelines suggested by Hu & Bentler (1999) and Marsh, Hau, and Wen (2004), CFI and IFI values exceeding 0.90 and 0.95 are typically considered acceptable and excellent fit indices respectively. Whereas, values less than 0.05 (RMSEA) and 0.08 (SRMSR) are typically considered satisfactory for model fit (Browne & Cudeck, 1993; Hu & Bentler, 1999). Lastly, simultaneous multigroup analyses (SMCA) were conducted to assess motivational processes models for gender equivalence when predicting exercise –related cognitive/affect responses and frequency of exercise behaviour (see Figure 3).

Chapter 4 – Results

Sample characteristics

A total of 154 male (Mean age = 21.46 years; *SD* = 2.80 years) and 259 female (Mean age = 21.17 years; *SD* = 3.65 years) university and college students enrolled either in a university or college in the Niagara Region provided data for this study. Twelve (2.82%) cases in the initial sample of 425 did not provide data pertaining to gender. Body Mass Index (BMI) values approximated the healthy range for this age cohort (Mean BMI of males = 24.79 kg/m^2; *SD* = 2.98 kg/m^2; Mean BMI of females = 22.78 kg/m^2; *SD* = 3.29 kg/m^2). At the time of data collection, the male respondents were (a) predominantly enrolled in an applied health sciences degree program (73.7 percent), (b) mainly enrolled in years 2 to 4 of their degree program (87.0 percent), (c) employed part-time (51.9 percent), and (d) mainly Caucasian (90.3 percent) and living off-campus (95.5 percent). The subsample of female respondents were (a) predominantly from an applied health sciences degree program (76.0 percent), (b) enrolled in years 2 to 4 of their degree (76.5 percent), (c) employed part-time (55.6 percent), and (d) indicated being Caucasian (97.3 percent) and residing off-campus (91.9 percent) overall.

The physical activity data provided the following demographic information concerning the sample's exercise status. First, the stage-specific breakdown for each gender was as follows: (a) Male subsample (Precontemplation = 0.0%, Contemplation = 3.2%; Preparation = 22.7%; Action = 8.4%; Maintenance = 63.0%); Females (Precontemplation = 0.0%; Contemplation = 7.3%; Preparation = 28.2%; Action = 13.1%; Maintenance = 49.4%). Using the classification scheme suggested by Rodgers and Gauvin (1988), it is likely that 67.5 percent of the male subsample and 53.1 percent of the female subsample were frequent (i.e., exercising ≥ 3 times/week) as opposed to infrequent (i.e., exercising 1-2 times/week) exercisers given their self-reported involvement in strenuous exercise over a typical week. Examination of responses to the GLTEQ indicated that the male (*M* = 54.12; *SD* = 60.86) and female (*M* = 86.78; *SD* = 31.35) subsamples were active on average across a typical week. Considerable range of GLTEQ

responses was evident in the initial male (0 to 4055) and female (0 to 705) responses that contributed to variability in GLTEQ summary scores.

Preliminary analyses

Out of the 425 respondents that provided data via the web-based interface, only 367 participants provided usable data. Individual responses were examined and it was noted that 13.65 percent of the initial sample had omitted at least one instrument entirely from their responses. Upon closer examination, 22 cases were removed because they failed to provide any data other than demographic variables (e.g., age, height, weight etc.). One case was deleted because they failed to provide data beyond the demographic and PANAS items. Six cases were removed because they failed to provide data beyond the BREQ-2 items, while one case was removed due to incomplete data beyond the PSDQ items. Moreover, eight cases were deleted since data were missing beyond the PNSE, whereas, a total of twenty cases were deleted because they failed to provide data from the perceived environmental support (e.g., *autonomy support*, etc.) items to the end.

Cases that provided incomplete data but had partial responses per subscale/instrument were addressed using the within person mean substitution. This technique has been recommended by Hawthorne and Elliot (2005) when imputing missing data in cross-sectional research particularly when each participant had provided responses to at least 50 percent of the items within an instrument. This was the case for the 367 participants retained from the original sample ($N = 425$). The within person mean substitution technique allows missing data to be imputed from the non-missing items for each case (Hawthorne & Elliot, 2005). For this study, the within person mean substitution imputation procedure was performed to derive a score for the missing data from each instrument used in this study per respondent.

Following the replacement of missing data due to non-response error, inspection of the item-level descriptive statistics revealed no apparent concern with reference to the normality of participant responses to each item comprising a psychological variable. The item-level

distributional characteristics observed in the present sample's data were as follows: a) PANAS (*M* = 2.55; *SD* = 2.83; *skew* = 0.26; *kurt* = -1.45), b) BREQ-2 (*M* = 1.77; *SD* = 1.57; *skew* = 0.17; *kurt* = -1.54), c) PSDQ (*M* = 4.33; *SD* = 1.21; *skew* = -0.78; *kurt* = 0.27), d) PNSE (*M* = 4.89; *SD* = 1.16; *skew* = -1.27; *kurt* = 1.74), e) *Autonomy Support* (*M* = 5.38; *SD* = 1.38; *skew* = -0.83; *kurt* = 0.28), f) *Structure* (*M* = 2.47; *SD* = 1.13; *skew* = -0.53; *kurt* = -0.39), g) *Involvement* (*M* = 2.62; *SD* = 1.22; *skew* = -0.69; *kurt* = -0.47). Analysis of the distributional responses to the GLTEQ items indicated one respondent who reported 420 sessions of strenuous exercise over a typical week. This case was removed from further consideration. The distributional properties of the remaining 366 cases were as follows: (a) Mild (*M* = 3.35; *SD* = 4.18; *skew* = 5.31; *kurt* = 49.78); (b) Moderate (*M* = 3.80; *SD* = 4.98; *skew* = 7.89; *kurt* = 80.80); and (c) Strenuous (*M* = 3.65; *SD* = 4.02; *skew* = 5.89; *kurt* = 52.78). Visual inspection of the skewness and kurtosis estimates suggests substantial deviation from univariate normality with marked leptokurtosis evident per manifest GLTEQ item.

Instrument-specific measurement model analyses

A series of CFAs were conducted to investigate the structural validity of instrument-specific latent variable measurement models. In total three multidimensional correlated latent variable measurement models (PNSE, BREQ-2, and PANAS) and four unidimensional latent variable measurement models (PSDQ-PSW, PESF-Autonomy Support, PESF-Structure, and PESF-Involvement) were examined using CFA procedures. Inspection of the global model fit indices associated with five of the measurement models revealed no obvious concerns with the structural validity of sample responses (see Table 1 for fit indices). Specifically, although the chi-square difference test suggested a significant deviation from the reference independence model for the five models, the CFI/IFI values exceed conventional thresholds and both the SRMSR and RMSEA values were tolerable. One exception to this observation concerned the PSDQ-PSW results whereby the RMSEA point estimate and bandwidth demonstrated by the 90% confidence interval suggested a lack of suitable fit. In brief, the results of the initial analyses

suggest that five of the a priori measurement models associated with the PNSE, BREQ-2, PANAS, PESF-Autonomy Support, and to a lesser extent PSDQ-PSW responses did not pose any serious threats to construct validity in the present data.

The pattern of global model fit indices concerning the remaining two measurement models (PESF-Involvement and PESF-Structure) was less convincing. Closer examination of the CFA for both models suggested a number of items that appeared on the basis of the initial analysis to be problematic. Inspection of the manifest item loadings in the PESF-Involvement model revealed that item 4 ("My friends aren't too bothered about my well-being") and item 6 ("My friends don't concern themselves with what I need to get from exercising") exhibited low (<0.40) standardized factor loadings of 0.37 (item 4) and 0.16 (item 6) respectively. The largest standardized residual within the observed covariance matrix also concerned *involvement* items 4 and 6 (z = 5.75; all other z's $\leq |2.0|$). Removal of both items 4 and 6 resulted in an improved fit of the trimmed *involvement* measurement model ($\chi^2 = 27.97$; $df = 5$; $p < .01$; *CFI* = .97; *IFI* = .97; *SRMSR* = .03; *RMSEA* = .11 [.07-.16]), however, item 7 ("My friends care about me") was highly kurtotic, displayed one of the largest standardized residuals, and depicted the largest improvement in the model fit based on the observed modification indices concerned correlating item 7 with item 3. After removing item 7, and reconfiguring the 4 item *involvement* measurement model, the fit of the sample data to the trimmed model ($\chi^2 = 3.66$; $df = 2$; $p = .16$; *CFI* = .99; *IFI* = .99; *SRMSR* = .02; *RMSEA* = .05 [.00-.12]) suggested no further need for refinement. All standardized factor loading were statistically significant ($p < .05$) in the final trimmed model (Mean = 0 .72; *SD* = 0.09; Range = 0.64 to 0.84). The resultant 4 involvement items were used in all subsequent analyses.

The measurement model concerning the structural validity of the original nine *structure* items was also deemed problematic with both the RMSEA point estimate and upper boundary of the 90% confidence interval suggesting room for improvement (see Table 1). The largest improvement in model fit suggested by the modification indices concerned correlating the error

terms associated with item 7 ("My friends make me feel positive about being able to perform") and item 9 ("My friends help me to feel confident about exercise"). These items also had the largest standardized residual in the covariance matrix (z = 2.53; All other z's ≤ | 1.50|). following the removal of both items, the fit of the trimmed 7-item measurement model concerning *structure* improved (χ^2 = 21.31; *df* = 14; *p* = .09; *IFI* = .99; *CFI* = .99; *SRMSR* = .02; *RMSEA* = .04 [.00-.07]), all remaining 7 manifest items loaded significantly ($p < .05$) on the largest latent factor (Mean = 0.74; *SD* = 0.10; Range = 0.55 to 0.85), and the pattern of residuals in the standardized covariance matrix implied minimal evidence of misfit in the trimmed 7-item measurement model (all observed z's < |1.0 |). The 7 *structure* items were retained in all subsequent analyses.

Reliability analysis, descriptive statistics, and bivariate correlations

Internal consistency reliability estimates (Cronbach's α; Cronbach, 1951) were computed for item scores derived from each psychological instrument used in this study. Cronbach's coefficient α (Cronbach, 1951) was used to estimate the ratio of true score to error variance in the sample responses per instrument/subscale for PESF, PNSE, BREQ-2, PANAS, and PSDQ-PSW scores respectively. Inspection of the data (see the principal diagonal in Table 2 for specific values) indicated that reliability coefficients ranged from 0.63-0.97 in this sample.

Descriptive statistics were calculated to examine response patterns within the sample data (see Table 2). Examination of sample responses to PESF subscales indicated that participants reported greater perception of *autonomy support* in exercise settings than either perceived *structure* or *involvement* from friends (see Table 2.). Consistent with past research (Wilson et al., 2006), participants reported greater perceptions of autonomy and competence via exercise than fulfillment of the need for relatedness. Also, consistent with previous studies (Mullan et al., 1997; Markland & Tobin, 2004) exercisers reported a more self-determined (i.e., higher identified and intrinsic) than controlled (i.e., external and introjected) motivational profile regulating exercise participation. Not surprisingly given the exercise status of this sample, the data indicated minimal endorsement of amotivation towards exercise in these participants. Nevertheless,

participants were physically active, generally satisfied with how they are physically, and reported greater perceptions of positive than negative affect when exercising

Bivariate correlations (Pearson *r*) between study variables are presented in Table 2. Several interesting patterns emerged from the analyses. First, the patterns of inter-scale relationships between PESF subscale scores were positive and moderate-to-large in magnitude based upon Cohen's (1992) guidelines. Second, the patterns of relationships between PNSE subscale scores were positive and ranged from weak-to-strong in magnitude (Cohen, 1992). The strongest association was between competence and autonomy followed by competence and relatedness with the weakest association observed between autonomy and relatedness in this sample. Third, subscale scores from the BREQ-2 were differentially correlated with each other. Consistent with previous studies (Mullan et al., 1997; Markland & Tobin, 2004), a quasi-simplex pattern of correlations was evident between BREQ-2 subscale responses. Specifically, subscales representing adjacent concepts organized within organismic integration subtheory of SDT (Deci & Ryan, 2002) were more positively associated with one another compared to increasingly distal concepts. The strongest association was between identified and intrinsic exercise regulation whereas the weakest association was between external and identified regulation for exercise.

The pattern of relationships between motivational processes (i.e., PESF, PNSE, and BREQ-2 subscales) and relevant behavioural and psychological outcomes of motivation revealed a number of interesting observations. First, the pattern of weak-to-moderate relationships between PESF and PNSE subscale scores indicated that *autonomy support* was the dominant correlate of competence and autonomy need fulfillment while *involvement* was the strongest correlate with relatedness in exercise. The pattern of correlations exhibited between PESF and PNSE subscales was larger in magnitude than the relationships between PESF subscales and other study variables (see Table 2). Second, the observed relationships between PNSE and BREQ-2 subscale scores revealed that (a) all need fulfillment subscale scores were negative albeit weakly correlated with amotivation, (b) a pattern of moderate-to-strong correlations was evident

between each psychological need assessed by the PNSE and non self-determined regulations of exercise, and (c) uniformly weak correlations were evident between PNSE subscale and introjected regulation with competence and autonomy being negatively yet weakly associated with external regulation for exercise. Finally, an inspection of the pattern of correlations between BREQ-2 subscale scores and relevant motivational outcome scores indicated (a) identified regulation was the strongest positive correlate of exercise frequency behaviour, (b) intrinsic regulation was the strongest correlate of physical self-worth and positive affect, and (e) external regulation for exercise was associated with reduced physical self-worth and greater negative affect accompanying exercise participation. The magnitude of the correlations between motives measured by the BREQ-2 and both behavioural and cognitive/affective consequences ranged from weak (r = .01) to strong (r = .57) in this sample's data (Cohen, 1992).

Structural equation model predicting behavioural and cognitive/affective outcomes of motivational processes

A model based on the tenets of SDT that specified the relationships between perceived environmental support from friends, psychological needs, motivation, and cognitive/affective consequences was evaluated using SEM procedures advocated for empirically testing theoretical models (MacCallum & Austin, 2000). In this particular model (see Figure 1), positive affect, negative affect, and physical self-worth were conceptualized as endogenous variables expressed as a function of the motives regulating exercise participation, which in turn, were hypothesized to be a function of psychological need satisfaction and perceived environmental support respectively. According to the results of SEM (see Table 3), indices approaching or meeting conventional standards of global model fit were evident. An examination of the standardized path coefficients embedded in the structural model (see Figure 2) indicated that: (a) perceived environmental supports positively predicted need satisfaction, (b) the psychological needs positively predicted the relative autonomy index latent variable and negatively (albeit insignificantly for competence) predicted amotivation, (c) amotivation was negatively associated

with positive affect and negative affect, and (d) the relative autonomy index was positively associated with physical self-worth and positive affect, while it was negatively associated with negative affect. Majority of the standardized path coefficients were statistically significant at p <.05, but there were a few pathways that were not statistically significant (see Figure 2). Examining the percent variance accounted for in endogenous latent constructs within the conceptual model indicated that: (a) perceived environmental supports account for 26 percent of variance between the psychological needs (R^2 ranged from 0.12 to 0.26), (b) psychological needs accounted for 31 percent of the variance between relative autonomy index and 7 percent for amotivation, and (c) exercise regulations accounted for 38 percent of variance between physical self-worth, 23 percent for positive affect, and 10 percent for negative affect. The amount of variance accounted for within endogenous latent constructs corresponds with the medium-to-large effect sizes advocated by Cohen (1992).

The second model examined (see Figure. 3) specified the relationships between perceived environmental support, psychological needs, exercise regulations, and participants' exercise behaviour. While the chi-square statistic implied some discrepancy between the target and reference models, the pattern of global model fit indices was generally supportive of the tenability of this conceptual model (see Table 3). Examining the structural pathway coefficients displayed several interesting patterns: (a) the environmental supports positively predicted psychological need fulfillment, (b) the fulfillment of psychological needs negatively predicted amotivation and positively predicted relative autonomy index, and (c) the pathway from amotivation to exercise behaviour was negative while relative autonomy index made a positive contribution to predicting exercise behaviour. The majority of the pathways were statistically significant ($p < .05$) although the pathways from competence to amotivation, relatedness to relative autonomy index, and amotivation to exercise behaviour were not significant ($p > .05$) in this sample data. Inspection of the percentage of variance accounted for within the endogenous latent constructs within the model corresponds with small-to-large effect sizes based on Cohen's (1992) guidelines.

Simultaneous multigroup covariance analysis: Exploring the effects of gender on motivational processes

Results of the invariance test across gender-specific subsamples are presented in Table 5 and Figure 4. Inspection of the increasingly restrictive models suggests no strong evidence for variability of the trimmed latent models across gender. Specifically, non-significant chi-square values were evident across four of the five increasingly restrictive models. Perhaps a greater interest is the minimal deterioration evident in the observed CFI values units do not exceed the threshold value (<-0.01) recommended by Cheung and Rensvold (2002). Given the limited change in overall model fit evident at each stage of model restriction, it seems reasonable to suggest that the trimmed model is invariant across gender. Structural path coefficients (all standardized) are presented for men and women in Figure 4.

Examination of sources of perceived support for exercise from friends

Participants were prompted with a series of probe questions (see method section) to illicit the number and sources of *autonomy support*, *structure*, and *involvement* felt while exercising. Inspection of the sample data revealed the presence of non-response error to items probing sources of perceived *involvement*, *autonomy support*, and *structure* in exercisers. The breakdown of missing data for each perceived environmental support constructs (i.e., *autonomy support*, *structure*, and *involvement*) was as follows: (a) 19.10 percent did not provide any sources for *autonomy support* (n = 81; Male = 33; Female = 36), (b) 24.2 percent did not provide any sources for *structure* (n = 103; Male = 35; Female = 56), and (c) 22.8 percent did not provide any sources for *involvement* (n = 97; Male = 40; Female = 46). These missing responses were not replaced in the present analysis given such an approach lacked any substantive conceptual or empirical justification required for imputation procedures (Hawthorne & Elliot, 2005). As such, a listwise deletion approach was used to identify usable responses from the sample data.

In total, the number of sources for each form of perceived environmental support reported from those participants who provided data was as follows: (a) 71 different sources of *autonomy*

support and *structure*, and (b) 73 different sources of *involvement*. More specifically, the male subsample reported 67 different sources for *autonomy support*, 71 for *structure*, and 73 for *involvement*, whereas, the female subsample reported 71 different sources for both *autonomy support* and *structure*, and 72 different sources for *involvement*. Frequency counts were examined per gender-specific subsample to determine the most salient sources of perceived environmental support for exercise participation. The results of the analyses are presented in Table 6, 7, and 8 for each type of environmental support. Miscellaneous sources (i.e., those that could not be logically reduced to a thematized source) notwithstanding, inspection of the frequency counts suggests that friends/peers was the most salient social target providing *autonomy support* and *involvement* for men and *involvement* only for women with this source also a salient contributor of *autonomy support* in female exercisers. Educators were the most salient social agents offering a sense of *structure* regarding exercise irrespective of gender with friends/peers in both genders and siblings, in females only, to be other important sources.

In order to determine if there were gender differences across the total number of perceived environmental sources reported with reference to exercise, a series of independent samples *t*-tests were performed. The result of the first independent sample *t*-test indicated that females ($M = 3.47$; $SD = 1.35$) reported more sources of *autonomy support* than males ($M = 2.89$; $SD = 1.35$, $t\ (342) = -3.80$, $p < .05$, Cohen's $d = 0.43$). The second and final independent samples *t*-tests indicated that females tend to report more sources of *structure* ($M = 2.96$; $SD = 1.43$, $t\ (320) = -2.43$, $p < .05$, Cohen's $d = 0.29$), and *involvement* ($M = 2.82$; $SD = 1.38$, $t\ (325) = -4.17$, $p < .05$, Cohen's $d = 0.50$) than males when asked to list 5 sources of support. Based on guidelines provided by Cohen (1992), the calculated effect sizes (Cohen's *d* values) were small-to- moderate in the present sample data.

A series of Chi-square analyses were computed to determine if there were differences between the types of sources reported. More specifically, the chi-square was computed to determine if males and females differ between the reported sources for *autonomy support*,

structure, and *involvement* with regards to exercise settings. The results of the chi-square revealed: (a) men and women differ in terms of sources of *autonomy support* for exercise (χ^2 = 20.38; df = 10, $p < .05$, phi = 0.24), (b) men and women differ in terms of sources of *structure* for exercise (χ^2 = 18.83; df = 10, $p < .05$, phi = 0.24), and (c) men and women do not appear to differ significantly in terms of sources of *involvement* for exercise (χ^2 = 9.53; df = 9, p = .39, phi = 0.17). Phi coefficients were calculated to determine the effect sizes (Grissom & Kim, 2005). The calculated effect sizes were small in the present sample data. Moreover, post hoc analyses were conducted to provide a clearer picture to where differences were, with respect to the reported sources. Examining the standardized residuals of the post hoc, suggest that males and females differ in terms of endorsement of the source media. Specifically, males more frequently reported media as a source of structure than their counterpart.

Table 1

Global indices of model fit across the instrument-specific data

Instrument	χ^2	*df*	*p-value*	*CFI*	*IFI*	*SRMSR*	*RMSEA (90% CI)*
1. PESF-Autonomy Support	31.28	9	<.01	.98	.98	.03	.08 (.05-.12)
2. PESF-Structure	119.09	27	<.01	.95	.95	.04	.10 (.08-.12)
3. PESF-Involvement	82.73	14	<.01	.92	.92	.07	.12 (.10-.14)
4. PNSE	545.65	132	<.01	.93	.93	.05	.09 (.09-.10)
5. BREQ-2	366.32	142	<.01	.94	.94	.07	.07 (.06-.07)
6. PANAS	45.83	34	.09	.98	.98	.04	.03 (.00-.05)
7. PSDQ-PSW	128.15	9	<.01	.96	.96	.02	.19 (.16-.22)

Note. PESF = Perceived Environmental Support-Friends (adapted from Tobin, 2003). *PNSE* = Psychological Need Satisfaction in Exercise Scale (Wilson et al., 2006). *BREQ-2* = Behavioral Regulation in Exercise Questionnaire-2 (Markland & Tobin, 2004). *PANAS* = Positive Affect Negative Affect Schedule-Short form (Mackinnon et al., 1999). *PSDQ-PSW* = Physical Self-Description Questionnaire-Physical Self-Worth Subscale (Marsh et al., 1994). *CFI* = Comparative Fit Index; *IFI* = Incremental Fit Index; *SRMSR* = Standardized Root Mean Square Residual. *RMSEA* = Root Mean Square Error of Approximation; *CI* = Confidence Interval for relevant point estimates.

Table 2

Descriptive statistics, reliability estimates, and interfactor correlations between motives and exercise behaviour

Latent Variables	*M*	*SD*	Skew.	*Kurt.*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*
1. Autonomy Support	5.38	1.07	-0.67	0.23	0.87														
2. Structure	2.37	0.89	-0.34	-0.33	.60	0.90													
3. Involvement	2.98	0.72	-0.91	1.40	.64	.56	0.81												
4. Competence	4.90	0.90	-0.98	1.08	.37	.21	.30	0.94											
5. Autonomy	5.38	0.75	-1.37	1.83	.31	.06	.18	.53	0.95										
6. Relatedness	4.38	1.09	-0.97	1.07	.36	.37	.41	.41	.21	0.92									
7. Amotivation	0.10	0.36	6.51	54.50	-.02	.03	-.02	-.17	-.22	-.09	0.83								
8. External Regulation	0.76	0.80	1.14	0.65	-.10	.06	.03	-.24	-.23	.08	.14	0.84							
9. Introjected Regulation	1.89	1.11	0.14	-0.99	.02	.05	.08	.15	.08	.17	-.11	.35	0.84						
10. Identified Regulation	3.15	0.75	-0.88	0.26	.25	.18	.21	.51	.41	.36	-.34	-.09	.48	0.80					
11. Intrinsic Regulation	2.97	0.82	-1.02	1.14	.24	.13	.18	.59	.36	.39	-.28	-.17	.17	.62	0.89				
12. Physical Self-Worth	4.33	1.13	-0.79	0.28	.27	.17	.18	.48	.29	.24	-.06	-.34	-.21	.31	.40	0.97			
13. GLTEQ-METS	51.49	29.00	0.13	-0.36	.20	.22	.16	.31	.15	.24	-.11	.02	.19	.35	.20	.21	-		
14. Positive Affect	3.75	0.63	-0.51	0.42	.27	.20	.24	.44	.26	.36	-.16	.01	.26	.45	.57	.29	.23	0.74	
15. Negative Affect	1.35	0.42	1.43	1.75	-.15	.01	-.10	-.08	-.14	.06	.05	.28	.09	-.08	-.02	-.13	.07	.01	0.63

Note. *PESF* = Percieved Environmental Support-Friends (adapted from Tobin, 2003). *PNSE* = Psychological Need Satisfaction in Exercise Scale (Wilson et al., 2006). *BREQ-2* = Behavioral Regulation in Exercise Questionnaire-2 (Markland & Tobin, 2004). *PANAS* = Positive Affect Negative Affect Schedule-Short form (Mackinnon et al., 1999). *PSDQ* = Physical Self-Description Questionnaire-Physical Self-Worth Subscale (Marsh et al., 1994).*GLTEQ-METS* = Godin Leisure Time Exercise Questionnaire (Godin & Shepherd, 1985). Reliability indices (Cronbach's Coefficient α; Cronbach, 1951) are placed along the principal diagonal for all relevant subscale scores. Correlations placed in the lower diagonal are bivariate *r*'s between scored constructs and sample size is consistent across each element in the matrix. All *r*'s greater than |.11| significant (two-tailed) at $p < .05$.

Table 3

Global model fit indices for structural models predicting motivational consequences in exercise

Model	χ^2	*df*	*p-value*	*CFI*	*IFI*	*SRMSR*	*RMSEA (90% CI)*
Model A	419.66	260	<.01	.93	.91	.10	.05 (.04-.06)
Model B	432.37	272	<.01	.93	.93	.10	.05 (.04-.06)

Note. Model A = Structural model depicted in Figure 2. Model B = Structural Model depicted in Figure 3. *CFI* = Comparative Fit Index; *IFI* = Incremental Fit Index; *SRMSR* = Standardized Root Mean Square Residual. *RMSEA* = Root Mean Square Error of Approximation; *CI* = Confidence Interval for relevant point estimates.

Table 4

Sequential multigroup covariance analyses testing the moderating effect of gender on a conceptual model of motivational processes associated with exercise behaviour

Hypothesis	χ^2	*df*	χ^2_d	df_d	*p-value*	*CFI*	*PNFI*	*SRMSR*	*RMSEA (90% CI)*
Model A	134.35	66	-	-	-	.93	.64	.09	.06 (.05-.08)
Model B	141.47	72	7.12	6	.31	.93	.69	.09	.06 (.05-.08)
Model C	141.47	73	0.00	1	.98	.93	.70	.09	.06 (.05-.08)
Model D	147.29	75	5.82	2	.06	.92	.71	.10	.06 (.05-.08)
Model E	153.63	85	6.34	10	.79	.93	.80	.10	.06 (.04-.07)
Model F	161.51	88	7.89	3	.05	.92	.82	.11	.06 (.04-.07)

Note. Model A = Baseline (unrestricted) model; Model B = assuming A, testing for equivalence of factor loadings; Model C = assuming B, testing for equivalence of factor covariances; Model D = assuming C, testing for equivalence of structural residuals; Model E = assuming D, testing for equivalence of error variances; Model F= assuming E, testing for the equivalence of structural pathways linking latent need support variable with latent need satisfaction variable to latent RAI variable to manifest exercise behaviour variable. *CFI* = Comparative Fit Index; *SRMSR* = Standardized Root Mean Square Residual. *RMSEA* = Root Mean Square Error of Approximation; *CI* = Confidence Interval for relevant point estimates; χ^2_d = change in chi-square value; df_d = change in degrees of freedom from previous model in the sequence; *p-value* = probability value; *PNFI* = Prasimony Normed Fit Index.

Table 5

Sequential multigroup covariance analyses testing the moderating effect of gender on a conceptual model of motivational processes associated with exercise-specific cognitions and affects

Hypothesis	χ^2	*df*	χ^2_d	df_d	*p-value*	*CFI*	*PNFI*	*SRMSR*	*RMSEA (90% CI)*
Model A	419.60	260	-	-	-	.93	.71	.10	.05 (.04-.06)
Model B	432.37	272	12.76	12	.39	.93	.73	.10	.05 (.04-.06)
Model C	432.37	273	0.01	1	.98	.93	.74	.10	.05 (.04-.06)
Model D	443.78	278	11.42	5	.04	.92	.75	.11	.05 (.04-.06)
Model E	467.86	296	24.09	18	.15	.92	.79	.11	.05 (.04-.06)
Model F	477.74	301	9.87	5	.08	.92	.80	.11	.05 (.04-.06)

Note. Model A = Baseline (unrestricted) model; Model B = assuming A, testing for equivalence of factor loadings; Model C = assuming B, testing for equivalence of factor covariances; Model D = assuming C, testing for equivalence of structural residuals; Model E = assuming D, testing for equivalence of error variances; Model F= assuming E, testing for the equivalence of structural pathways linking latent need support variable with latent need satisfaction variable to latent RAI variable to latent physical self-worth/positive and negative affect variables. *CFI* = Comparative Fit Index; *SRMSR* = Standardized Root Mean Square Residual. *RMSEA* = Root Mean Square Error of Approximation; *CI* = Confidence Interval for relevant point estimates; χ^2_d = change in chi-square value; df_d = change in degrees of freedom from previous model in the sequence; *p-value* = probability value; *PNFI* = Prasimony Normed Fit Index.

Table 6

Frequency distribution of sources of autonomy support for exercise across gender

Source	Male		Female	
	Frequency	%	Frequency	%
Parents	0	0	6	2.7
Siblings	2	1.7	3	1.3
Coach/fitness instructor/trainer	3	2.5	2	0.9
Friends/Peers	35	28.9	40	17.7
Other Family	9	7.4	9	4.0
Romantic Partner	18	14.9	46	20.4
Medical Professional	1	0.8	3	1.3
Educators	13	10.7	22	9.7
Work/Colleagues	4	3.3	4	1.8
Media	2	1.7	0	0
Miscellaneous	34	28.1	91	40.3

Note. Frequency is the number of raw scores provided per source within each gender-specific subsample. The % data represent the fraction of the global number of raw scores represented by each source per gender subsample. Zero means no source reported for this subsample. Effective subsample size providing responses to request for autonomy support data: (a) Male = 121; (b) Female = 226.

Table 7

Frequency distribution of sources of structure for exercise across gender

Source	Male		Female	
	Frequency	%	Frequency	%
Parents	3	2.5	9	4.4
Siblings	2	1.7	5	12.4
Coach/fitness instructor/trainer	2	1.7	7	3.4
Friends/Peers	23	19.3	23	11.2
Other Family	8	6.7	9	4.4
Romantic Partner	8	6.7	20	9.8
Medical Professional	5	4.2	7	3.4
Educators	27	22.7	52	25.4
Work/Colleagues	2	1.7	2	1.0
Media	9	7.6	2	1.0
Miscellaneous	30	25.2	69	33.7

Note. Frequency is the number of raw scores provided per source within each gender-specific subsample. The % data represent the fraction of the global number of raw scores represented by each source per gender subsample. Zero means no source reported for this subsample. Effective subsample size providing responses to request for structure data: (a) Male = 119; (b) Female = 205.

Table 8

Frequency distribution of sources of involvement for exercise across gender

Source	Male		Female	
	Frequency	%	Frequency	%
Parents	2	1.8	7	3.3
Siblings	1	0.9	6	2.8
Coach/fitness instructor/trainer	3	2.6	10	4.7
Friends/Peers	39	34.2	50	23.5
Other Family	10	8.8	14	6.6
Romantic Partner	17	14.9	48	22.5
Medical Professional	0	0	1	0.5
Educators	5	4.4	12	5.6
Work/Colleagues	3	2.6	4	1.9
Media	0	0	0	0
Miscellaneous	34	29.8	61	28.6

Note. Frequency is the number of raw scores provided per source within each gender-specific subsample. The % data represent the fraction of the global number of raw scores represented by each source per gender subsample. Zero means no source reported for this subsample. Effective subsample size providing responses to request for involvement data: (a) Male = 114; (b) Female = 213.

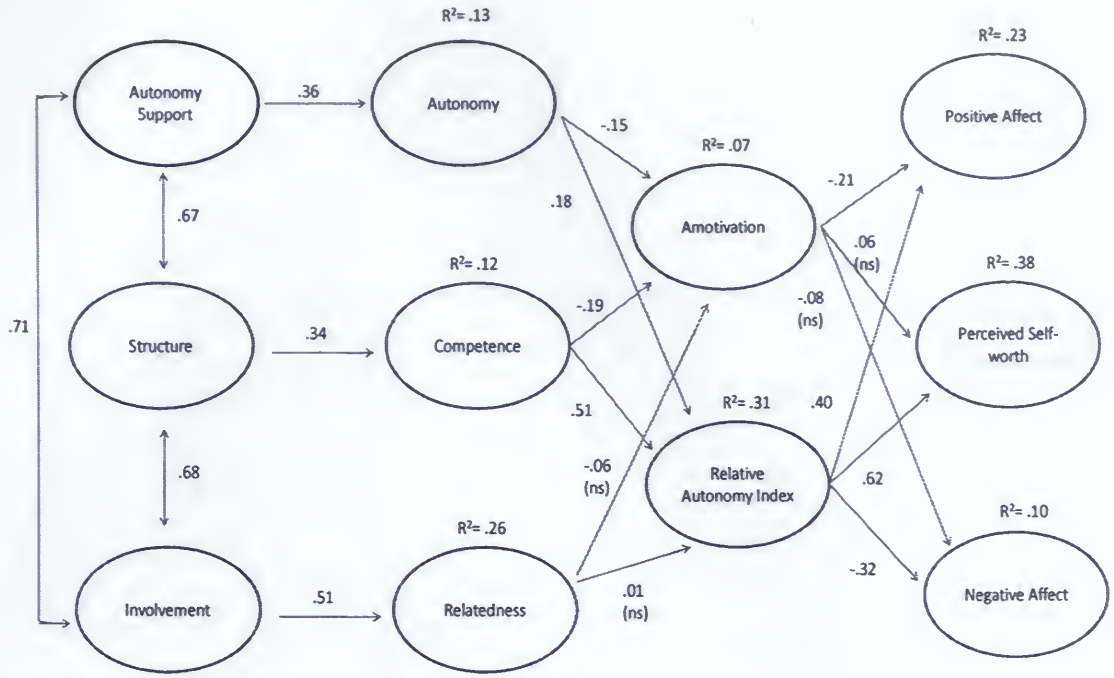


Figure 2. Motivational process model predicting cognitive and affective consequences of exercise participation based on Vallerand's (1997) HMIEM. All structural pathways are statistically significant at $p < .05$ unless otherwise designated (ns = not statistically significant at $p < .05$). Ellipses represent latent variables. Manifest Factor Loadings, item variances, and residual variances are not shown for clarity.

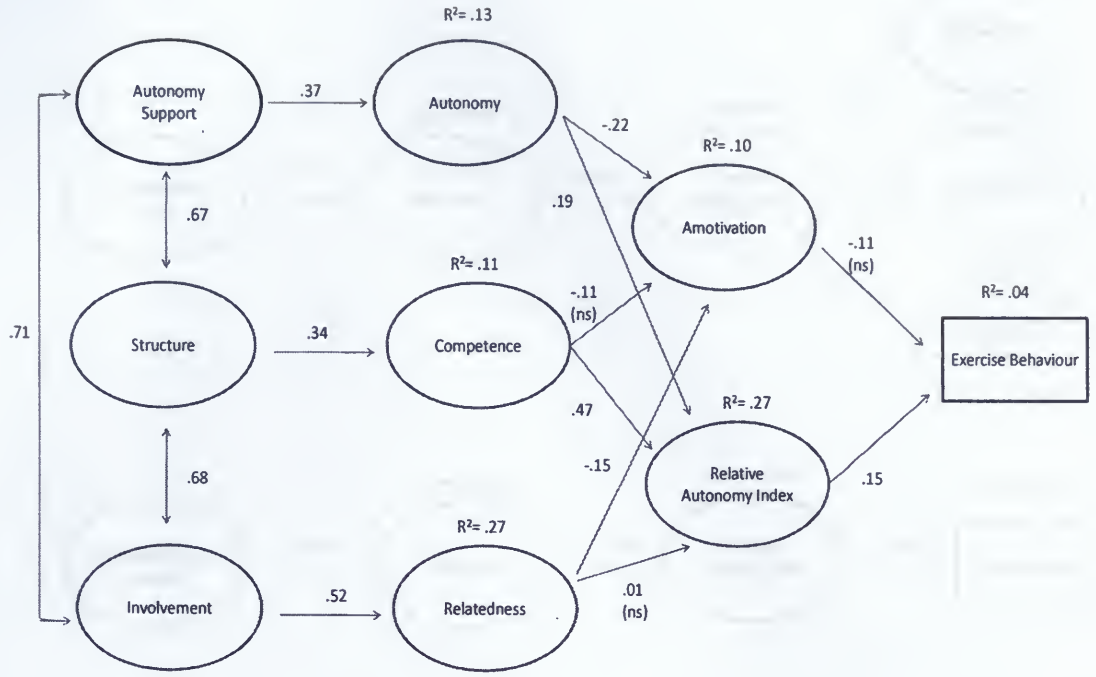


Figure 3. Motivational process model predicting frequency of exercise participationacross a typical week based on Vallerand's (1997) HMIEM. All structural pathways are significant ($p < .05$) unless otherwise noted (ns = not statistically significant at $p < .05$). Ellipses represent latent variables. Rectangles represent manifest indicators. Factor Loadings, item variance, and residual variances are not shown for clarity.

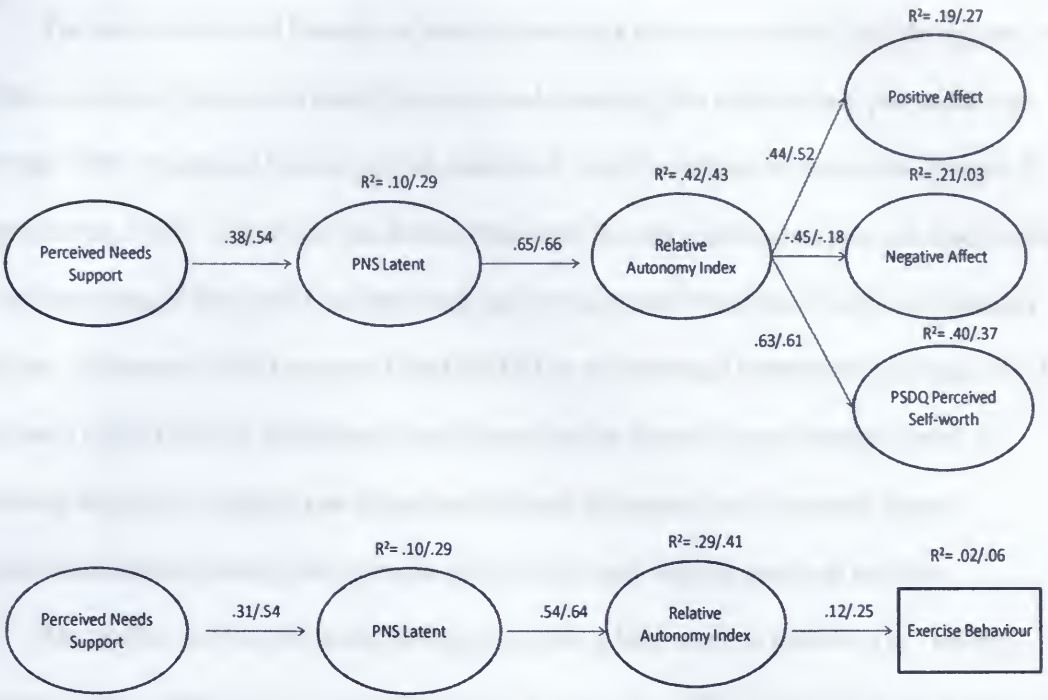


Figure 4. Motivational processes models testing for gender equivalence when predicting exercise-related cognitive/affect responses and frequency of exercise behaviour using Vallerand's (1997) HMIEM. *PNS* = Psychological Need Satisfaction. All structural pathways are statistically significant standardized estimates ($p < .05$). Structural coefficients are presented separately for men (left) and women (right). *R*-squared values on the left are for the male subsample and on the right for the female subsample. All ellipses are latent variables. The rectangle is a manifest indicator from the GLTEQ responses. Factor Loadings, item variance, and residual variances are not shown for clarity.

Chapter 5 – Discussion

The well-established benefits of health-enhancing physical activity (including exercise) has led to a surge of interest in identifying and understanding the motivational processes that determine both persistence behaviour and associated cognitive/affective responses (Hagger & Chatzisarantis, 2007). Central to this interest has been the advancement of relevant theory to aid our understanding of how and why particular processes impact physical activity participation decisions. Vallerand (1997) proposed the HMIEM as a conceptual framework drawing from Deci and Ryan's (2002) SDT to understand how factors within the social environment (such as interaction with one's friends) can shape motivational processes and ultimately impact engagement and persistence with relevant target behaviours such as physical activity.

The present investigation had several purposes which were as follows: (a) Test the sequence of motivational processes embedded in Vallerand's (1997) HMIEM in the domain of structured exercise, (b) Identify important others who represent sources of perceived environmental support for exercise based on Deci and Ryan's (2002) SDT, and (c) Explore and test the impact of gender on motivational process and sources of perceived environmental support for exercise.

Summary of study

The data from the present investigation provided several interesting results that are worth mentioning. First, initial analyses of the instrument-specific measurement models suggested partial support for the structural validity of scores from all psychological instruments used in this investigation with the notable exception of *involvement* and *structure*. Second, the results of the structural equation modeling analyses predicting the cognitive/ affective outcomes of exercise indicated that perceived environmental support positively predicted psychological need satisfaction, which in turn, positively predicted relative autonomous exercise motivation and negatively predicted amotivation. Positive affect and physical self-worth were both positively predicted by relative autonomous exercise motivation whereas amotivation negatively predicted

exercise-specific affective experiences. The model predicting exercise behaviour had similar patterns with reference to the environmental support-psychological need fulfillment relationship. Amotivation negatively predicted exercise behaviour while relative autonomous exercise motivation made a positive contribution to predicting exercise behaviour, although the percentage of variance in weekly exercise behaviour accounted for within this model was small (Cohen, 1992). Finally, the results of the invariance analyses revealed that males and females do not appear to differ meaningfully in terms of the motivational processes regulating exercise participation depicted in Vallerand's (1997) HMIEM.

The results of the exploratory analyses concerning sources of support for exercise within the SDT (Deci & Ryan, 2002) framework generated several interesting results. First, a number of different sources ($n = 73$) were provided by exercisers and this number varied across dimensions of *autonomy support*, *structure*, and *involvement*. Second, friends/peers were the most salient social target providing *autonomy support* and *involvement* for men, whereas it was most salient target providing *involvement* for women. Educators appeared to be the most salient social target providing *structure* irrespective of gender. Third, males and females differed in terms of the number of reported sources for each form of environment support. Specifically, females were more likely to list more sources of *autonomy support*, *structure*, and *involvement* than males. Finally, men and women differ in terms of sources of *autonomy support* and *structure* but did not differ in terms of sources of *involvement* for exercise.

Measurement of motivational concepts from SDT and HMIEM

A series of CFA's were conducted to investigate the structural validity of scores derived from instrument-specific latent variable measurement models in line with Messick's (1995) recommendations. In brief, the results of the CFA's suggested that five of the measurement models representing the PNSE, BREQ-2, PANAS, PESF-Autonomy Support, and to a lesser extent PSDQ-PSW configurations did not pose any serious threats to construct validity in the present data given the pattern of observed global model fit indices combined with the scant

modifications implied by the standardized factor loadings and matrix of standardized residuals. Both the PNSE and PSDQ-PSW measurement model analyses depicted RMSEA point estimates and values for the upper limit of the 90 percent confidence interval that were less than desirable (Hu & Bentler, 1999). Nevertheless, the remaining omnibus model fit indicators suggested both the PNSE and PSDQ-PSW measurement models were tenable in the present data. The anomalous RMSEA values associated with the PSDQ-PSW measurement model are most likely a result of model misspecification which resulted from omitting other PSDQ subscales from this study. The observations for the PNSE suggest in line with McDonough and Crocker's (2007) research that further construct validity research is warranted with the PNSE before accepting it as the instrument of choice to capture psychological need fulfillment in exercise contexts from the perspective of Deci and Ryan's (2002) SDT.

The pattern of global model fit indices concerning the remaining two measurement models (namely PESF-Involvement and PESF-Structure) were much less convincing in terms of support for structural validity of score interpretations. On the basis of the initial CFA's, several items were deleted from the PESF-Involvement and PESF-Structure to improve the global model fit. Specifically, item 4 ("My friends aren't too bothered about my well-being"), item 6 (My friends don't concern themselves with what I need to get from exercising"), and item 7 ("My friends care about me") were sequentially removed from the pool of original seven PESF-Involvement items to improve model fit. This is perhaps not surprising since Tobin (2003) also reported the deletion of items to improve model fit in her original development work concerning the PESF items. Tobin (2003) reported deleting item 1 ("Make time for me even though they are busy"), item 4 ("Aren't too bothered about my well-being"), and item 6 ("Don't concern themselves with what I need to get from exercising"), which is a similar pattern of modifications observed in this study. One plausible explanation for the troubling nature of these items concerns the psychometric issues associated with positive and negatively valence items designed to capture the same underlying concept (DeVellis, 2003). Sixty-six percent of the items deleted by both

Tobin (2003) and this study were negatively phrased which implies the plausibility of a methods artefact in participant responses (Messick, 1995).

Inspection of the CFA's concerning the PESF-Structure item responses revealed comparable problems as observed with the PESF-Involvement measurement models. Two items were eliminated from the original pool of *structure* items on the basis of the statistical evidence generated from the present data. Specifically, the items removed were item 7 ("My friends make me feel positive about being able to perform") and item 9 ("My friends help me to achieve my exercise goals"). After the deletion of these two items, a considerable improvement in the model fit was observed for the PESF-Structure measurement model. This finding is in line with Tobin (2003) who reported the deletion of four items from *structure* subscale of the PESF. These items were item 5 ("Make sure I understand the best ways to exercise"), item 6 ("Give me exercises that are suited to my level"), item 8 ("Help me to feel confident about exercise"), and item 9 ("Help me to achieve my exercise goals"). The problematic nature of item 9 focusing on the role of others in helping people achieve their exercise goals was noted both in this study and by Tobin (2003). One possible explanation of this finding may be due to the applicability of the items. Tobin (2003) examined *structure* as it was perceived from staff at an exercise facility whereas the present study examined *structure* perceived from friends more globally within the context of self-driven exercise. Thus, the *structure* items may be more applicable to friends than to exercise facility staff as indicated by fewer items dropped from the present study. Tobin (2003) suggested in her initial study that these items were problematic potentially due to the wording of the items themselves.

Closer examination of the correlations between the perceived environmental support constructs (i.e., *autonomy support*, *structure*, and *involvement*) offered evidence of convergent validity in the present data. Convergent validity refers to the ability to establish that scores derived from instruments that theoretically should be associated demonstrate the expected empirical relationships (Trochim, 2001). In this study, the interrelationships between perceived

environmental support constructs was moderate-to-large in magnitude (Cohen, 1992) and uniformly positive in direction. The process of establishing construct validity evidence is concerned with the ongoing mosaic of evidence (Messick, 1995; Trochim, 2001) and the pattern of relationships between perceived environmental support constructs is encouraging especially in light of the structural validity issues previously noted herein and with Tobin's (2003) research. The absolute value of correlations offering convincing evidence of convergence (balanced with sufficient evidence of divergence; Messick, 1995) remains speculative with no formal or established conventions to guide application in the social sciences (Trochim, 2001). The pattern of bivariate and multivariate relationships suggests that the concepts measured by the PESF share minimally ~33.0 percent common variance between each other which does not appear overly problematic in terms of conceptual distinction based on other SDT-related research with the BREQ (Mullan & Markland, 1997) and the BREQ-2 (Wilson et al., 2004). Given that the PESF is a new instrument with minimal evidence to justify the broad spectrum of construct validity issues, the available data generated by this study suggests the core items comprising the PESF developed by Tobin (2003) hold considerable promise for advancing our understanding about sources of environmental support specific to SDT and motivated behaviour in exercise settings.

Complimenting the validity of the PESF scores, the internal consistency reliability indices of the *structure* and *involvement* subscale scores were similar to those reported in Tobin's (2003) study (α's were 0.93 and 0.95; Tobin, 2003). The observed coefficient α values (Cronbach, 1951) noted in this study were marginally lower than those reported by Tobin (2003) in her work with British residents referred to an exercise-scheme on the recommendation of their family physician. Two possible explanations can account for this observation. First, it is plausible that sampling variability influenced the observed reliability indices as would be expected in social science research (Crocker & Algina, 1986). Second, it seems plausible that the removal and retention of different items from the PESF compared with Tobin's (2003) study may explain the different reliability values noted herein. Collectively, however, both investigations

suggested the presence of minimal error variance in the assessment of *autonomy support*, *structure*, and *involvement* based on participant scores.

Testing propositions from Vallerand's (1997) HMIEM

One key component of Vallerand's (1997) model is the directional path between the social factors and the basic psychological needs which has received limited attention in exercise psychology research (Edmunds et al., 2008; Tobin, 2003; Wilson et al., 2004). Specifically, this pathway marks the start of the motivational process within the HMIEM (Vallerand, 1997). There is an abundance of literature reporting the beneficial effects stemming from psychological need fulfilment within exercise and the consequences it has on fostering feelings of positive affect and promoting more self-determined forms of motivation (Deci & Ryan, 2002; Edmunds et al., 2008; Wilson & Rodgers, 2007). Therefore, it is pertinent to examine factors that foster psychological need fulfillment and previous research (Wilson et al., 2004) and commentary (Wilson & Rodgers, 2007) have recommended this as an important line of inquiry for applications of SDT to exercise science research. Perceptions of *autonomy support*, *structure*, and *involvement* with reference to exercise in general, or friendship targets in particular, have yet to be extensively studied. This study noted small-to-moderate positive relationships between the perceived environmental support constructs and psychological need fulfillment and moderate-to-strong effects based on the percentage of need satisfaction variance accounted for within the model analyses (Cohen, 1992). Nevertheless, this finding is practically important because it suggests that promoting psychological need fulfillment is plausible through the provision of appropriate forms of environment support within the context of self-chosen exercise settings.

Vallerand's (1997) HMIEM was evaluated using SEM procedures which have been advocated for empirically testing theoretical models (MacCallum & Austin, 2000). In brief, the indices of global model fit observed in both the predictive and invariance-testing analyses provide support for Vallerand's (1997) propositions concerning the relevant sequence of motivational events important for understanding exercise participation. Closer examinations of the structural

pathways revealed that all indices were mainly in the hypothesized direction offering further validation support for the HMIEM in exercise settings.

While the bulk of the available data supported the tenability of the HMIEM as applied to exercise, select anomalous findings with reference to the psychological need fulfillment-motivation for exercise relationship were noted. Examination of the structural pathways presented in Figures 2 and 3 provide support for the energizing role of competence and autonomy perceptions but little support for the role of relatedness in exercise with reference to motivating exercise behaviour. This observation is hardly novel (Wilson et al., 2007) and yet understanding the role of relatedness in physical activity contexts such as exercise remains controversial (Edmunds, Ntoumanis, & Duda, 2007). It is possible that the observed relationships are merely a function of the variable reduction strategy applied to the BREQ-2 data to create a latent variable for the SEM analyses as previously used and observed by Wilson et al. (2007). The pattern of differential relationships observed at the bivariate level (see Table 2) would support such a proposition given that greater relatedness was clearly correlated in a positive fashion with more self-determined than controlled motives for exercise as expected according to SDT (Deci & Ryan, 2002). An alternative explanation concerns the potentially distal role played by relatedness in motivating exercise amongst adherent individuals who have likely already internalized the regulation of behaviour with the self (Deci & Ryan, 2002). Future studies would do well to distinguish this issue more fully as the observations concerning relatedness are not novel.

Further examination of the structural pathways between the need support constructs and the basic psychological needs provided more insightful information. This study noted that the need support constructs were able to positively predict psychological need fulfillment. The finding was quite novel since there has only been one published study that tested all three need support constructs along the motivational process (Edmunds et al., 2008). Edmunds and colleague's (2008) stated, "none of the social-contextual characteristics emerged as significant predictors of any of the psychological needs at baseline"(p. 383). On the other hand, a non-

published study by Tobin (2003) noted that *autonomy support*, *structure*, and *involvement* was able predict psychological need fulfillment, which was consistent with this study. There appears to be some controversy with regards to directional association with the need support constructs and the basic psychological needs, thus, future studies may want to further examine this relationship to clarify the issue.

Inspection of the variance accounted for in each motivational consequence (namely exercise behaviour, exercise-induced affective experiences, and feelings of physical self-worth) also offer mixed support for application of the HMIEM to exercise. While the data reported in Figure 2 concerning affect and cognition as motivational consequences is relatively convincing based on the moderate-to-large effect size estimates observed in the SEM, the data concerning the prediction of weekly exercise behaviour is much less convincing with only 4.0% of variance accounted for in the SEM analysis. This amount of variance is comparable to a small effect size (Cohen, 1992) and is not overly supportive of the proposed model given previous SDT-based research in Canadian exercisers that report much larger effects with reference to predicting exercise behaviour from self-determined sources of motivation (Wilson et al., 2004). However it was not surprising that the amount of variance predicted concerning the cognitive and affective consequences were much greater than exercise behaviour, since previous studies have noted similar trends with regards to other psychological variables (i.e., behavioural intention and positive/negative affect) (Edmunds et al., 2007; Edmunds et al., 2008).

One explanation for this finding is the exclusion of other variables from the model that may predict (or explain) exercise behaviour. According to CCHS (2005), lack of time was reported as a determinant of low participation rates in physical activities such as exercise. Moreover, low physical activity rates have been shown to be influenced by geographical region (Gilmour, 2007). For example, geographic variability in physical activity participation status has been noted in Canada (Gilmour, 2007). Specifically, the western provinces in Canada report engaging in more regular physical activity behaviour compared to the eastern provinces

(Gilmour, 2007). Personality is another variable that may be able to predict exercise behaviour (Rhodes, 2006). Vallerand's (1997) HMIEM does not address the construct of personality at the contextual level, despite the fact that personality is an important component of causality orientations sub-theory within SDT (Deci & Ryan, 2002). Hence, it seems probable that given the myriad of factors that can determine exercise participation that any reductionistic model is unlikely to account for a majority of behavioural variance with respect to exercise or physical activity.

Another explanation for the portion of exercise behaviour accounted for in the models tested within this study may be a result of the strategy used to specify the structural models tested within the present study. Specifically, in order to provide an appropriate test of Vallerand's (1997) model in terms of the implied motivational sequence of processes, the responses to the BREQ-2 were condensed into a single latent variable (i.e., relative autonomy index) which is consistent with previous studies (Hagger, Chatzisarantis, & Harris, 2006; Ntoumanis, 2005; Standage et al., 2003; Wilson et al., 2007). Koestner and Losier (2002) have questioned the procedure of reducing constructs spanning SDT's motivational continuum into a single latent variable based on the possible loss of valuable information. One recent study has provided empirical evidence with exercisers to suggest that creating a composite latent relative autonomy motivational index with BREQ scores can result in a loss of predictive power and potentially confounding conclusions regarding the salience of extrinsic versus intrinsic motivational influences (Wilson, Blanchard, & Grattan, Nehl, & Baker, 2007). Thus, variable reduction protocols used in the SEM analyses may have contributed to the small amount of variance in exercise behaviour explained in this study. Future research many want to empirically determine if model complexity (or simplification) accounts for differences in variance accounted for with reference to exercise behaviour.

The amount of variance accounted for with reference to the cognitive outcomes were similar to previous study by Edmunds and colleagues (2007) and (2008) where behavioural

intention was a cognitive outcome. Collectively, they noted that autonomy support, structure, and involvement were positive predictors of behavioural intention, whereas, this study noted that physical self-worth was related to the support constructs. In addition, Edmunds et al. (2007) also examined other cognitive outcomes, such as barrier self-efficacy and commitment and noted intrinsic motivation as a positive predictor. Despite that this study did not examine behavioural intention as a cognitive outcome, it is important to note the similarity of the pattern observed between the motivational constructs and the cognitive outcomes with regards to the direction and magnitude.

The findings with regard to the affective outcomes in this study were different from what were reported by Edmunds et al. (2008). Specifically, Edmunds and colleagues (2008) noted that amotivation was a positive predictor negative affect, while this study found amotivation to negatively predict negative affect although it was not statistically significant. One possible explanation for this observation is that the instruments used to measure the affective outcomes was different from this study.

Gender differences were analyzed by conducting a simultaneous multigroup covariance analyses to determine the sensitivity of a conceptual model drawn from Vallerand's (1997) HMIEM. In brief, the results suggest the trimmed structural model was largely invariant across gender. In other words, males and females did not differ meaningfully in terms of the sequence of motivational processes implicit in Vallerand's (1997) HMIEM. Given that SDT proposes that these psychological processes should not vary across gender, this finding is consistent with Deci and Ryan's (2002) arguments and suggests further support for the applicability of SDT-based concepts for understanding exercise behaviour. From a practical perspective, this finding suggests that practitioners do not have to specifically tailor environments based on gender to nurture the energization of behaviour via motivation given that the impact of the concepts included in this study appears largely equivalent across gender.

Sources of support for exercise

Exploring the different possible target sources of support for exercise has not previously been examined in exercise contexts. This study was novel insofar as it was the first study to attempt to empirically identify the different sources of support for exercise using concepts from SDT as a guiding framework. The nature of the sources reported by the participants were typically associated individuals they knew personally (i.e., brother), or individuals who they may have interaction with on a regular basis at the university/college (i.e., professors). However, the dominant source of support in this study was consistently the category labelled as miscellaneous. The miscellaneous category was made up of support sources (e.g., health fairs and gym) that did not fit suitably or logically into the other themes emerging from the data and therefore were categorized into a heterogeneous theme of essentially uncodable sources. On the basis of the raw data that comprised the miscellaneous category, minimal interpretational consideration was pursued with reference to this theme.

One important finding of the exploratory analyses was the overall number of different support sources for exercise reported by the participants. Specifically, seventy-three different targets were identified by participants as being perceived sources of support for exercise. The majority of the sources appear to have obvious intuitive appeal (i.e., friends and parents), however, closer inspection of the raw data suggests some idiosyncintic sources emerging from participant responses (i.e., fans and health fairs). One possible explanation for these idiosyncintic responses may stem from the wording of the elicitation questions used to derive the data. The vagueness evident in certain raw responses (e.g., health fairs) in combination with the peculiarity of select responses (e.g., sport fans) suggests that the wording of the elicitation probes may have been confusing for some participants. Future investigations may want to clearly inform the individual that the types of sources being sought refer to individuals who played (or presently are involved with) a significant and important role in their exercise behaviour.

The results of the thematic analysis codified all raw participant responses into 11emergent themes to reduce and simplify the number of reported sources of exercise support for

further analyses. These 11 themes were: (a) parents, (b) siblings, (c) coach/fitness instructor/trainer, (d) friends/peers, (e) other family, (f) romantic partner, (g) medical professional, (h) educators, (i) work/colleagues, (j) media, and (k) miscellaneous. One interesting pattern that emerged was the uniformity of the responses across the three support constructs drawn from the SDT framework. Specifically, friends, romantic partner, and educators were the most frequent reported source of support for exercise across *autonomy support*, *structure*, and *involvement*. However, educators appeared to be the most important source for *structure*. This observation is not entirely surprising given the *structure* items corresponded with individuals who would provide feedback about progress, clarify what needs to be done to get results, suggest the best ways to exercise, help foster feelings of confidence, and provide support for goal attainment. Given that the sample was comprised of college and university students enrolled in course-based post-secondary educational programs, the likelihood of a professors or lab instructor being a source of support for exercise seems more probable than if the sample were drawn from a more diverse population.

Limitations and future directions

Although this study offered novel and interesting evidence to inform the nature of motivational processes integral to exercise, a number of limitations inherent in this study and future directions should be acknowledge to advance the literature on motivational processes in exercise. Each limitation is presented below with accompanying suggestions for future research using and extending Vallerand's (1997) HMIEM in exercise psychology.

The first limitation of the present study concerns the issue of measurement which remains a vexing issue in applied social science research (Messick, 1995; Trochim, 2001). One particular measurement issue of concern is the self-report nature of the data comprising this study. Self-report data remain a pervasive method of assessment in exercise psychology yet poses a number of interpretational problems based upon issues such as recall bias and social desirability response sets. Given the nature of the concepts embedded within this study, it seems reasonable that a self-

report format was chosen to assess variables aligned within Vallerand's (1997) HMIEM. Future studies may want to adopt less subjective methods of measuring motivational consequences. For example, studies have adopted the use of motion accelerometery and pedometer use in an attempt to avoid the limitations of self-reported exercise behaviour and the associated problems of monomethod bias (Pedhazur & Pedhazur Schmelkin, 1991) on the basis of expert opinion (Welk, 2002). While reliance on alternative approaches to assessment may alleviate or reduce concerns of self-report data, such approaches are not without their own limitations including the lack of feasibility in large-scale population health studies (Welk, 2002) and the impracticality of assessing psychological variables such as psychological need fulfillment via methods other than self-report (Wilson et al., 2004).

The second limitation of this study pertains to study design with specific reference to two interrelated issues, namely the sampling methods employed and the timing of test administrations. This study adopted a cross-sectional design such that participants provided data at only one point in time within their own lives. Cross-sectional designs offer minimal insight into causal flow between constructs because they fail to satisfy issues of temporal precedence and satisfactorily account for extraneous influences (Trochim, 2001). This limitation is not unique to the present study and has been reported in a plethora of SDT-based research investigation within exercise psychology (see Wilson & Rodgers, 2007). Future investigations may want to adopt a longitudinal approach to offer greater insight into causal relations amongst variables integral to the HMIEM. Examining the motivational processes stipulated within HMIEM over time may provide a better understanding of the interactions between the constructs proposed by Vallerand (1997). Careful attention should be paid to the time period selected for examination so meaningful change can be captured and relevant change is not obfuscated (Backhouse, Ekkekakis, Biddle, Foskett, & Williams, 2007).

Another concern that pertains to study design is the sampling method. For the purposes of this study, a purposive sampling method was adopted based on Trochim's (2001) guidelines so

that the sample consisted of individuals engaged in exercise behaviour. Purposive sampling is a non-probability based approach that collects sample elements from an undefined target population using inclusion/exclusion criteria (Trochim, 2001). External validity is a chief concern in non-probability based sampling given the inability to determine if the cohort sampled adequately represents the target population of interest. This investigation was restricted to young, post-secondary based, Canadian adults which limit the generalizability of the data to other countries (e.g., England, United States of America), cultures (e.g., Asia, Europe, Africa), and demographic cohorts (e.g., adapted sport athletes, older adults) for whom issues of exercise motivation and behavioural persistence remain important challenges.

The third limitation in this investigation concerns the amount of missing data noted in the original sample of respondants examined in the first stages of analysis. Out of the 425 respondents that provided data, only 367 participants were deemed usable following the initial analysis of non-response errors (Trochim, 2001). Specifically, 13.65 percent of the initial sample had omitted at least one instrument entirely from their response patterns. A number of possible reasons may account for the presence of missing data including: (a) the web-base interactive design may have been confusing and unappealing to participants, (b) the length of time required to complete the questionnaires may be perceived as onerous and overly burdensome, and (c) participants may have misunderstood certain questions and required clarification from a researcher who could aid with the data collection in person. On the basis of Hawthorne and Elliot's (2005) recommendations for handling missing data, this study adopted a within-person mean substitution approach to offset the effects on non-response error within the effective sample ($n = 367$). Since previous studies have reported no concerns in comparison of data from electronic and traditional paper-pencil formats (Lonsdale, Hodge, & Rose, 2006), future studies may wish to investigate the pervasiveness of non-response error across different methods of data collection in exercise psychology research. Additional attention to the effects of replacing

missing data within empirically based exercise psychology studies could prove useful given the recognized nuances of contexts that can affect such analytical practices (Wood & Zhu, 2006).

The fourth limitation concerning this investigation is the restricted array of criterion variables examined in the SEM analyses. For this particular study, exercise behaviour, physical self-concept, and positive/negative affect were the criterion variables of interest used to evaluate claims from Vallerand's (1997) HMIEM. Although Vallerand (1997) suggests that the consequences may be broadly defined within the categories of cognitive, affective, and behavioural domains, this study restricted its focus to only four criterion variables representing the conceptual domains outlined within the HMIEM. Future research may wish to examine consequences that compliment and extend those utilized in the present research. Attention to cognitions associated with the darker side of exercise participation such as dependence, symptomatic tendencies, exercise addiction, and so forth may prove useful given that they represent content domains relevant to the target behaviour that differ markedly in nature from the motivational consequences investigated in this study. Further attention to other markers of exercise-based affect may also prove illuminating considering the conceptual and empirical challenges inherent in this area of exercise psychology (Ekkekakis & Petruzello, 2000).

The fifth limitation of the present study pertains to the reductionistic approach employed in the motivational models tested via SEM procedures. For purposes of the invariance analyses, for example, the perceived environmental support constructs, basic psychological needs and exercise motivation responses were combined to form single latent variables representing each stage of the HMIEM (Vallerand, 1997). The reduced model complexity was largely imposed due to the small size of the male subsample. The troubling consequence of combining motivational constructs in this manner is that you begin to loose potentially useful information that may be statistically and conceptually meaningful (Koestner & Losier, 2002). Previous studies imply some problems with reference to the nature of model specification when it concerns testing propositions embedded within the HMIEM (Vallerand, 1997). For example, Ntoumanis (2005)

used a solitary latent construct in his model testing strategy to capture psychological needs, autonomous motivation, and environmental support for basic psychological needs. In contrast, Standage and colleagues examined the direct effect of three sources of perceived environmental support on each of the three basic psychological needs posited within SDT, which in turn, predicted autonomous motives, introjected regulation, and amotivation. Collectively, these studies combined with the current investigation suggest that the methods of data analysis informing tests of the HMIEM remain inconsistent across investigations and thereby potentially stagnating further development of Vallerand's (1997) seminal work. Future studies may want to test a more complex model across gender, without the reduction of the perceived environmental support constructs, psychological need satisfaction constructs, and the motivation constructs to determine the reproducibility of the current results.

The sixth limitation concerns the process of theory testing with specific reference to the SDT-based background of the HMIEM. For instance, within the SDT framework there are four sub-theories and in this present study investigation three of the four sub-theories were directly or indirectly examined given the HMIEM was used to conceptualize this study. Deci and Ryan (2002) propose SDT is a constellation of four mini-theories which overlap to make one theoretical framework for understanding human motivation and development. The causality orientations sub-theory was excluded from this investigation and has been overshadowed in much of the literature applying SDT to the study of exercise motivation issues, which questions the extent to which this investigation is actually testing theory. Past research has also taken a similar approach whereby only one or two components of SDT were examined in each investigation (Edmunds et al., 2008; Mullan & Markland, 1997; Wilson et al., 2004) suggesting that the entire SDT framework may prove difficult to test within a single exercise-based study. Future studies may wish to draw logically from all four of SDT's sub-theories into a single investigation to explore potential synergies and identify testable hypotheses to inductively advance the theory.

The seventh limitation concerns the source of support chosen for this study. Specifically, this study examined the effects that perceived support from friends have on the motivational processes. One previous study by Hagger and colleagues (2007) examined multiple sources of support (i.e., parents, peers, & PE teacher) in exercise settings and noted that perception of support from parents, peers, and PE teachers were associated with more self-determined exercise regulation (i.e., intrinsic motivation and identified regulation). In addition to Hagger et al. (2007), the exploratory findings within this study suggested that other sources of support, such as romantic partners and educators may be as important as friends. Therefore, future studies may wish to further explore the role that romantic partners and educators have on motivating exercise behaviour.

The final limitation concerning this study is the exploratory nature of the portion of the investigation concerned with identifying sources of support for exercise and testing associated gender differences. One obvious concern is evident in the array of response options ($N = 5$) for each elicitation question that may have encouraged or restricted the number (and nature) of sources for exercise support provided by respondents in this sample. For example, if participants had more than five sources for exercise support that they believe to be equally important, they may have felt a sense of restriction or obligation to pick between sources that they believe are equally important. Future studies may want to investigate other methods of extracting this information from participants without the participants feeling restricted or obligated to provide sources.

The findings of this study has some degree of practical applications with regards to relationship between need support and psychological need fulfillment. Drawing from the findings within this study, providing environments that nurture choice, that offers feedback, and provide a sense of sincerity of involvement with the person can have psychological and motivational benefits, especially with regards to exercise behaviour, cognitive, and affective consequences. In addition, it appears that perceived support from friends/peers, romantic partner,

and educators were the most strongly endorsed source of support in the exercise domain. This finding has some merit of practical application with regards to structuring exercise program. For example, it may be beneficial to incorporate the involvement of the exerciser's friend/romantic partner into the exerciser's exercise program given that they were perceived to be important sources of providing support in the exercise context.

Summary

The purpose of this study was to test the contextual level sequence of motivational process proposed by Vallerand (1997) within an exercise context. An additional sub-purpose was to explore target sources of environmental support experienced by young adult exercisers. Overall, the results of the investigation highlight the challenges inherent in measuring and analysis concepts integral to Vallerand's (1997) HMIEM and Deci and Ryan's (2002) SDT. These measurement challenges notwithstanding, it appears that this study provides at least partial support for the sequence of processes formulated by Vallerand's (1997) HMIEM with a novel target (i.e., friends) and in a specific context (i.e., exercise). Collectively, this study implies that encouraging decision reaching, setting clear and realistic goals with suitable feedback, and involving oneself genuinely with others have motivational potency and seem worth of additional study.

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Appendix A

Demographics

This first part of the questionnaire is designed to describe the people participating in this study. All information received is held in confidence. Please provide your...

Age _____

Height _____ Feet/inches _____ Metres

Weight _____ Pounds (lbs) _____ Kilogram (Kgs)

Please check one of the following...

What is your gender?

❑ male ❑ female

What faculty are you registered with at Brock University?

What year of study are you currently in at Brock University?

What is your current employment status?

❑ Full-Time Employed ❑ Part-Time Employed ❑ Unemployed

How would you describe your ethnic origin?

❑ Aboriginal ❑ Caucasian/White ❑ Asian ❑ Other

Stage of Change for physical activity

Physical activity is defined as all body movement produced by the skeletal muscles that results in an increase in energy expenditure done during leisure and non-leisure (i.e., work) time. This includes:

- **Endurance activities** *that strengthen the heart and lungs (such as running, aerobics, walking, and swimming)*
- **Flexibility activities** *that encourage bending and stretching (such as yoga, dancing, curling, and bowling)*
- **Strength activities** *that require you to exercise your muscles against some resistance to increase their physical strength (such as opening heavy doors, resistance training exercise with weights, or yard work such as raking leaves or chopping wood).*

Regular physical activity involves doing a combination of activities on 4 or more days of the week, at a moderate-to-vigorous intensity (such that your heart and breathing rate increases but does not have to exhaust you), that together add up to 30 minutes of physical activity per day.

Examples of regular physical activity include taking a half-hour brisk bike ride at least 4 times per week or completing 3 short but brisk 10 minute walks each day from Monday to Friday.

Please keep this definition of regular physical activity in mind as you respond to the following questions.

According to the definition provided above, do you participate in regular physical activity?	
Yes, I **have been** regularly physically active for **more than 6 months**	❑
Yes, I **have been** regularly physically active but for **less than 6 months**	❑
No, but I **intend** to participate in regular physical activity in the **next 30 days**	❑
No, but I **intend** to participate in regular physical activity in the **next 6 months**	❑
No, and I **do not intend** to participate in regular physical activity in the **next 6 months**	❑

Godin Leisure Time Exercise Questionnaire (GLTEQ)

*Consider a typical week (7 days), how many times on the average do **YOU** do the following kinds of exercise for more than 15 minutes during your free time **(write the appropriate number in each box for each level of activity intensity)**?*

Intensity of the activity	**Times per week**
• **Mild (minimal effort, no perspiration)** (e.g., yoga, fishing, bowling, horseshoes, golf, snowmobiling)	
• **Moderate (not exhausting, light perspiration)** (e.g., fast walking, , tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, dancing)	
• **Strenuous (heart beats rapidly, sweating)** (e.g., running or jogging, hockey, soccer, squash, cross country skiing, judo, roller skating, vigorous swimming, vigorous long distance bicycling, vigorous aerobic dance classes, heavy weight training)	

Positive Affect and Negative Affect Scale (PANAS)

*This scale contains a number of words describing different feelings and emotions. Indicate to what extent **YOU** generally feel this way when **YOU** exercise. That is, how **YOU FEEL** on the average when **YOU** exercise.*

	Very Slightly or not at all	A Little	Moderately	Quite a bit	Extremely
Inspired	1	2	3	4	5
Afraid	1	2	3	4	5
Alert	1	2	3	4	5
Upset	1	2	3	4	5
Excited	1	2	3	4	5
Nervous	1	2	3	4	5
Enthusiastic	1	2	3	4	5
Scared	1	2	3	4	5
Determined	1	2	3	4	5
Distressed	1	2	3	4	5

BREQ-2

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

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

Physical self-concept scale

These questions describe how people feel about themselves physically. Please circle the number next to each question that best describes how you feel about yourself physically.

	False	*Mostly False*	*More false than true*	*More true than false*	*Mostly true*	*True*
I am satisfied with the kind of person I am physically.	1	2	3	4	5	6
Physically, I am happy with myself.	1	2	3	4	5	6
I feel good about the way I look and what I can do physically.	1	2	3	4	5	6
Physically, I feel good about myself.	1	2	3	4	5	6
I feel good about who I am and what I can do physically.	1	2	3	4	5	6
I feel good about who I am physically.	1	2	3	4	5	6

PNSE

The following statements represent different experiences people have when they exercise. Please answer the following questions by considering how YOU TYPICALLY feel while you are exercising

	False	Mostly False	More false than true	More true than false	Mostly True	True
1. I feel that I am able to complete exercises that are personally challenging	1	2	3	4	5	6
2. I feel attached to my exercise companions because they accept me for who I am	1	2	3	4	5	6
3. 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
4. I feel confident I can do even the most challenging exercises	1	2	3	4	5	6
5. I feel a sense of camaraderie with my exercise companions because we exercise for the same reasons	1	2	3	4	5	6
6. I feel confident in my ability to perform exercises that personally challenge me	1	2	3	4	5	6
7. I feel close to my exercise companions who appreciate how difficult exercise can be	1	2	3	4	5	6
8. I feel free to exercise in my own way	1	2	3	4	5	6
9. I feel free to make my own exercise program decisions	1	2	3	4	5	6
10. I feel capable of completing exercises that are challenging to me	1	2	3	4	5	6
11. I feel like I am in charge of my exercise program decisions	1	2	3	4	5	6
12. I feel like I am capable of doing even the most challenging exercises	1	2	3	4	5	6
13. I feel like I have a say in choosing the exercises that I do	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 good about the way I am able to complete challenging exercises	1	2	3	4	5	6
16. I feel like I get along well with other people who I interact with while we exercise together	1	2	3	4	5	6
17. I feel free to choose which exercises I participate in	1	2	3	4	5	6
18. I feel like I am the one who decides what exercises I do	1	2	3	4	5	6

Sources of Support Questionnaire

The following questions ask you to describe in your own words different types of experiences you have had with others about YOUR exercise participation. Different people in YOUR life have different ways of interacting with you about exercise participation and we would like to know more about these people in YOUR life. More specifically, we would like to know who these people are in your life (e.g., mother, father, partner, friend, etc) and to what extent they influence your experiences with exercise and participation behaviour.

Who makes you feel this way when participating in exercise?
1.
2.
3.
4.
5.

We would like to know more about the people in your life who provide with information about the consequences you can expect from exercising, and/or offer feedback about exercise that enables you to perform this behaviour.

Who makes you feel this way when participating in exercise?
1.
2.
3.
4.
5.

We would like to know more about the people in your life who make YOR feel that they are dedicating their time to being involved in your exercise activities, show interest in you as a person who exercises, and makes you feel accepted as an exerciser.

Who makes you feel this way when participating in exercise?
1.

2.

3.

4.

5.

Social Contextual Characteristics

Part A- Autonomy Support (HCCQ; Williams et al., 2002)

The following questions ask about your interactions with FRIENDS who may influence your exercise behaviour. FRIENDS are a personally defined group with whom you identify and spend time with.

Friends have different styles in dealing with people, and we would like to know more about how you have felt about your encounters with your FRIENDS about exercise.

	Strongly Disagree			Neutral			Strongly Agree
1. I feel that my friends have provided me choices and options	1	2	3	4	5	6	7
2. I feel understood by my friends	1	2	3	4	5	6	7
3. My friends convey confidence in my ability to make changes	1	2	3	4	5	6	7
4. My friends encourage me to ask questions	1	2	3	4	5	6	7
5. My friends listen to how I would like to do things	1	2	3	4	5	6	7
6. My friends try to understand how I see things before suggesting a new way to do things	1	2	3	4	5	6	7

Part B- Structure and Involvement (PESQ; Tobin, 2003)

The following questions ask about the interactions you have with your FRIENDS about exercise.

	Not true		Sometimes true		Very true
My friends make time for me even though they are busy	0	1	2	3	4
My friends make me feel positive about being able to perform	0	1	2	3	4
My friends make me feel like I matter to them	0	1	2	3	4
My friends aren't too bothered about my well-being	0	1	2	3	4
My friends provide clear feedback about my progress	0	1	2	3	4
My friends look after me well	0	1	2	3	4
My friends make sure I understand the best way to exercise	0	1	2	3	4
My friends make it clear to me what I need to do to get results	0	1	2	3	4
My friends are concerned about my well-being	0	1	2	3	4
My friends give me exercises that are suited to my level	0	1	2	3	4
My friends help me to feel confident about exercise	0	1	2	3	4
My friends don't concern themselves with what I need to get from exercising	0	1	2	3	4
My friends make it clear what to expect from engaging in the activities	0	1	2	3	4
My friends help me to achieve my exercise goals	0	1	2	3	4
My friends give me good advice	0	1	2	3	4
My friends care about me	0	1	2	3	4

Appendix B

Letter of Invitation

Title of Study: University Students' Motives to Engage in Health Behaviours
Principal Investigator: Sovoeun Muon, Masters' Student, Faculty of Applied Health Sciences, Brock University
Faculty Supervisor: Philip M. Wilson, Ph.D., Assistant Professor, PEKN Department, Brock University

Introduction: The following research project which you are being asked to participate in is entitled "University Students' Motives to Engage in Health Behaviours t". The principle researcher is Sovoeun Muon, a graduate student, at Brock University, who is interested in university students' perception of autonomy support in exercise context.

Purpose: The primary purpose of this study is to examine the reasons why students' exercise and how interacting with important others impacts these motives. The secondary purpose of this study will be to identify which important others who support your exercise behaviour. Your assistance in the study is greatly appreciated in helping develop a deeper understanding of how these interactions impact the motivation of students to exercise and your experiences felt through exercise participation.

Involvement: If you choose to participate in this study, you will be asked to complete a series of questionnaires via an internet site on a single occasion that will take 15-20 minutes. Questions will attempt to identify sources of support in the exercise context and examine the influences that these sources have on your motives for exercise and exercise behaviour in university students. A sample question is "I feel that my important others have provided me with choices and options about exercise in terms of improving my health".

Benefits: This research should benefit both the academic and health care communities in several ways. First, it is a priority for both researchers and health professionals to constantly review and test current conceptual models as means of testing theory in a practical domain. Second, knowing more about what effect important others have on student's motivation for a healthy lifestyle may be useful for implementing programs and interventions that will support or change healthy living in university students. Third, this study will yield information pertaining to how important others affect students' perceptions of certain psychological and physical health indices. This information may be a useful starting point for promoting healthy practices that enhance the responsiveness of the portion of Canada's population that remain physically inactive. Finally, it is possible that completion of this study will provide greater insight into relevant sources of support in exercise contexts that are influential in improving or altering your exercise behaviour.

Participation: Participation in this study is voluntary and individuals may decline answering any question(s) that they find invasive, offensive or inappropriate. All information are collected anonymously and treated confidentially which means we will not be sharing your personal information with other people. There are no known psychological or physical risks associated with participation. If you wish to participate, please click on the following weblink:

---insert weblink about here----

A summary of the overall results from this study can be made available upon request once the data collection and management phases of this project are complete. If you wish to receive a summary of the results from this study, please contact the principal investigator, Sovoeun Muon, or his faculty supervisor, Dr. Philip M. Wilson, using the contact information provided below.

Thank you for your time and consideration,

Sovoeun Muon	Philip M. Wilson, PhD
Graduate Student	Assistant Professor
Dept. of Physical Education & Kinesiology	Dept. of Physical Education & Kinesiology
Brock University	Brock University
sm03hr@brocku.ca	phwilson@brocku.ca
This study has been reviewed and received ethics clearance through Brock University's Research Ethics Board [06-091]	

Appendix C

Brock University, Faculty of Applied Health Sciences
Informed Consent

Date	October 5, 2007
Study Title	University Students' Motives to Engage in Health Behaviours

Sovoeun Muon	Philip M. Wilson, PhD
Graduate Student	Assistant Professor
Dept. of Physical Education & Kinesiology	Dept. of Physical Education & Kinesiology
Brock University	Brock University
sm03hr@brocku.ca	phwilson@brocku.ca
	905 688 5550 Ext. 4997

You are invited to participate in a study that involves research. The purpose of this study is to examine the relationship between interactions with others, student motivation, and physical activity.

I understand that:

- I have been invited to participate in a study that will require 15-20 minutes of my time on one occasion
- I will be asked to complete a series of questions using an internet web site as a study participant
- I am free to decline to answer any questions or avoid participating in any component of the study
- I am free to withdraw from this study at any time and may do so without penalty. I am free to withdraw my participation during the data collection phase of this investigation by closing the internet window housing this study at any time. I understand that once my data have been collected they cannot be removed from the study given that they are anonymously provided
- I am participating voluntarily and without reimbursement for my involvement in the study
- I am aware that the data are anonymous and will remain confidential meaning I will not be identified as a participant in this study in any way during data collection or presentation of the study findings.
- I understand the data collected for this stored will be stored electronically on a file to be kept in the office of the principal investigator and faculty supervisor. All data will be kept for 5 years post-publication and then destroyed. Access to this data is restricted to only the principal investigator and faculty supervisor.
- I understand that I may not benefit directly but that indirect benefits may result from my participation in this study such as offering greater insight into the way in which students are motivated. I also understand that additional befits of my participation in this study may include provision of greater insight into the effects of parents on student's health behaviours, as well as, the prevalence of select health behaviours in Brock University students which may be useful in health promotion initiatives on campus.
- I understand that there are no foreseeable risks associated with my participation in this study other than disclosure of personal information. If disclosing this information makes people feel uncomfortable in any way they should contact the Brock University Student Health Services at (905) 688 5550 Ext. 3243 to address their concerns
- I understand that the data collected in this study may be published in professional outlets including academic articles and conference proceedings and that I may obtain a copy of these materials by contacting the principal investigator or faculty supervisor directly. These materials will contain only aggregate information pertaining to the variables measured in this study (e.g., physical activity behaviour, food intake behaviours etc).

I agree to participate in this study described above. I have made this decision based on the information I have read in the Letter of Invitation. I have had the opportunity to receive any additional details I wanted about the study and understand that I may ask questions in the future. I understand that I may withdraw this consent at any time. Please print and retain a copy of this informed consent form for your own personal records.

☐ I consent to participate in this study by checking this box Date:

If you have any questions about this study or require further information, please contact the Principal Investigator or the Faculty Supervisor (where applicable) using the contact information provided above. This study has been reviewed and received ethics clearance through the Research Ethics Board at Brock University (File 06-091). If you have any comments or concerns about your rights as a research participant, please contact the Research Ethics Office at (905) 688-5550 Ext. 3035, reb@brocku.ca.

Appendix D

Verbal Script for participant recruitment in study

Test Administration Instructions

The following verbal instructions will be used to "guide" the data collection phase for each test administration throughout this project.

"Good morning/evening. My name is Sovoeun and I am a graduate student in the Faculty of Applied Health Sciences. I am conducting a study that focuses on university students' perceived sources of autonomy support in exercise context. Specifically, I will be examining the influences that these sources of autonomy support have on certain psychological and physical health indices. Are you actively involved in a healthy lifestyle? Do you want to change your health behaviours? Or are you simply interested in contributing to research focusing on health promotion? If so please join me and become a participating member of my thesis work. I am conducting this study as part of my master thesis under the direction of Dr. Philip M. Wilson. This study is designed to further understand relationships between personal and social influences that surround university students and how these impact their motivation to engage in healthy lifestyle practices. I am very interested in health and wellness promotion and believe this experience will help me to further understand why students chose to engage or refrain from healthy behaviour, as well as how they perceive their current health. I ask that if you choose to participate, you will complete a series of questions via a web-based interface that will take approximately 15-20 minutes of your time. Your participation is voluntary and all of the information that you provide will remain confidential. This means that none of your personal information will be shared with any other person or party in such a manner that you could be identified as a consequence of participating in this project. If you would like to participate in our study, please visit the following web page for more information [hyperlink]. If you have any questions please ask and I would be happy to speak with you. Thank you for considering our project. This project is being overseen by my faculty supervisor (Dr. Philip M. Wilson, Department of Physical Education & Kinesiology). The study has been reviewed and received clearance through Brock University's Research ethics Board ()"

Brock University, Faculty of Applied Health Sciences
Second e-mail contact

If you have not responded to the invitational e-mail asking for your participation in my study, here is the link that will direct you to the brief survey on university students' experiences with exercise which myself (Sovoeun Muon) had notified you about via e-mail a few days ago. Currently, there is very little information on the important factors that motivate exercise in university students, and thus your participation in this study will provide insight into identifying important reasons for engaging in exercise and how these reasons influence psychological and physical health indices. Your thoughts and time spent responding to the survey will be of great help and would be greatly appreciated.

There are two ways to answer this survey:

1. Touch the "website link" attached with this e-mail and it will direct you to the on-line survey.

2. If you have difficulty accessing the website link, please touch the "Reply" command so that you can send a message to the principal investigator for help.

Should you have nay questions, you can reach me Sovoeun Muon (Principal Investigator) at [telephone] or via e-mail (sm03hr@brocku.ca).

Brock University, Faculty of Applied Health Sciences
Final e-mail contact

Previously, I (Sovoeun Muon) sent you a survey via e-mail asking for your participation in my study. I am asking university students about their experiences in exercise to gain a better understanding about the processes motivating this important health behaviour. As of today, I have not received a completed survey from you. I realize this is a busy time of the school year. However, I have personally contacted you and others now in hopes of obtaining the insights only university students like you can provide about their exercise experiences. This information you provide will be important in terms of making valuable contributions to understanding health behaviour and changing health promotion. As I mentioned previously, your answers are confidential and will be combined with other responses before providing any conclusions about this study when completed. In case the previous questionnaire has been deleted from your e-mail account, I have included it again for your convenience.

There are two ways you can respond:

1. Click on the web link that is attached to this e-mail. It will direct you to the online survey.

2. If you have difficulty accessing the website link, please touch the "Reply" command so that you can send a message to the principal investigator for help.

Should you have any questions or concerns, feel free to contact me Sovoeun Muon at [telephone], or by e-mail at sm03hr@brocku.ca. Thank you for your cooperation.

Sovoeun Muon

Ethics Approval

From: Research Ethics Board [mailto:reb@brocku.ca]
Sent: Thursday, November 15, 2007 9:18 AM
To: Philip Wilson
Cc: Ian Brindle; Michelle McGinn
Subject: REB 06-292 WILSON - Modification Accepted

FROM: Michelle McGinn, Chair
Research Ethics Board (REB)

TO: Philip Wilson, PEKN
Enrique Garcia Bengoechea

FILE: 06-292 - WILSON

DATE: November 15, 2007

END DATE: May 1, 2008

The Brock University Research Ethics Board has reviewed the research proposal:

Motivation and physical activity: The role of perceived relatedness

The Research Ethics Board finds that your ***modification request*** to an ongoing project involving human participants conforms to the Brock University guidelines set out for ethical research.

Please Note: The Positive Affect Negative Affect Schedule appears twice. If this is intentional, please define "physical activity" (in the first section) and "exercise" (in the second section) so that participants are clear that the measure is focused on two different aspects of the project topic.

MM/bb

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