The Effect of Socializing During Exercise on Psychological Need Satisfaction, Motivation to Exercise, and Wellbeing

by

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Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

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Abstract

Previous research has indicated that exercising with other people improves interest and engagement in physical activity (e.g., Christensen, Schmidt, Budtz-Jorgensen, & Avlund, 2006; Estabrooks & Carron, 1999). However, the degree of socializing with other people engaged in by exercisers has not been manipulated in previous studies. In the present study, the amount of socializing during exercise was manipulated in order to evaluate the effect of social connection on motivation to exercise. Two perspectives on the role of socializing in exercising were considered and discussed – Social Facilitation (Zajonc, 1965) and Self-Determination Theory (SDT; Deci & Ryan, 2000). In order to test the importance of social contact during exercise, previously inactive women between the ages of 18-30 were randomly assigned to exercise for 12 sessions in one of three conditions. In the "social partner condition", two participants exercised together and also discussed personal topics. In the "non-social partner condition", two participants exercised together, but did not discuss personal topics. Lastly, in the "exercise alone condition", participants exercised alone.

In general, it was hypothesized that the social partner condition would lead to the greatest improvements in satisfaction of the psychological need for relatedness, subjective vitality, motivation to exercise, amount of physical activity, fitness level, affect, interest, and effort in exercise. Non-social partners were expected to experience some benefits from exercising with a partner, but not to the same extent as those in the social partner condition. Participants who exercised alone were expected to experience the fewest improvements. The partner relationships were also examined more closely, with the expectation that pairings that were more interpersonally complementary (that is, more similar on affiliation, and reciprocal on dominance) would positively affect outcomes. Further, partners were expected to become more similar in

their exercise behaviour and motivation due to their repeated interactions over the course of the study. A one-month follow-up session assessed whether motivation and exercise behaviour observed at the end of the study changed or were sustained over time.

The hypotheses were partially supported. Overall, exercise contributed to improved vitality, fitness, and affect, with few differences amongst the conditions. Participants in both partner conditions reported greater relatedness, or social connection, after a month of exercising together, than the exercise alone condition participants. Some interesting motivational patterns emerged at the end of the study and at a one-month follow-up, with some indication that the social partner condition most greatly benefited motivation. Interpersonal complementarity positively impacted competence, relatedness, and fitness, but surprisingly had a negative impact on vitality. Partners did not become more similar to one another over the course of the study, suggesting a lack of mutual influence. The findings are discussed within the context of Self-Determination Theory and Social Facilitation.

These findings contribute to a growing body of literature that indicates that the social aspects of physical activity are essential for physical and mental wellbeing. Further research is required to evaluate how social factors can be utilized to promote greater enjoyment of and adherence to physical activity.

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Dedication

I dedicate my dissertation work to my family, for I would not be where I am today if not for your love and support throughout my life. Thank you especially to my parents, William and Sheila Boyd, for your consistent love, support, and for teaching me the value of hard work. During times of self-doubt, I drew strength from your unwavering belief in me. I would like to express my gratitude to my grandmother, Agnes Ball, for supporting and encouraging me throughout my many student years. Thank you also to my sisters, Elizabeth and Rachel; although life may take us down different paths you are always by my side. Lastly, thank you to my husband, Matthew Bells, with whom I share my passion for life and learning. I am deeply grateful to all of you, and dedicate this project to you.

Table of Contents

List of Materials

Appendix A

List of Tables

Appendix B

List of Figures

Appendix C

Introduction

Exercise provides significant physical and mental health benefits when engaged in consistently (Warburton, Nicol, & Bredin, 2006). Indeed, those who do not exercise regularly are at risk for a host of physical problems, including heart disease, obesity, Type-II diabetes, certain types of cancer, and premature death (Canadian Society for Exercise Physiology, 2011; Warburton et al., 2006). In addition to improving physical health, exercise has been linked to more effective emotion regulation (Hsaio & Thayer, 1998; Thayer, 2001), improved mood (Gauvin, Rejeski, & Norris, 1996) and, in clinical samples, to reduced depression (Stathopoulou, Bowers, Berry, Smits, & Otto, 2006) and less anxiety (Wipfli, Rethorst, & Landers, 2008). Physical activity is an important aspect of achieving and maintaining physical and mental health throughout the lifespan.

Unfortunately, physical activity rates decline throughout the adult years (Statistics Canada, 2012). Adults between the ages of 18 to 64 are advised to accumulate at least 150 minutes of moderate- to vigorous-intensity aerobic physical activity per week in bouts of 10 minutes or more, and to engage in muscle strengthening exercises at least two days per week (Canadian Society for Exercise Physiology, 2011). According to national self-report data collected in 2011, approximately 56% of Canadian men and 51% of Canadian women were considered physically active in their leisure time (Statistics Canada, 2012). In contrast, the Canadian Health Measures Survey required that participants wear accelerometers in order to measure the actual amount of movement engaged in, revealing that only about 17% of men and 14% of women achieve the recommended 150 minutes of physical activity per week accumulated in bouts of at least 10 minutes (Colley et al., 2011). This finding reveals the discrepancy between self-reported data of exercise behaviour, which depends upon accurate

recall and reporting, and the actual activity levels engaged in by the Canadian population (Colley et al., 2011).

Perhaps part of the reason for this discrepancy is that even amongst those who consider themselves to be exercisers, activity is not necessarily engaged in regularly. For example, in a sample of more than 1800 exercisers, Sallis et al. (1990) found that 20% had experienced three or more relapses (defined as not exercising for three or more months at a time) within the past five years. Awareness of the benefits of exercise and the consequences of inactivity do not seem to address the problem; many people attempt to engage in more activity, but within six months of starting an exercise program, approximately half of participants quit (Marcus, Bock, Pinto, & Clark, 1996). Given the many health benefits of exercise and potential problems related to inactivity, understanding the circumstances that might facilitate interest and persistence at exercise is a central concern. Various social factors considered to date include support and encouragement from family and peers (Carron, Hausenblaus, & Mack, 1996), cohesiveness of exercise groups and sports teams (Spink & Carron, 1994; Vazou, Ntoumanis, & Duda, 2006), and whether or not exercise is engaged in with a partner (Granner, Sharpe, Hutto, Wilcox, & Addy, 2007).

Interactions with social partners may be an important factor that enhances interest and engagement in exercise, and better understanding the importance of exercise partnerships is the main focus of the present research. The next section examines how the quality of social interactions might impact on exercise-related affect, engagement and motivation to exercise.

Interpersonal Relationships and Exercise

A number of studies suggest that socializing during exercise is rewarding, and as such people who exercise with others remain engaged and interested in exercise. In a survey of 2,025

adults, 57% of active participants reported exercising with a partner as an important factor in determining whether or not they exercise (Granner et al., 2007). As well, a substantial percentage of both male (55%) and female (40%) exercisers reported that they prefer unstructured exercise with others over other exercise formats (such as a structured fitness class, alone at a fitness facility, or in complete isolation), making exercise with others highly preferred for both genders (Burke, Carron, & Eys, 2006). Taken together, these studies indicate that exercising with a partner may enhance engagement in exercise for a large proportion of exercisers. By extension, a preference for exercising with others creates a barrier to exercise when an exercise partner is unavailable. In fact, one study demonstrated that 14% of university students were inactive because they lacked a training partner (Gyurcsik, Bray, & Brittain, 2004). Potentially, satisfaction of this desire to exercise with a partner could enhance interest, effort, and motivation to exercise.

Of particular relevance to the current project is understanding the mechanism through which exercising with a partner might impact on interest and persistence in exercise. The role of others in exercise motivation can be understood by examining two different explanatory frameworks: social facilitation, and Self-Determination Theory (SDT). A description of each of these frameworks and how they may contribute to understanding relationships in exercise follows.

Social Facilitation

The theory of social facilitation (Allport, 1924; Zajonc, 1965) may explain why exercising in groups or partnerships benefits exercisers. According to this theoretical perspective, the mere presence of others improves one's performance on a variety of tasks. In the strictest sense, mere presence refers to a situation in which the other people do not provide

any reinforcement or information regarding one's performance, and do not provide an opportunity for competition or imitation. Allport (1924, p. 262) defined social facilitation as arising from the sight or sound of other people engaged in the same activity, suggesting that social facilitation can arise amongst co-actors. In pioneering work in the area of social facilitation, Triplett (1898) observed that engaging in an activity in the presence of co-actors enhances performance. He observed that cyclists riding in a group cycled 30% faster than when riding alone. He then followed up on this observation by conducting an experimental study of 40 children winding string on a reel. The children wound the string on six trials, alternating between working in isolation and in the presence of another child completing the same task. He observed that in most cases, children wound the string faster when in the presence of another child, in spite of factors that could have influenced performance such as fatigue or practice. He attributed these observations to arousal at the sight of another person's activity, contributing to greater effort.

Since Triplett's early work, hundreds of studies have evaluated the effects of social facilitation on different types of performance situations, with some studies supporting social facilitation and others calling into question the strength of this effect (for reviews see Bond & Titus, 1983; Strauss, 2002). Bond and Titus conducted a meta-analysis of 241 studies involving approximately 24,000 participants, and concluded that for simple and well-learned tasks, speed is increased but accuracy is not. Observation during complex tasks resulted in more variable outcomes, with performance sometimes being enhanced, and at other times being impaired.

Subsequently, a number of researchers have elaborated upon Zajonc's (1965) suggestion that the presence of others increases a generalized drive or arousal across situations, and have posited explanations for why differences may occur across situations. For example, Sanders (1981) noted differences in outcomes depending upon the actor's experience with the activity; he

suggested that observers are distracting, and when the task is not particularly well-learned, the performance-impairing distraction is greater than the performance-enhancing arousal of being observed. Blascovich and Tomaka (1996) suggested that physiological differences occur when people are observed doing a well-learned activity versus an unfamiliar activity. In a study of cardiovascular reactivity and response times during tasks such as pattern recognition, Blascovich, Mendes, Hunter, and Salomon (1999) found that when participants were observed while engaging in an unfamiliar task, their cardiovascular activity was consistent with perceived threat, and accuracy was lower than when they were alone. When the task was well-learned, participants were more accurate with an audience than when they were alone. These results suggest that social facilitation is most likely to occur when people are observed doing familiar or simple tasks.

Physical activities that require investment of either strength (as in lifting weights) or speed (as in cycling) are typically considered to be simple tasks, with the expectation that performance improves in the presence of other people (Strauss, 2002). For example, in a study of walking, groups of four walkers completed a significantly greater distance than solitary walkers over a six-minute period (Grindrod, Paton, Knez, & O'Brien, 2008). Similarly, when other people are not participating, but are observing the physical activity, performance is enhanced (Worringham & Messick, 1983). For instance, in Worringham and Messick's (1983) study, 36 joggers ran a distance of 90 yards in one of three conditions. Joggers in the first condition completed the entire 90 yards alone with no observers. Joggers in the second condition ran 45 yards alone, and then for 45 yards ran past a woman sitting with her back to them, testing the effect of mere presence. In the third condition, joggers ran 45 yards alone, followed by another 45 yards past the woman while she was facing them, presenting the possibility of evaluation.

Only in this final condition did participants increase their speed significantly during the second half of the run. It seems that there must at least be the possibility that the other person present is attending to the activity; otherwise social facilitation is unlikely to occur. These studies demonstrated that social facilitation occurs during physical activity when exercisers participate in a group activity or are observed by a non-participant.

Perhaps social facilitation can arise at a fitness facility amongst unacquainted individuals exercising in one another's presence. Most physical activities completed at a fitness facility are simple, well-learned activities, even for novice exercisers (consisting of lifting weights, stationary cycling, jogging, and so on). After a brief period of familiarization with how to use the equipment, most people exercising in a gym engage in rather repetitive activities, and so may be in a situation to experience social facilitation from the arousal of being around other people.

Application of social facilitation theory to exercise suggests that exercising in the presence of other exercisers should enhance effort, regardless of the relationship status amongst exercisers. Therefore, although people report a preference for exercising with another person, it should make little difference whether they have a training partner or are simply in the presence of unknown others also engaging in physical activity. It seems from the research on social facilitation that co-actors and observers have a similar effect on increasing effort in the activity, and so an exercise partner may not provide additional benefit over simply being in the presence of other exercisers at the fitness facility. The present study will examine this possibility, along with the predictions based on Self-Determination Theory (SDT; for theoretical reviews see Deci & Ryan, 2000; Ryan & Deci, 2000a; Ryan & Deci, 2000b), which provides a framework for understanding how social relationships may enhance motivation.

Self-Determination Theory

Self-determination is defined as pursuing activities with a sense of choice, freedom, and purpose, and is associated with enhanced vitality and wellbeing (Deci & Ryan, 2000). Further, Self-Determination Theory (SDT) defines a person's motivational orientation as occurring along a continuum of self-determination, such that one's actions in a particular domain may be more or less self-determined (Deci & Ryan, 2000). See Figure 1 for illustration of this continuum. There are three broad categories of motivation described by SDT: amotivation, extrinsic motivation, and intrinsic motivation (Ryan & Connell, 1989). *Amotivation* is considered to be a state occurring when a person has no intention to act (Ryan, Williams, Patrick, & Deci, 2009), and so in the exercise domain is expected to be associated with a lack of physical activity. *Extrinsic motivations* are those in which the activity is engaged in for some external gains, such as improved appearance or social approval (Frederick & Ryan, 1995). In contrast, *intrinsic motivation* is considered to be the most self-determined motivational orientation, as the activity is pursued because of the interest, pleasure, or optimal challenge that the individual derives from the activity itself (Frederick & Ryan, 1995). Both types of motivation contribute to exercise engagement; however, extrinsic motivation is experienced as more controlling than intrinsic motivations, and intrinsic motivation is related to more consistent engagement in physical activity (Frederick-Recascino, 2002; Koestner & Losier, 2002).

Increasingly self-determined behaviours arise through the process of internalization, or the integration of socially valued activities and beliefs into one's identity. According to SDT, individuals have a desire to develop meaningful relationships with other members of their social group, and in the pursuit of this social connection, they engage in culturally relevant activities and endorse the values and beliefs of their social circle (Deci & Ryan, 2000; Ryan & La Guardia,

2000). This process of internalizing cultural values may occur more or less completely, and the more successful the internalization process, the more self-determined the individual feels in engaging in the activity. According to SDT, this process yields an ordered set of four types of extrinsic regulations as follows, ranging from the most controlled to the most self-determined: External, introjected, identified, and integrated regulations.

Activities driven by direct external contingencies to obtain rewards or to avoid punishment are experienced as controlling, and are thereby the least self-determined type of extrinsic regulation, known as *external regulation* (Deci & Ryan, 2000). For instance, a person may begin exercising in order to attain approval or avoid censure from others, such as doctors or family members. The activity is likely to cease if the external contingencies are removed, and therefore, such a regulation will not be likely to promote exercise engagement in the long-term.

Introjected regulations are also experienced as controlling; however, the control or feeling of pressure arises from within (Deci & Ryan, 2000). An individual acting from this motivational base considers the activity valuable, but has not fully assimilated the activity with other life goals, values, and beliefs. Rather, the person feels pressured to engage in the activity to maintain contingent self-worth, or to avoid feeling guilt or shame (Deci & Ryan, 1995; Mullan, Markland, & Ingledew, 1997). For instance, an individual may exercise in order to avoid negative emotions such as embarrassment or shame related to their appearance. Introjected regulations are associated with unstable engagement in the activity, because the individual feels conflicted about the activity (Koestner & Losier, 2002).

Identified regulation is a more fully internalized form of regulation, in which the activity is considered personally relevant and worthwhile (Ryan & La Guardia, 2000). Importantly, the individual considers the long-term benefits of the activity (Koestner & Losier, 2002). For

instance, a person with an identified regulation toward exercise may value the health benefits of exercise and so engage in exercise willingly. Identified regulations toward exercise are linked with frequent engagement in exercise, positive attitudes toward exercise, and enhanced physical fitness (Wilson, Rogers, Blanchard, & Gessell, 2003).

Finally, *integrated regulations* are fully internalized and integrated with other important aspects of the self (Wilson, Rogers, Loitz, & Scime, 2006). The values and activities involved in exercise have been evaluated with respect to other values, and are fully assimilated and congruent with the individuals' self-view (Ryan & La Guardia, 2000). As such, an individual acting from integrated regulations toward exercise considers exercise to be consistent with other life goals and fully endorses this activity. Such an individual would be expected to engage in exercise regularly and persistently. Integrated regulation is differentiated from identified regulation in that the activity is not simply valued and considered important; it is completely synthesized with self-identity (Ryan & Deci, 2000b).

Many studies have supported the utility of SDT in the exercise domain (for a review, see Wilson, Mack, & Grattan, 2008). For instance, more self-determined regulations have positively predicted higher levels of moderate-intensity self-reported exercise behaviour (e.g., McDonough & Crocker, 2007; Wilson, Rodgers, Blanchard, & Gessell, 2003), and increased persistence at exercise (Vansteenkiste, Simons, Soenens, & Lens, 2004). Importantly, SDT encompasses a number of sub-theories, which further assist in explaining human motivation and behaviour. Of particular relevance to the present research is the Basic Psychological Needs Theory (BPNT; Deci & Ryan, 2000).

Basic Psychological Needs Theory

BPNT describes the importance of the social environment in the maintenance of intrinsic regulations, and internalization of extrinsic motivations (Ryan & Deci, 2000a; Ryan & Deci, 2000b). According to Ryan and Deci (2000a), intrinsic regulation is the most self-determined type of motivation, and an activity is most likely to be sustained when it is motivated by intrinsic regulation. However, extrinsic regulations also contribute to engagement in activity, especially if the activity is not always enjoyable. In particular, the individual also experiences the most completely internalized extrinsic regulations (identified and integrated) as non-controlling. Regulations at the self-determined end of the continuum contribute to a number of positive outcomes, including psychological wellbeing, creativity, and engagement in the activity (Deci & Ryan, 2000).

Internalization of extrinsic motivations to exercise is necessary, because some aspects of exercise may be difficult, challenging, or tedious, and so it is not always engaged in simply for enjoyment. Even people who are highly intrinsically motivated may experience some aspects of exercise as more onerous than enjoyable. Identified and integrated regulations may support long-term adherence to exercise through periods that are less intrinsically rewarding.

According to BPNT, internalization of motivations is dependent upon satisfaction of the psychological needs for autonomy, competence, and relatedness (Deci & Ryan, 2000). The need for *autonomy* is satisfied when one feels that they have choice over their activities and experiences, such as being able to select the exercises engaged in. The need for *competence* is satisfied by feeling a sense of mastery and skill in the domain. The need for *relatedness* is satisfied by feeling meaningfully connected to another individual or a group, and supported in the activity. According to Ryan and Deci (2000a), all people are driven to satisfy these basic

psychological needs, and when these needs are met, intrinsic, integrated, and identified regulations are enhanced, whereas when these needs are not satisfied, the individual experiences controlled regulations and deficits in wellbeing.

A number of studies within the sport and exercise domain, as well as in other fields (e.g., education and work), have demonstrated relations between satisfaction of the three psychological needs and self-determined motivations (Barbeau, Sweet, & Fortier, 2009; Kowal & Fortier, 2000; Ntoumanis, 2001; see Vallerand, 1997, for a theoretical review). Studies have demonstrated the importance of psychological need satisfaction in exercise in a variety of samples, including youth (Standage, Duda, & Ntoumanis, 2005), adults (Edmunds, Ntoumanis, & Duda, 2006), and athletes in various sports, such as basketball (e.g., Blanchard, Mask, Vallerand, De La Sablonniere, & Provencher, 2007). For instance, Standage, et al. (2005) utilized a questionnaire method to assess need support, need satisfaction, motivation, and affect regarding physical education in 950 British secondary school students. Need satisfaction positively predicted intrinsic motivation and negatively predicted amotivation and external regulation. These authors also found that, although not predicted by theory, satisfaction of psychological needs was related to introjected regulation, which is experienced as a more controlling, pressured type of motivation. As noted previously, introjected regulations are associated with unstable engagement in physical activity (Koestner & Losier, 2002), and it seems that introjection also relates in unpredictable ways with the psychological needs. In a study of adults who engaged in regular exercise, satisfaction of all three psychological needs was related to greater self-determined motivation toward exercise (Edmunds, Ntoumanis, & Duda, 2006). Similar findings were also obtained amongst those who engaged in team and individual sports, with satisfaction of competence, autonomy, and relatedness being related to self-determined

motivation for the sport in basketball players (Blanchard, Amiot, Perreault, & Vallerand, 2009; Blanchard et al., 2007) and master's level swimmers (Kowal & Fortier, 2000).

Further, perceived satisfaction of psychological needs in the exercise domain is related to overall improvements in energy and positive affect (Wilson, Mack, Blanchard, & Gray, 2009). For example, in Study 1 of a two-part research program, women reported on perceived need satisfaction and subjective vitality at the beginning and end of a 12-week exercise program (Wilson, Longley, Muon, Rodgers, & Murray, 2006). Greater need satisfaction at the end of the study was associated with improved subjective vitality, or a general sense of wellbeing and energy in one's daily life. In Study 2, male and female university students exercising at a fitness facility completed a questionnaire at a single time point. In this study, satisfaction of all three of the psychological needs was related to feeling more positive affect and less negative affect during a typical exercise session. Similarly, a study of the role of coaching practices on perceived need satisfaction in male and female adult athletes from a range of sports also indicated that need satisfaction is important for wellbeing (Adie, Duda, & Ntoumanis, 2008). Specifically, athletes who felt greater satisfaction of autonomy, competence, and relatedness also reported a greater sense of vitality. In another study of the beneficial effects of need satisfaction, the satisfaction of competence predicted the completion of more strenuous exercise, both directly and indirectly via its effect on identified regulation (Edmunds, Ntoumanis, & Duda, 2006).

Thus, satisfaction of basic psychological needs seems to have a positive impact both on continued motivation to engage in physical activity, as well as on enhanced overall wellbeing. Given the focus of this paper on the social aspects of exercise, a closer look at research examining the role of satisfaction of relatedness in promoting exercise motivation follows.

The Role of Relatedness in Exercise Motivation

The need for relatedness is typically studied within the context of research examining the individual and combined impact of the three needs on motivation to exercise. A study of male and female adults participating in a 12-week supervised stationary cycling program assessed changes in need satisfaction and behavioural regulations in exercise (Wilson, Rodgers, Blanchard, & Gessell, 2003). In this study, both perceived competence and relatedness increased over time. However, the more self-determined regulations (identified and intrinsic regulation) were correlated with competence and autonomy, but not relatedness. Further, these self-determined regulations predicted greater physical fitness and engagement in activity. This study presented the possibility that relatedness may have less relevance in the exercise domain than either autonomy or competence.

A subsequent study assessed change in need satisfaction and motivation from the beginning to the end of a 12-week aerobic exercise class (Wilson & Rogers, 2008). In this study, the authors utilized the Psychological Need Satisfaction in Exercise (PNSE) questionnaire (Wilson, Rogers, Rodgers, & Wild, 2006), a measure which assesses satisfaction of all three needs in the exercise domain. At both time points, competence and autonomy were more satisfied than need for relatedness. Further, modelling of the effect of the three needs on motivational outcomes indicated that satisfaction of competence predicted both identified and intrinsic regulations (self-determined motivations), satisfaction of autonomy only predicted identified regulation, and satisfaction of relatedness predicted both intrinsic regulation and external regulation (a controlled motivation). The authors suggest that relatedness may enhance more controlled motivations in situations where the individual is driven to engage in the activity to enhance social connections. According to Deci and Ryan (2000), introjection, a more

controlled form of regulation, may be the result of support for relatedness in the absence of support for autonomy. That is, feeling pressured to engage in an activity to achieve acceptance or friendship may promote development of more controlled than self-determined motivations. However, importantly, relatedness is also linked with intrinsic regulation, suggesting that satisfaction of relatedness may contribute to self-determined regulations when relationships are supportive and fun, rather than perceived as sources of external pressure.

Similarly, a study of female exercisers examined the effects of the various combinations of needs, and found that when relatedness alone was satisfied, participants experienced introjected regulations toward exercise (Markland & Tobin, 2010). However, overall level of need satisfaction (autonomy, competence, and relatedness) promoted identified regulation, which was the most self-determined extrinsic regulation assessed. Both autonomy and competence needs, but not relatedness, contributed to intrinsic regulations (Markland & Tobin, 2010). A more recent study looking at the behavioural consequences of satisfaction of the psychological needs found that only the need for competence significantly predicted exercise participation for female exercisers (Martinez, Oberle, & Nagurney, 2013). Therefore, it seems that satisfaction of the need for competence has been most closely linked with both self-determined motivations to exercise, as well as more frequent exercise behaviour, and that relatedness may play an equivocal role in promoting motivation to exercise.

Interestingly, Wilson et al. (2006) suggested that some studies do not demonstrate a link between relatedness and motivation because many studies examine individuals already engaged in an established exercise program. According to these authors, regular exercisers may have internalized regulations to exercise, and therefore social connection to facilitate development of self-determined regulations may be less essential than for new exercisers. It seems, therefore,

that assessing the importance of relatedness for those at the early stages of an exercise program may provide further insight into this issue. Another possibility is that it may be difficult to satisfy the need for relatedness in the exercise domain if exercise is completed alone, but that when it is satisfied, it enhances motivation. Although there have not been any studies experimentally manipulating social conditions and measuring relatedness outcomes, there is a broad literature examining the benefits of exercising with other people.

A number of studies have found that a connection with others in the exercise context is important to factors such as interest, persistence, and adherence. Belonging to a supportive and cohesive team is related to athletes' motivations to continue in their chosen sports (Vazou et al., 2006). Young soccer players (10-14 years) who had a close friend on their team and felt accepted by the rest of their team were more likely to play on the team one year later (Ullrich-French & Smith, 2009). Similarly, feeling a sense of cohesion in exercise groups (having a common purpose to achieve instrumental goals and to meet emotional needs of partners) has been related to stronger intentions to continue exercising (Christensen, Schmidt, Budtz-Jorgensen, & Avlund, 2006). Further, feeling that one belongs to a cohesive group is related to more positive affect during the exercise session (Courneya, 1995; McDonough & Crocker, 2007; Wilson & Rogers, 2008) and continued attendance at an exercise program (Estabrooks & Carron, 1999; Spink & Carron, 1994). Thus, it seems that the conversation, encouragement, and support received from others during exercise is important to maintaining interest in the activity.

The role of relatedness may be particularly important for activities that are not experienced as inherently interesting or fun. Relatedness may play a specific role in providing a secure relational base from which one can explore and engage in tasks (Deci & Ryan, 2000), thereby providing the opportunity for intrinsic motivation to develop. Further, involvement in a

social atmosphere which values physical activity and fitness may contribute to internalization of similar values.

In addition to facilitating internalization of motivations to exercise, socializing during exercise may impact on exercise-related changes in affect. Further, the benefits of socializing during exercise may be impacted by whether partners have complementary interpersonal styles; that is, they are similar in terms of warmth, and opposing in degree of dominance. A discussion of these issues follows.

Socializing During Exercise and Psychological Outcomes

As mentioned earlier, a great deal of research demonstrates that exercise produces positive psychological outcomes, including improvements in affect (e.g., Wilson, Mack, Blanchard, & Gray, 2009), an increased sense of vitality (e.g., Adie, Duda, & Ntoumanis, 2008) and, in clinical populations, reductions in symptoms of depression and anxiety (Stathopoulou et al., 2006). Studies of both regularly active adults and sedentary adults have demonstrated that affect is improved following exercise (Carels, Coit, Young, & Berger, 2007; Hsiao & Thayer, 1998). Further, participants' experience of improved affect following exercise has been linked to greater participation in physical activity six and 12 months later (Williams et al., 2008), presumably in part due to the mood enhancement effects they achieve from exercise.

To date, few studies have examined different factors that can enhance affect during exercise, and thereby contribute to continued physical activity engagement. According to Gauvin, Rejeski, and Norris (1996), socializing during exercise may be responsible for a large proportion of the changes in affect. That is, people may experience more positive affect (e.g., feeling more engaged and revitalized) when exercising with other people in group fitness or sports but not when exercising alone (also see Gauvin & Rejeski, 1993). It is possible that

participating in exercise with another person may lead to improved affect after the session, contributing to continued adherence to the exercise program.

Some authors have suggested that sedentary adults do not experience mood elevation from physical activity (Ekkekakis & Lind, 2006; Gauvin, Rejeski, Norris, & Lutes, 1997). In one study, intensity level was investigated as a variable that could affect mood shifts in sedentary women. The women in this study did not experience mood elevations, regardless of the intensity of the activity; however, the higher-intensity activity elicited negative mood in the sedentary women who were also overweight (Ekkekakis & Lind, 2006). These findings indicate that overweight women may be especially vulnerable to increased negative mood if the exercise intensity becomes uncomfortable. Gauvin and others (1997) likewise observed that sedentary men and women did not experience mood enhancement following a single bout of aerobic exercise. Hsiao and Thayer (1998) suggested, however, that beginners have a tendency to exercise too intensely for their fitness level, resulting in pain and discomfort that dampen positive mood changes. As individuals gain more exercise experience and their fitness levels improve, the mood elevation following exercise should become more apparent, and provide immediate reinforcement following exercise. Thus, sedentary people may be capable of experiencing mood enhancement from exercise if they exercise at an appropriate intensity for their fitness level, and with improved fitness the mood effects may be even stronger.

In support of Hsiao and Thayer's (1998) suggestion, other authors have found positive mood shifts in sedentary adults following exercise. One experimental study compared energy level and mood changes of regular exercisers (ultramarathon runners and moderate exercisers) and non-exercisers following a 20-minute run (Hoffman & Hoffman, 2008). After the run, regular exercisers reported increased vigour and decreased fatigue, whereas non-exercisers

experienced no changes in energy levels. General mood was improved for all participants, although regular exercisers reported a mood effect twice as strong as that of non-exercisers. The weaker mood effect for non-exercisers may occur because other factors such as discomfort during the activity diminished the potential for experiencing positive affect (Hsiao & Thayer, 1998). It is also possible that the regular exercisers reported more positive moods because they are more aware of changes in their mood due to previous experience with mood enhancement following exercise (Hsiao & Thayer, 1998).

A study of obese adults beginning a behavioural weight loss program involving exercise also provides indication that inactive individuals, including those who are overweight, are capable of exercise-induced mood enhancement (Carels, Coit, Young, & Berger, 2007). In this daily diary study, the participants reported elevated mood following exercise sessions, especially following their longer and more intense sessions. Importantly, the participants of this study were permitted to select the duration and intensity of the exercise, which may have allowed them to optimize these factors in order to experience the greatest mood benefit, while minimizing their risk of physical discomfort.

Increasing the experience and awareness of exercise-related affect improvement may have the most impact on new exercisers. People who are beginning an exercise program may not have fully internalized motivations for exercising, and so may need additional incentives to continue exercising. New exercisers may not be as aware of the benefits of exercise on changes in affect, or may not experience such changes in early exercise sessions due to fatigue and muscle soreness associated with the beginning of an exercise program. New exercisers have been shown to differ from regular exercisers in their self-reported reasons to exercise, reporting more controlled motivations such as weight control and improved appearance, whereas

experienced exercisers identify socializing and improved affect as reasons to exercise (Hsiao & Thayer, 1998). It seems that experienced exercisers are more aware of benefits that can be experienced within an exercise session, rather than over the long-term, which may be important in maintaining interest and enjoyment in the exercise session.

In summary, it seems that socializing during exercise may have a two-fold benefit to the exercisers. First, it may satisfy their need for relatedness, and as a consequence lead to greater internalization of motivations to exercise. Second, the social interaction may contribute to better mood and enjoyment in the exercise session, and this greater enjoyment of the exercise may lead to long-term engagement in exercise (Gauvin, Rejeski, & Norris, 1996; Hsiao & Thayer, 1998). An intervention that allows beginners to experience enjoyable social interactions and improved affect could potentially produce greater exercise adherence.

Socializing during exercise generally seems to be rewarding for exercisers, but the degree of interpersonal complementarity with one's partner might enhance or detract from the benefits of exercising together. The interpersonal style of the exerciser and her companion is considered next.

Interpersonal Complementarity

At present, it is unclear how interpersonal complementarity contributes to a well-functioning exercise partnership. Interpersonal theory proposes that the participants in any given social interaction bring their own trait characteristics to the interaction, but also adapt their behaviour in accordance with their partner (Carson, 1969; Kiesler, 1983). Interpersonal behaviours are characterized as occurring on two orthogonal dimensions: dominance (characterized by dominance and submissiveness at opposing poles), and affiliation (characterized by friendliness and hostility at opposing poles) (Carson, 1969; Wiggins, 1979).

An individual's interpersonal style can be characterized in terms of their typical, preferred level of each of these two dimensions, and the full spectrum of interpersonal style can be represented as a circular structure called the interpersonal circumplex.

Importantly, interpersonal theory makes predictions about the success of interactions between individuals based on the complementarity of their behaviours (Carson, 1969). On the dominance dimension, complementarity is evident when an individual reacts to a dominant interactional partner with a reciprocal submissive response. On the warmth dimension, complementarity arises when the participants respond to one another with similar levels of friendliness. The more complementary a relationship, the more satisfying and stable it is expected to be. For instance, in the early stages of therapy, complementarity between the patient and therapist were related to both patient and therapist's positive perceptions of the therapeutic alliance (Kiesler & Watkins, 1989).

According to interpersonal theory, when people spend more time together, greater complementarity is likely to develop as they accommodate to one another's interpersonal styles. Some studies strongly support this hypothesis (e.g., Sadler & Woody, 2003); however, some other findings suggest limits on such accommodation (e.g., Bluhm, Widiger, & Miele, 1990). In Orford's (1986) review of 14 studies of complementarity, he found that, as expected based on theory, friendly-dominant and friendly-submissive responses were often found to elicit one another. However, contrary to theory, dominant behaviours typically elicited dominant reactions, and hostility often elicited friendliness. Orford (1986) suggested that other factors may contribute to behavioural responses, including status, relationship duration, and gender.

Some authors have attempted to assess complementarity in existing relationships. For instance, Ansell, Kurtz, and Markey, (2008) utilized the college roommate setting to examine the

development of complementarity in a naturalistic setting, consistent with the recommendations outlined by Kiesler (1996). According to Kiesler (1996), complementarity is most likely to develop when the two participants are peers, of the same gender, in an unstructured setting, and the behaviour of one participant can influence what the other person does (p. 104). The participants were male and female college roommate dyads who lived together for one semester, and rated their roommate's interpersonal traits of warmth and dominance (Ansell, Kurtz, & Markey, 2008). Interestingly, the interpersonal styles of female roommates were strongly complementary, whereas those of men were not. However, for both men and women, when the dyad was closer to perfect complementarity on dominance, the relationship was closer. Complementarity on the warmth dimension also contributed to relationship closeness. It seems that relationships which approach complementarity are more satisfactory, at least for women.

Interpersonal complementarity has received little attention in the exercise domain; however, research from other domains suggests that a complementary pairing could enhance satisfaction in the relationship, and potentially, willingness to engage in exercise with that partner. The present work examines how exercising with a partner may contribute to changes in affect and motivation for novice exercisers by manipulating the presence or absence of an exercise partner during exercise sessions. I suggest that exercising with others to whom one has an emotionally meaningful connection could enhance aspects of exercise that are important to continued participation, such as interest, affect, and motivation. However, there may be some circumstances in which exercising with another person may negatively impact on immediate outcomes such as affect, interest, and effort in the exercise session. Such circumstances may occur when partners have non-complementary interpersonal styles.

The Present Study

In summary, many research studies have found a benefit of socializing during exercise on variables such as motivation, affect, and vitality (e.g., Christensen, Schmidt, Budtz-Jorgensen, & Avlund, 2006; Gauvin, Rejeski, & Norris, 1996; Ullrich-French & Smith, 2009; Vazou, Ntoumanis, & Duda, 2006). However, in order to obtain more conclusive evidence regarding the benefit of exercising with others, studies in which the quality of social connection is manipulated are necessary. The present study fills this gap in the research by assigning participants to one of three social conditions at the beginning of an exercise program. In the two partner conditions, participants were assigned to a previously unknown partner, and instructed to interact with that partner in a specified manner. Specifically, in the *non-social partner* condition, participants were instructed to focus on building fitness by exercising together, and to discuss exercise but no other topics with their partner. Participants assigned to the *social partner* condition were encouraged to form a relationship with their partner by discussing topics of their own choosing while exercising together. The partner conditions contrast quality of potential relationships, and whether a meaningful connection such as that most likely achieved in the social partner condition is valuable to exercise outcomes, or if a relationship specific to exercise is sufficient. The exercise alone condition provides a contrast to assess differences between exercising with a partner versus exercising alone. Further, the present study included a longitudinal component, wherein participants exercised in their assigned condition for 12 exercise sessions over a four-week period, allowing for assessment of changes in exercise motivation and behaviour, as related to satisfaction of the basic psychological needs.

Participants completed pre- and post-study questionnaire packages, and exercised at an on-campus fitness facility at the University of Waterloo three times per week for four weeks (12

exercise sessions total). Pre- and post-study variables of motivation, exercise behaviour, vitality, psychological need satisfaction, and fitness level were assessed. At each exercise session, changes in affective states (positive affect, negative affect, fatigue, and tranquillity), effort, and interest in exercise were measured. One month following the end of the study, participants completed an online follow-up questionnaire package assessing exercise motivation and behaviour.

The hypotheses are described in the context of five over-arching goals of the study. These goals were to: (1) gain a better understanding the role of relatedness in the exercise domain, (2) determine whether different conditions in which people exercise with others lead to differing outcomes, (3) replicate previous work on the general benefits of engagement in exercise by novice exercisers, (4) explore how partners influence each other's exercise outcomes, and (5) interpret the results from the perspective of theories about social influence in exercise. There are two main questions within each goal, which are described below.

Goal 1: To Better Understand the Role of Relatedness in the Exercise Domain

First, what is the effect of different amounts of socializing during exercise on satisfaction of the need for relatedness, and also, does socializing have any effects on the other basic needs (for competence and autonomy)? According to Basic Psychological Needs Theory (Deci & Ryan, 2000; Ryan & Deci, 2000a), participants should be more engaged in and self-determined in their motivations to exercise when their psychological needs are satisfied within the exercise domain. Previous studies have found that relatedness is less satisfied in the exercise domain (e.g., Wilson & Rogers, 2006), which could indicate that this need is less relevant, or perhaps a more purposeful intervention is required to satisfy this need. Relatedness may be more difficult to satisfy, but no less important than the needs for autonomy and

competence. In order to address these issues, I assessed whether the different study conditions affected relatedness. I predicted that participants who exercised and socially interacted with a partner at each exercise session would report the greatest satisfaction of relatedness, followed by participants who exercised in the presence of a partner with whom they did not converse socially. Participants who were assigned to exercise alone were not expected to report an increase in relatedness.

Satisfaction of the psychological needs of competence and autonomy were of less interest in the present study, but were assessed with the goal of better understanding relatedness. Generally, it was expected that participants would feel that competence and autonomy were more greatly satisfied after exercising regularly for a month. Potentially, partners exercising together would provide each other with more feedback and guidance in the exercise sessions, and this would contribute to greater satisfaction of their need for competence. Satisfaction of the need for autonomy was expected to be highest for participants exercising alone, because they had the greatest control over when they exercised and which exercises they completed.

Second, how does the degree to which satisfaction of the need for relatedness, compared to satisfaction of the other basic needs for competence and autonomy, relate to motivation for exercise (e.g., self-determined versus extrinsic types of motivation)? This second question was aimed at further evaluating the role of satisfaction of relatedness on motivation to exercise. Past studies (e.g., Wilson & Rogers, 2008) have found that satisfaction of competence is a stronger predictor of self-determined motivations than are satisfaction of either relatedness or autonomy. I expected that satisfaction of relatedness would be related to more self-determined types of motivation, and weaker extrinsic types of motivation. However, based on previous research findings, I also expected that satisfaction of the need for competence would

have a positive impact on self-determined motivation and a negative impact on extrinsic motivation.

Goal 2: To Evaluate Whether the Degree of Socializing Engaged in During Exercise Contributes to Different Motivational Outcomes

First, does the extent of socializing during exercise have an effect on motivational outcomes at post-study? Motivation was evaluated before participants began the study, after they completed the 12 exercise sessions, and one month following the end of the study. I expected that exercising with a close partner would more readily satisfy the basic psychological needs, and thereby enhance the internalization of more self-determined motivations to exercise. As such, I predicted that participants in the social partner condition would develop the most self-determined motivations to exercise, followed by participants in the non-social partner condition. Participants in the exercise alone condition were expected to experience the least improvement in motivation.

Second, does the extent of socializing during exercise have an effect on motivational outcomes at follow-up? The one-month follow-up was intended to determine whether the motivational differences between the conditions were still present at follow-up, persisting beyond the relational context in which they developed. I expected that participants exercising in the social partner condition would experience enhanced motivation at post-study, and that this advantage would be retained one month after the study ended.

Goal 3: To Replicate Previous Work on the General Benefits of Engagement in Exercise by Novice Exercisers

First, are there improvements over the month in overall physical and psychological wellbeing, and if so, are these improvements affected by the degree of socializing engaged in during exercise? Previous research has shown that regular exercise is related to physical and psychological wellbeing (e.g., Warburton, Nicol, & Bredin, 2006). As such, I expected to find that, after one month of regular exercise, participants in all conditions would demonstrate improvements in exercise intensity/duration, performance on the fitness test, and subjective vitality. Further, participants who exercised with a social partner were expected to enjoy the exercise sessions more and so engage in exercise for longer and more intense sessions, thereby experiencing greater benefits than those in the non-social partner condition, followed by those who exercised alone.

Second, are there pre-to-post session improvements in affect, and do these pre-to-post session differences become larger over the month? Similarly, do levels of interest and effort for exercise sessions increase over the month, with greater increases in the social partner condition? Before and after each session, participants reported on their affect, and, after each session, their interest and effort put forth in that session. I expected that as participants acquired more exercise experience and greater awareness of the benefits of exercise, they would report increasingly improved affect, interest, and effort after each exercise session. Further, I expected that when differences did occur amongst the three conditions, participants in the social partner condition would show the greatest advantage.

Goal 4: To Explore How Partners Influence Each Other's Exercise Outcomes

First, do partners who exercise together become more similar in their motivations and wellbeing outcomes, consistent with the phenomenon of mutual influence? Participants in two of the three conditions interacted with a partner at all exercise sessions. Of interest was the potential influence, whether positive or negative, that partners have on each other. I expected that those in the social partner condition would be more likely than those in the non-social partner condition to influence one another, by virtue of a potentially closer relationship. For instance, I expected that social partners would have more similar motivations at the post-study session than at pre-study, through personal discussions and observation of one another's exercise behaviours. Participants in the exercise alone condition never meet others in this condition, and so their outcomes should be no more similar at the end of the study than at the beginning.

Second, do outcomes for exercising pairs depend on the degree to which their interpersonal styles are complementary? In addition to becoming more similar through interaction with one another, partners may begin the study with more or less complementary interpersonal styles. Complementary interpersonal styles contribute to greater relationship satisfaction, and so complementarity was expected to contribute to an overall advantage in psychological need satisfaction, motivation, vitality, and fitness. Likewise, less complementary pairings were expected to interfere with partner connection and lead to poorer outcomes, particularly for participants in the social partner condition, as their more social interactions would more readily reveal incompatibilities. Therefore, the nature of the relationship with the exercise partner may be important for understanding the changes in motivational framework that occur.

Goal 5: To Interpret the Results from the Perspective of Theories about Social Influence in Exercise

First, how can the results be understood using the framework of social facilitation? According to social facilitation theory, the mere presence of other people can enhance performance. Similar outcomes across all three conditions would support social facilitation theory by indicating that exercising in a gym with other people around is sufficient to enhance exercise behaviour and motivation, and an exercise partner does not provide additional benefit.

Second, how can the results be understood within the framework of Self-Determination Theory (SDT)? In general, SDT predicts that satisfaction of the basic psychological needs contributes to self-determined motivation. I will evaluate whether the different social conditions differentially affect need satisfaction and motivational outcomes. If the results support SDT, there should be differences amongst the three conditions, indicating advantages of socializing on motivation.

Method

Participants

Women between the ages of 18-30 who self-identified as non-exercisers or irregular exercisers (exercising less than twice per week over the previous month) were recruited from the University of Waterloo campus through posters, in-class announcements, emails, and a psychology research database. Recruitment information given to potential participants indicated that current regular exercise was an exclusionary criterion, and that participants in the study would be required to start to exercise regularly (a sample flyer/poster is provided in Appendix A). The study was run over four semesters, between September 2009 and December 2010. One hundred and seventy-nine women participated in the pre-study session of the study. Of these, 11 declined to participate in the exercise component of the study, or did not attend the first exercise session. The following descriptive statistics and analyses are based on the sample of 168 participants who attempted the exercise component of the study.

Participants ranged in age from 18-30 years, with their mean age being 20.87 (*SD* = 3.02) and the modal age being 18 years. Regarding ethnicity, participants reported being Caucasian (35.9%), Other Asian (e.g., Chinese) (25.3%), South Asian (17.1%), African (6.5%), First Nation (2.4%), Hispanic (1.8%), other (8.8%), and 2.4% declined to respond. Regarding relationship status, participants were single (58.2%), dating (31.8%), married/common-law (7.6%) and 2.4% declined to respond.

All participants were members of the University of Waterloo community, and all had achieved a minimum educational level of secondary school (grade 12). One hundred and forty-six participants identified themselves as undergraduate students, 12 were graduate students, and the 12 remaining participants were university staff, alumni, or married to current students. The

average student participant was in second year of undergraduate studies (M = 2.27, SD = 1.16; mode = 2). Students from a range of programs of study were represented, including the Faculty of Arts (36.7%), Science (19.0%), Mathematics (15.8%), Applied Health Studies (11.4%), Environment (9.5%), and Engineering (7.0%), with one student participant (0.6%) declining to provide program information.

Participants' Body Mass Indices (BMIs) were calculated using weight and height measurements obtained at Session 1 (BMI = weight in kilograms/(height in metres)^2). Mean BMI at the pre-study session was 22.38 (SD = 3.64), which is considered to be in the normal weight range (18.5-24.9) (Health Canada, 2003). BMI at the post-study session (Session 14) was 22.94 (SD = 4.31), which is also within the normal range.

Participants were eligible to participate in the study if they exercised less than twice per week, and indeed, participants were fairly inactive at the onset of the study. The Leisure-Time Exercise Questionnaire (LTEQ; Godin & Shephard, 1985) was used to obtain descriptive data regarding engagement in physical activity, and is described in more detail in the measures section. Participants reported engaging in at least 30 minutes of continuous activity of all intensity levels on an average of 0.97 days/week (SD = 0.83) over the past month. The majority participated in exercise once or less per week (N = 103; 61.7%), with the modal frequency of exercise being zero times per week over the last month. In assessing intensity level of exercise, participants were asked, "During a typical 7-day period (a week), in your leisure time, how often do you engage in any regular activity long enough to work up a sweat (heart beats rapidly)?" to which the majority of participants responded "never/rarely" (N = 109; 64.1%), or "sometimes" (N = 67; 33.5%). In sum, participants were fairly inactive, either not participating in physical activity prior to the start of the study, or participating on an irregular basis.

Procedure

The study consisted of 14 sessions at an on-campus fitness facility at the University of Waterloo. The first session consisted of a questionnaire package, test of fitness, and orientation to the fitness facility. After this session they were randomly assigned to one of three conditions in which the social interaction was manipulated, and they then exercised in the assigned condition for 12 sessions (three times per week for four weeks). The 14th session was comprised of a post-study questionnaire package and a test of fitness. One month after the study ended, participants completed an online questionnaire. A general overview of the procedure at each session is described below, followed by a more detailed description of the measures utilized at each time point.

Pre-screening. Participants expressed interest in the study primarily through email, and occasionally by telephone or in person at a recruitment table in the student centre. In response, the experimenter provided them with an explanation of the study commitment, and two pre-screening measures to determine eligibility for the study. The first was the Physical Activities Readiness Questionnaire (PAR-Q; Canadian Society for Exercise Physiology, 2002), which assessed whether the participant had any physical problems (e.g., chest pain, joint problems) that would limit activity, and should consult with a doctor before beginning an exercise program. This scale was administered to participants electronically prior to enrolment in the study. If interested individuals endorsed potential health problems, the experimenter requested information about the individual's ability to begin exercising safely. Those who had underlying health conditions and who had not received the guidance of a physician regarding starting physical activity were advised to seek medical advice and were not enrolled in the study. The second pre-screening measure administered assessed intensity and quantity of physical activity

the participant engaged in before beginning the study. Participants who exercised regularly over the past month (defined as at least 30 minutes for twice per week or more) were not eligible to participate. Given the student population, it was necessary to permit brief periods of mild exercise (mainly walking or cycling) for the purpose of transportation.

Pre-study session (orientation). The pre-study session was run in small groups between 8 am and noon Monday to Friday by the author and one research assistant. Typically, between four and six participants were scheduled for each pre-study timeslot. Participants were advised of the study procedures and risks, and signed the consent form if they agreed to participate. The Orientation Session protocol, which was followed at all pre-study sessions, is provided in Appendix A. Participants then completed a questionnaire package assessing baseline status, which included measures (described below) of motivation to exercise (Markland & Tobin, 2004), need satisfaction in exercise (Wilson, Rogers, Rodgers, & Wild, 2006), interpersonal style (Moskowitz, 1994), and subjective vitality (Ryan & Frederick, 1997). The Leisure-Time Exercise Questionnaire (LTEQ; Godin & Shephard, 1985) was also administered at this session to determine exercise behaviour at commencement of the study. In addition, basic level of fitness was assessed using a standardized Six-Minute Walk Test (American Thoracic Society, 2002). Height in centimetres and weight in kilograms were also measured. A description of all measures is presented below.

After completion of the measures and the Six-Minute Walk Test, participants were provided with a tour of the fitness facility, which typically took between 20-30 minutes depending on the size of the group. The author took a personal trainer specialist course through Can-Fit-Pro in 2009 and so was permitted by the University of Waterloo Campus Recreation to provide instruction to participants on use of exercise equipment at the fitness facility. The tour

included instruction on facility policies, safety, and use of the exercise equipment. Demonstrations on use of the cardiovascular machines (e.g., treadmill, elliptical), strength training machines (e.g., bench press), and free weights were provided, and participants were encouraged to try the machines during the tour. The protocol was followed to ensure consistency of information provided; however, tours were modified in response to participants' questions, knowledge, and ability level. For example, some strength training machines were too challenging for some participants' current fitness level, and so alternative exercises were suggested or demonstrated. Participants were scheduled to attend the first exercise session within several days of attending the pre-study session.

First exercise session (instructions and introduction). At the first exercise session, participants were provided with instructions on how to complete the exercise sessions. If placed in one of the two partner conditions, they met their partner at this session and received the instructions together. Participants were randomly assigned to condition and partner, with the only constraint on pairings being that people who were partnered had similar schedules in order to facilitate scheduling of exercise sessions.

All participants received an information sheet outlining the study protocol and were also given verbal instructions about the study requirements (for more details about the information conveyed to participants, the information sheets and verbal instructions are provided in Appendix A). Participants were given slightly different rationales for the study, depending on the condition to which they were assigned. A brief description of these instructions follows.

Participants in the exercise alone condition were instructed to exercise alone three times per week for four weeks, for a minimum of 30 minutes in each session. The rationale given was that this would allow them to concentrate on the exercise they chose and to work towards

building their fitness level over the course of the four weeks. They were asked to avoid bringing others with them to their workout and to not engage others during their workout.

Participants in the non-social partner condition were instructed to exercise together three times per week for four weeks. The rationale given was that an exercise partner may be helpful in providing encouragement, feedback on form, and assist when lifting weights. They were told that they could discuss exercise and encourage one another, but they were to stay focused on the exercise, and should avoid conversing about other topics as this could interrupt their concentration.

Like the previous condition, participants the social partner condition were instructed to exercise together three times per week for four weeks. Unlike the non-social partner condition, they were instructed to discuss topics such as school and relationships, in addition to exercise, and to get to know each other well. The rationale given was that they would be better able to support each other's workouts if they developed a relationship with each other.

Participants scheduled the remaining 11 exercise sessions at the beginning of the first exercise session. Participants in the partner conditions were required to schedule their sessions at mutually convenient times. After receiving the instructions, participants exercised for the remainder of the sessions in the condition assigned. The procedure for the exercise sessions follows.

Exercise sessions (12 sessions). All exercise sessions took place between 8 am – noon Monday to Friday, or Saturday 12 – 3 pm. An experimenter was present at all sessions to confirm attendance, administer questionnaires, ensure study protocol was being followed, and answer participant questions. Upon arrival at the gym, participants obtained the exercise session questionnaire from the experimenter and received an entry to a draw to win an iPod Shuffle.

Participants completed a brief measure of state affect, and then exercised for a minimum of 30 minutes, with no maximum time. After exercising, participants completed the following: questions about the type of exercise completed, state affect, and interest and effort in the exercise session.

Post-study session. Participants attended the post-study session alone or with their partner. Typically, participants in the partner conditions attended this final session together, although they could attend separately if they could not be scheduled together. The majority of the pre-study questionnaire package was re-administered, including assessment of intensity/quantity of exercise, motivation to exercise, psychological need satisfaction in exercise, and feeling alive and vital. Participants also repeated the 6-minute walk test and were weighed. Participants in the partner conditions also completed a measure of interpersonal complementarity with their partner. The post-study session lasted approximately 30 minutes.

One-month follow-up. In order to assess maintenance or change in exercise motivation and exercise behaviour since the end of the study, participants were contacted one month after the post-study session. Participants were provided with a link to a website and a login and password to access these questionnaires.

A more detailed description of the measures administered at each time point, and their psychometric properties now follows.

Baseline and Follow-up Measures

Leisure-Time Exercise Questionnaire (LTEQ). The LTEQ (Godin & Shephard, 1985) is a brief measure assessing frequency of participation in strenuous, moderate, and easy exercise over the past month. Participants rate the number of times on average they engage in strenuous, moderate, and easy exercise for at least 15 minutes each time they exercise. A summary score of quantity and intensity of exercise is calculated as follows: 9(strenuous) + 5(moderate) + 3(easy). Total weekly leisure activity is calculated in arbitrary units by summing the products of the separate components. This measure was utilized as a pre-screening tool, and was also administered at pre-study, post-study, and the 1-month follow-up in order to assess change in participation in exercise over the course of the study. This scale was used to obtain data regarding participants' exercise behaviour before beginning the study, and these data were included above in the description of participant characteristics.

Six-Minute Walk Test. Participants walked for six minutes in a standardized indoor environment to estimate their level of fitness at pre-study and post-study. This exercise was completed individually. The 50-metre walking course was 20 metres in length by 5 metres in width. Each corner was marked with a cone to indicate where the participant was to turn. Masking tape was used to mark each 5-metre interval along the length of the course. Experimenters followed a script in providing the same instructions to all participants, as per the guidelines of the American Thoracic Society (2002). The experimenter explained the task to the participant, demonstrated walking around one cone, and informed them of the time limit. Participants were asked to walk quickly without running. The experimenter used a stopwatch to time the walking test, and observed and recorded each lap completed. At each one-minute interval, the experimenter informed the participant of the number of minutes remaining, and

provided a standard encouragement as per the script. The participant was asked to stop walking when six minutes was over, and the experimenter used the pre-set 5-metre intervals and a measuring tape to determine the number of metres completed in the partial final lap. The experimenter then multiplied the participant's total number of laps completed by 50 metres, and added the number of metres completed in the last lap, and recorded the total distance walked. Immediately before and after the walking test, participants rated their shortness of breath and fatigue on the Borg CR10 Scale (Borg, 1998), ranging from 0 (*nothing at all*) to 10 (*very, very hard*).

At the orientation session, participants reported, on average, low levels of fatigue (M = 1.64, SD = 1.36) and minimal breathlessness (M = .55, SD = 1.03) before the walking activity. After walking for six minutes, participants reported an average breathlessness of 2.25 on the BORG scale (SD = 1.36), and an average fatigue of 2.25 (SD = 1.54). The change in scores from before exercise to after exercise was significant for both fatigue, $t(121) = 4.50$, $p < .001$) and breathlessness, $t(121) = 13.76$, $p < .001$. There were no significant differences amongst the conditions on fatigue or breathlessness either before or after the walking test (tests ranged from $F(2,119) = .82$, *ns*, to $F(2, 121) = 1.47$, *ns*). In sum, participants reported subjective increases in breathlessness and fatigue after walking, but on average, were only mildly challenged by this activity. Participants in the three conditions did not significantly differ in physical ability as measured by this test.

Body Mass Index (BMI). Participants were weighed in kilograms and measured in centimetres at Session 1 and Session 14. Participants removed shoes and any heavy items of clothing (e.g., coats) prior to weighing. These measurements were used to calculate Body Mass

Index (BMI), and compared to Health Canada (2003) guidelines for weight classification to determine whether the participant was above, below, or at an average weight for her height.

Behavioural Regulation in Exercise Questionnaire 2 (BREQ-2). The original BREQ (Mullan, Markland, & Ingledew, 1997) employed the SDT perspective on motivation and assesses behavioural regulations to exercise along a continuum of volitional engagement (autonomy). The BREQ included four subscales assessing intrinsic, identified, introjected, and external motivations toward exercise. Markland and Tobin (2004) developed the BREQ-2, which included the original BREQ items along with an amotivation subscale. Wilson, Rodgers, Loitz, and Scime (2006) produced an integrated regulation subscale, which was distinct from the five factors of the BREQ-2 and allowed for a complete assessment of the motivational continuum within the exercise domain. The present study included all six regulation subscales. Following the question, "Why do you exercise?" participants rated how true each statement was for them on a 5-point scale ranging from 0 (*not true for me*) to 4 (*very true for me*). Sample items include: "I don't see why I should have to exercise" (amotivation), "I exercise because other people say I should" (external), "I feel guilty when I don't exercise" (introjected), "I value the benefits of exercise" (identified), and "I exercise because it's fun" (intrinsic). A sample item from the integrated regulation scale is, "I exercise because it is consistent with my life goals." The inclusion of all six subscales resulted in a 23-item long measure. Theoretically, subscales that are located in closer proximity to one another on the autonomy continuum should be more strongly correlated with one another than those that are more distal. Indeed, a factor analysis of the BREQ by Wilson, Rodgers, and Fraser (2002) observed a simplex pattern of relationships amongst the subscales.

The relative autonomy index (RAI) is typically calculated using the following formula:

$$RAI = (3 * Intrinsic + 2 * Integrate + 1 * Identified - (1 * Introject + 2 * External + 3 * Amotivation)$$

Each subscale is multiplied by a weight indicating its influence in the sum. Further, the controlled motivations are subtracted from the self-determined motivations. Traditionally, amotivation is included in the RAI calculations; however, new research indicates that this variable is conceptually different from the other regulations because it indicates lack of behavioural regulation (Gaine & La Guardia, 2009). The removal of amotivation produced an unbalanced equation; therefore, the controlled regulations were divided by 3, and the self-determined regulations were divided by 6. The equation used in the present study was:

$$RAI = \frac{1}{6}(3 * Intrinsic + 2 * Integrate + 1 * Identified) - \frac{1}{3}(1 * Introject + 2 * External)$$

The product of this equation is an indicator of a participant's relative autonomy toward exercise and was used to assess levels of autonomous exercise regulation. In a previous study, these subscales have shown good reliability, ranging from .70 for identified regulation to .91 for intrinsic regulation (Wilson, et al., 2006). The internal-consistency reliabilities of these subscales at pre-study in the present study were also satisfactory: .82 for amotivation, .80 for external regulation, .73 for introjected regulation, .76 for identified regulation, .63 for integrated regulation, and .88 for intrinsic regulation.

Psychological Need Satisfaction in Exercise Scale (PNSE). This 18-item scale, developed by Wilson, Rogers, Rodgers, and Wild (2006), was used to assess satisfaction of three psychological needs (relatedness, autonomy, and competence) within the exercise domain. Participants rated on a 6-point Likert scale from 1 *(false*) to 6 (*true*) how they typically feel while exercising. The wording of the items in the perceived relatedness subscale were changed slightly so that this measure could be sensibly completed by participants in the exercise alone condition. Sample items include, "I feel close to my exercise companions" (perceived relatedness), "I feel free to choose exercises I participate in" (perceived autonomy), and "I feel confident I can do

challenging exercise" (perceived competence). Subscale scores are computed by averaging the scores for the items on each factor. In the present sample at pre-study, the reliability coefficients were .93 for perceived competence, .94 for perceived autonomy, and .91for perceived relatedness.

Social Behaviour Inventory (SBI). The SBI (Moskowitz, 1994) assessed four interpersonal characteristics based on the axes of the interpersonal circumplex (e.g., Kiesler, 1983; Wiggins, 1979). Four subscales consisting of 12 items each describe interpersonal behaviours on the dimensions of dominance (dominance versus submissiveness) and affiliation (agreeableness versus hostility). Sample items are "I expressed an opinion" (dominance), "I gave in" (submissiveness), "I listened attentively to the other" (agreeableness), and "I criticized the other(s)" (hostility). Participants rate how often they engaged in the behaviours over the past month, ranging from 1 (*never*) to 6 (*almost always*). Items are averaged to produce a score for each subscale. Dominance and Affiliation scores are calculated for each individual. Dominance is calculated by subtracting the submission score from the dominance score, with a higher score indicating greater Dominance. Affiliation is calculated by subtracting hostility from agreeableness, with a higher score indicating greater Affiliation. This inventory has shown good validity and stability, with participants' behaviours across days and with various friends and acquaintances consistent over time as measured by the SBI. Internal-consistency reliabilities of the subscales at pre-study were .78 (dominance), .84 (submissiveness), .76 (affiliation), and .75 (hostility). The reliabilities of the overall dimensions were .67 for Affiliation and .83 for Dominance.

Lack of complementarity between partner's scores was evaluated using the statistical method described by O'Connor & Dyce (1997). Deviation from perfect complementarity on

Dominance was calculated by taking the absolute value of the sum of the Dominance scores for both partners. Deviation from perfect complementarity on Affiliation was calculated by taking the absolute value of the difference between partner's scores. This means that regarding Dominance, a partnership where the dominance scores are -3 and 3, or -1 and 1, will both receive a deviation from perfect complementarity score of 0, indicating that they are complementary. Regarding Affiliation, the more similar the two partner's scores are, the closer they will be to achieving perfect complementarity and a score of 0.

In the present paper, for ease of comprehension and discussion of the results relating to complementarity, the dyad complementarity scores were subtracted from 6. Thus, higher scores indicate greater complementarity, and lower scores indicate less complementarity.

Trait Subjective Vitality (TSV). This 7-item scale assesses how alive and energetic respondents feel in general in their life, and is a reflection of psychological wellbeing (Ryan & Frederick, 1997). Participants rate how true each statement is for them on a 7-point Likert scale ranging from 1 (*not at all true*) to 7 (*very true*). Sample items include, "I feel alive and vital" and "I look forward to each new day." A subjective vitality score is computed by averaging the item scores, with a higher score indicating greater subjective vitality. Subjective vitality has been found to correlate positively with self-actualization, mental health, self-esteem, better body functioning, and physical self-efficacy (Ryan & Frederick, 1997). Internal-consistency reliability of this 7-item scale in the present study was .69.

Measures Administered at each Exercise Session (12 Sessions Total)

Physical Activity Affect Scale (PAAS). The PAAS consists of 12 adjectives describing emotions and physical states commonly experienced following exercise (Lox, Jackson, Tuholski, Wasley, & Treasure, 2000). Lox et al. (2000) selected items for this scale based on results of a factor analysis of the items on the Exercise-Induced Feeling Inventory (EFI; Gauvin & Rejeski, 1993) and the Subjective Exercise Experiences Scale (SEES; McAuley & Courneya, 1994). The PAAS consists of four three-item subscales labelled positive affect, negative affect, fatigue, and tranquillity. Immediately before and following exercise, participants rate on a five-point scale how much each item describes how they are currently feeling, ranging from 0 (*do not feel*) to 4 (*feel very strongly*). Sample items on each subscale include *enthusiastic* (positive affect), *crummy* (negative affect), *tired* (fatigue), and *calm* (tranquillity). Mean scores on each subscale are calculated, with higher scores indicating a stronger endorsement of the affective or physiological state. Consistent with previous research, the four subscales generally showed acceptable internal consistency with the current sample. In the present study, I utilized change in affect from before the session to after the session as the variable of interest. Across the 12 exercise sessions, positive affect reliabilities ranged from .57 to .73, with a mean of .65; tranquillity reliabilities ranged from .44 to .80, with a mean of .63; fatigue reliabilities ranged from .59 to .79 with a mean of .73; negative affect reliabilities ranged from .41 to .83 with a mean of .66.

Interest/enjoyment in exercise. The 7-item interest/enjoyment subscale of the Intrinsic Motivation Inventory (IMI; Ryan, 1982) was used to assess how much participants were interested in and enjoyed the exercise sessions. After each exercise session, participants indicated how true each statement was for them on a 7-point scale, ranging from 1 (*not at all true*) to 7

(*very true*). Items were modified slightly so as to focus directly on their interest and enjoyment specifically of the exercise activity. A sample item is "I enjoyed doing this exercise very much." The scale score is calculated by taking the mean of the seven items, with higher scores on this scale indicating greater interest and enjoyment of the exercise activity. This scale has very good reliability; across the 12 sessions the internal consistency reliabilities ranged from .89 to .94, with a mean of .92.

Effort in the exercise session. Two questions were developed by the author to assess participants' effort in the exercise sessions. The two questions were "How much did you push yourself in your exercise today?" and "How challenging was the exercise you did today?" They responded to these two items on a 7-point Likert scale ranging from 1 (*not at all*) to 7 (*very much*), and the average of these two items represents how much effort they exerted in their exercise activities on a given day. Across the 12 sessions, the internal consistency reliability of this two-item scale ranged from .26 to.94, with a mean of .82. These items seemed to become more consistent as participants gained more exercise experience, with all reliabilities after the third exercise session being .87 and higher.

Type of exercise. Following each session, participants reported the type of activity completed (e.g., rowing, elliptical, weights, etc.). They also recorded in minutes the amount of time spent exercising. This information was used for descriptive purposes.

Results

Descriptive Statistics

Participant attrition from pre-study to the first exercise session. One hundred and seventy-nine women participated in the pre-study session. Of these, 168 participants attended the first exercise session and were randomly assigned to a condition. Sixty-two participants (31 dyads) were assigned to exercise alone, 48 participants (24 dyads) were assigned to exercise as non-social partners, and 58 participants (29 dyads) were assigned to exercise as social partners. Attempts to enrol an approximately equal number of participants in each condition were made and differences in the number of participants in each condition were unintentional, primarily caused by participants failing to arrive as scheduled at this first exercise session. Differences between the two partner conditions occurred due to chance and not due to a preference on the part of participants, as they were not informed that there were two possible partner conditions.

In order to determine whether there were differences between the 11 participants who attended only the pre-study session and the 168 who attempted the exercise portion of the study, I compared mean scores of the two groups on a number of potentially relevant variables. No differences emerged between the two groups on age, year in school, Body Mass Index (BMI), distance walked, vitality, the behavioural regulations, and psychological need satisfaction in exercise (t-tests ranged from $t(1, 174) = 1.87$, $p = .06$ for BMI, to $t(1, 174) = .09$, *ns*, for distance walked). Thus, the participants who attempted to complete the exercise portion of the study did not differ in any meaningful way from participants who only attended the pre-study session.

Participant attrition over the course of the exercise sessions. Participants were required to attend at least eight of the 12 exercise sessions and also the post-study session in order to be included in the final analysis. Attendance at a minimum of eight sessions was required so that all

participants would be engaged in regular exercise for the duration of the study, and so that those in the partner conditions would interact regularly.

Twenty-six participants withdrew from the study during the exercise phase. Four participants withdrew after attending fewer than four exercise sessions and 22 participants attended between four and eight exercise sessions. Given the dyadic nature of the study, if a participant withdrew from the study, her partner was not included in the analysis, with a total of 44 participants being removed from the analysis. A final sample of 124 participants, or 62 dyads was retained for the dyadic analysis (20 dyads in each of the partner conditions, and 22 dyads in the exercise alone condition).

The 124 participants included in the final analysis attended an average of 10.72 exercise sessions (*SD* = 1.32), with the mode being all 12 exercise sessions attended. There were no differences amongst the three exercise conditions in the number of sessions attended, $F(2, 121) = 1.15$, *ns*. Most participants who completed at least eight exercise sessions also completed the post-study session (96.8%).

There were no significant differences between participants who completed the study and those who withdrew on the variables of age, year in school, BMI, behavioural regulations in exercise, vitality, walking distance, or the psychological need of relatedness at the pre-study session (non-significant t-tests ranged from $t(1, 176) = 0.01$ for age, to $t(1, 156) = 1.34$ for year in school). However, differences emerged between completers and non-completers in perceived satisfaction of competence and autonomy at the pre-study session. Women who completed the study reported at the beginning of the study that they felt less satisfaction of the need for competence in the exercise domain ($M = 3.56$, $SD = 1.23$) than did those who withdrew ($M = 3.98$, $SD = 1.28$), and this difference was significant, $t(1, 177) = 2.07$, $p = .04$. As well,

participants who completed the study reported at the beginning that they felt less autonomous in the exercise domain at the pre-study session (M = 4.38, SD = 0.11), than did those who withdrew (M = 4.77, SD = 0.14), and this difference was also significant, $t(1, 177) = 2.11$, $p = .04$. Thus, those who completed the study may have found that the structure of the study helped them meet their relatively unsatisfied psychological needs.

Description of exercise activities. Participants were required to exercise for at least 30 minutes at each of the 12 exercise sessions, and indeed, this was the modal time spent exercising for the 124 participants retained in the study. The mean number of minutes spent exercising across all sessions was 41.3 minutes (SD = 10.64). The conditions did not differ in average number of minutes per session, $F(2, 118) = 2.19$, *ns*.

Participants were permitted to select their activities at each session, and were not required to complete specific exercises. For the 124 participants retained in the analysis, averaging across the 12 sessions, 71% of participants engaged in strength training, including weight machines (e.g., bench press, leg press) and free weights, at any given exercise session. Typically, about half (54%) of participants engaged in stretching at any given exercise session. On average, most participants (86%) engaged in one cardiovascular activity at any given session, and 8% engaged in two or three cardiovascular activities in any given session. The most common type of cardiovascular activity engaged in during a given session was the cross-trainer/elliptical (used by an average of 49% of participants at each session), followed by the stationary bicycle (34%) and the treadmill for running or walking (30%). As well, on average, 19% of participants engaged in other activities available at the gym; most typically, the rowing machines, skipping ropes, and mat exercises utilizing body weight for resistance, including crunches, push-ups, or other self-directed exercises.

Pre-study descriptive statistics and outliers. The data were evaluated for outliers and unusual responses. An initial examination of boxplots did not reveal any outliers. The data were then examined for non-normality by looking at the skew and kurtosis of each of the predictor and outcome variables. Skew greater than 3 and kurtosis greater than 10 were considered unusual, in accordance with Kline's (2011) criteria. According to these guidelines, none of the variables in the present study exhibited unusual skew or kurtosis. Means, minimums, maximums, skew, and kurtosis for all pre-study predictor variables are presented in Table 1.

The Mahalanobis distance was also used to assess for multivariate outliers. The Mahalanobis distance allows for assessment of whether a particular case is unusual because of a number of simultaneous, moderate to large deviations on variables, which may not be detected by examination of boxplots. There were no multivariate outliers in the variables at the pre-study session. However, at post-study, three participants provided unusual responses on the BREQ-2 (either over-endorsement of all items, or failure to endorse any items strongly), indicating uncertain motivational regulations. As such, the scores of these three participants were not utilized for analyses of the BREQ-2 at post-study.

Relations amongst Pre-Study Variables

In order to establish whether variables were relating in the expected ways in the present sample, I obtained and examined intercorrelations at pre-study and post-study, utilizing all available data (168 participants at pre-study and 137 participants at post-study). I also utilized structural equation modelling to evaluate whether psychological need satisfaction predicts behavioural regulations in exercise at pre-study.

Behavioural regulations related to exercise. The pre-study correlations and reliability estimates for the subscales of the BREQ-2 are presented in Table 2. Consistent with Self-

Determination Theory, the regulations that are located proximal to one another on the scale are more positively correlated with one another, and those located most distal from one another are negatively correlated with one another. Integrated regulation is the one exception, as it is uncorrelated with amotivation and external regulation. A similar pattern of results was obtained at post-study, and these post-study correlations are presented in Table 3. Comparing the correlations across the two tables, the relations amongst the behavioural regulations in exercise items seem to be fairly stable over time, even when participants change their frequency of engagement in exercise.

Psychological needs related to exercise. The intercorrelations amongst the three psychological needs were also assessed. These variables were moderately correlated with one another, with significant correlations between perceived competence and perceived autonomy ($r = .52$, $p < .001$), perceived competence and perceived relatedness ($r = .48$, $p < .001$), and perceived relatedness and perceived autonomy ($r = .30$, $p < .001$). These results indicate that the three subscales are measuring different, but related, concepts. At post-study, the relations amongst the variables in this scale were similar, with significant correlations between perceived competence and perceived autonomy ($r = .61$, $p < .001$), perceived competence and perceived relatedness ($r = .33$, $p < .001$), and perceived relatedness and perceived autonomy ($r = .20$, $p < .05$).

Behavioural regulations related to psychological needs. The relations amongst the psychological needs and exercise regulations were of interest in the present study. As such, correlations between the psychological needs and the exercise regulations are presented in Table 4. Greater satisfaction of the need for perceived competence was negatively correlated with amotivation and external regulation, and positively correlated with self-determined regulations

(identified, integrated, and intrinsic), which was expected given previous literature demonstrating the strong relation between competence and exercise motivations and outcomes. Similarly, need for perceived autonomy was negatively correlated with amotivation and external regulation, and positively correlated with the self-determined regulations (identified, integrated, and intrinsic); however, autonomy differed from competence in that it was also positively correlated with introjected regulation. Interestingly, perceived relatedness was not significantly correlated with the controlled regulations and amotivation; however, it was positively correlated with all three self-determined regulations. Perhaps perceived relatedness may serve a function in enhancing self-determined regulations, although its impact on controlled regulations may be negligible. All three psychological needs were correlated with the Relative Autonomy Index, as would be expected. The relations between the psychological needs and behavioural regulations in exercise were mainly preserved at post-study (Table 5).

Physical and psychological wellbeing correlations. The relations among the physical and psychological wellbeing variables were also examined. At pre-study, people who reported engaging in more intense and longer exercise sessions also reported feeling greater subjective vitality (r = .19, p = .02), suggesting that more exercise is related to greater positivity and energy in daily life. Similarly, exercise intensity/duration was related to feeling more vital at post-study (r = .26, p = .003). Distance walked provided an objective fitness assessment and was expected to correlate with self-reported intensity/duration of exercise, but this was not the case at either the pre-study session (r = .12, *ns)* or the post-study session (r = .16, *ns*). Distance walked was also unrelated to subjective vitality at the pre-study session (r = -.03, *ns*) and at the post-study session (r = -.01, *ns*). In summary, objectively measured fitness did not relate to vitality or self-

reported exercise behaviour; however, self-reported exercise behaviour did relate to subjective vitality.

Physical and psychological wellbeing related to psychological needs and exercise regulations. I also examined the relations between the behavioural regulations involved in exercise and physical/psychological wellbeing, and between the psychological needs and physical/psychological wellbeing. Table 6 presents these correlations at pre-study. Participants who felt more self-determined in the exercise domain reported greater subjective vitality; as well, satisfaction of each of the three basic psychological needs was related to greater vitality. Distance walked at the pre-study session was related to weaker amotivation and greater satisfaction of the need for autonomy in the exercise domain. As well, there was a tendency for more self-determined motivations and greater satisfaction of competence to be correlated with the distance walked by participants. The exercise intensity/duration reported by participants at the pre-study session was related to both identified and integrated regulations, although the relation with the RAI did not reach significance. Further, participants who reported greater exercise intensity/duration at pre-study also reported more perceived competence in the exercise domain. As noted earlier, greater competence satisfaction in exercise at pre-study was associated with a tendency to withdraw early.

Of note, these relations were very similar at post-study, as shown in Table 7. As at pre-study, there were few relations between the behavioural regulations and physical wellbeing (distance walked and exercise intensity/duration). Relations between vitality and the behavioural regulations were very similar to those at pre-study, with the exception that subjective vitality became significantly negatively related to amotivation.

Pre-study structural equation modelling of PNSE predicting BREQ-2. The structural equation model (SEM) in Figure 2 was utilized to determine the effect of the three psychological needs on the six regulations at pre-study, using the entire sample of 168 participants. Wilson and Rogers (2008) conducted similar modelling, without the integrated regulation and amotivation subscales, and obtained relationships between self-determined regulations to exercise and need satisfaction, particularly for competence. In the present study, greater satisfaction of the psychological needs was expected to predict more self-determined regulations (intrinsic, integrated, and identified), and weaker endorsement of controlled regulations (introjected and external) and amotivation. When all three needs were considered simultaneously, only need for competence performed as would be expected: competence was related to less amotivation (r = -.38, p < .001) and less external regulation (r = -.29, p = .002), and did not affect introjected regulation (r = -.01, *ns*); further, competence was related to more self-determined regulations, namely higher identified (r = .44, p < .001), integrated (r = .35, p < .001), and intrinsic (r = .51, p < .001) regulations. Thus, feeling more competent in exercise is likely to positively affect motivation to exercise.

Satisfaction of the needs for autonomy and relatedness seem to have weaker relations with the behavioural regulations. Satisfaction of autonomy was related with greater introjected regulation (r = .19, p = .04); however, no other relations achieved significance. Satisfaction of the need for relatedness was not significantly related to the behavioural regulations in exercise. These findings are consistent with previous studies, which have suggested that within the exercise domain, competence is the most pertinent need (Wilson & Rogers, 2008). However, it should be noted that when the relations between the needs and regulations were examined

separately, both autonomy and relatedness were significantly related with a number of the behavioural regulations in exercise (as shown in Table 4).

Change over Time

The remaining analyses examined changes occurring over time using the 124 participants (62 dyads) who completed the study. First, the changes between pre-study and post-study were assessed to evaluate whether predictions involving differences amongst the three conditions were supported. Second, I examined whether these post-study outcomes were affected by partner interpersonal complementarity within the two partner conditions. Third, I evaluated change between the post-study session and a one-month follow-up, to ascertain whether participants' scores on motivation and exercise behaviour remained the same or continued to change. Last, I assessed whether there were changes over the course of the exercise sessions in the affect, interest, and effort that participants experienced at each session.

An important feature of the data collected in the present study is that it is dyadic in nature. It is expected that the individuals involved in dyadic interactions adapt in response to their partner's behaviour, such that there is an aspect of mutual influence. In the current study, partners were previously unacquainted and were randomly assigned to exercise with one another, allowing for an examination of the development of mutual influence over time. It was expected that, through their interactions, partners would become more similar to one another in terms of motivation, need satisfaction, and physical and psychological wellbeing (Sadler, Ethier, & Woody, 2011). As such, traditional statistical techniques such as ANOVA or regression are severely limited as these assume independent data (Cook & Kenny, 2005; Sadler, Ethier, & Woody, 2011). The dyad, rather than the individual, was utilized as the focus of statistical

analysis in the current study, using structural equation modelling in AMOS 20 (Cook & Kenny, 2005; Kenny, Kashy, & Cook, 2006; Sadler, Ethier, & Woody, 2011).

Specifically, a model allowing dependence for interchangeable dyad members was utilized, with the three conditions being run simultaneously as a multiple-sample SEM (see Figure 3). Partners were considered to be interchangeable because they did not have any distinguishing characteristics (such as gender) to use in assigning them as either partner 1 or partner 2. Given that partners were interchangeable, the means, variances, and covariances were set equal and are indicated on the diagram by the same parameter name (for example, for both partners in the social condition at the pre-study session, the mean is indicated by 'm1s' and the variance by 'v1s', and the covariance between pre-study intrinsic regulation and post-study intrinsic regulation is denoted 'as'). The null hypothesis that there was no difference across the conditions was tested, and the associated fit statistics were obtained. In this model, the intercorrelations between partners at the first time point (pre-study) and the second time point (post-study) can be compared, providing information about how similar or alike partners become through interacting over 12 exercise sessions.

An alternative method of examining dyadic data is to utilize the Actor-Partner Interdependence Model (APIM; Kenny, Kashy, & Cook, 2006); however, if the APIM were used, the pre-study variables would be considered predictive of the post-study variables, rather than simply correlated. This type of model would be particularly useful if the path coefficients describing the effect of one participant's initial scores on their own post-study scores (actor effects) and their partner's post-study scores (partner effects) were the focus of analysis. However, in the present study, actor and partner effects were of less interest than differences across conditions in change between pre-study and post-study, and the development of mutual

influence between partners as indicated by more related scores at the post-study session. As such, we utilized the simpler model allowing dependence for interchangeable dyad members, enabling us to evaluate the differences amongst means and intraclass correlations. This analysis, for use with pairs of subjects, produces results is comparable to repeated-measures ANOVA for independent subjects. The APIM model would yield results comparable to repeated measures ANCOVA for independent subjects.

Change between pre-study and post-study. To evaluate hypotheses regarding change between pre-study and post-study, I examined basic need satisfaction, the behavioural regulations in exercise, and physical/psychological wellbeing. Tables 8, 9, and 10, provide the pre- and post-study means and standard deviations for the psychological needs, behavioural regulations, and psychological/physical wellbeing variables, as well as an indication of whether the difference between pre- and post-study is significant. As expected based on random assignment to condition, there were no differences among the conditions at pre-study. I expected that participants exercising in the social partner condition would demonstrate an advantage over the other two conditions in terms of need satisfaction, motivation, and physical and psychological wellbeing, and so I tested whether there were differences amongst the three conditions at post-study, and these differences amongst conditions at post-study are reported below. The presence of an interaction between time and condition was tested for each variable in order to determine whether the conditions change differently over time. Further, I evaluated whether the intraclass correlations changed over time, as a greater correlation between partner's scores at post-study compared to pre-study would indicate mutual influence. The next section describes change in means of the variables between the pre-study and post-study sessions to

determine the effect of condition on change, followed by a discussion of change in intraclass correlations to indicate partner mutual influence.

Change in means between pre-study and post-study. The pre-study and post-study means and the differences between means, follow for each psychological need (perceived competence, perceived autonomy, and perceived relatedness), the behavioural regulations related to exercise, and physical/psychological wellbeing.

Psychological need satisfaction related to exercise. As shown in Table 8, across all three conditions, satisfaction of the need for competence at post-study was significantly greater than at pre-study. Perceived competence did not differ significantly amongst the conditions, $\chi^2(2, N = 62) = 0.95$, *ns*, at post-study, suggesting that all three conditions performed about equally in improving perceived competence. The interaction of condition with time, $\chi^2(2, N = 62) = 0.56$, *ns*, was also not significant, indicating that the three conditions changed in a similar way between the two time points. These findings partially support the hypothesis that participants would feel more competent at the end of the study than at the beginning; however, it seems that exercising with a partner did not contribute to improved competence, in spite of the greater opportunity to receive feedback and support.

I had expected that there would be an advantage to exercising alone in enhancing satisfaction of the need for autonomy. Satisfaction of the need for autonomy improved significantly in both the exercise alone and non-social partner conditions, but not in the social partner condition; however, differences amongst conditions were not statistically significant at post-study, $\chi^2(2, N = 62) = 2.63$, *ns*. The interaction of condition with time was also not significant, $\chi^2(2, N = 62) = 3.18$, *ns*, suggesting that the three conditions changed in a similar way across the two time points.

Satisfaction of the need for relatedness improved significantly in the non-social partner condition, and approached significance for the social partner condition. This result is somewhat unexpected, as I had predicted that relatedness would be more greatly satisfied in the social partner condition, rather than the non-social partner condition. The three conditions significantly differed at post-study, $\chi^2(2, N = 62) = 11.46$, $p < .01$, with the two partner conditions satisfying relatedness more than the alone condition. The test of the interaction of condition with time also emerged as significant, $\chi^2(2, N = 62) = 7.10$, $p < .05$, and is illustrated in Figure 4. These results suggest that exercising at a fitness facility merely in the presence of other people, as in the exercise alone condition, is not sufficient to satisfy perceived relatedness. However, exercising with a partner, even if the relationship is specific to the exercise activity, as in the non-social partner condition, is likely sufficient to satisfy the need for relatedness in the exercise domain.

Behavioural regulations related to exercise. Exercising with a partner was expected to lead to internalization of the value of exercise behaviour. Therefore, I had predicted that exercising with a social partner would lead to enhanced self-determined regulations toward exercise at post-study. A number of changes in behavioural regulations toward exercise emerged from the pre-study to post-study session (Table 9). Regarding participants' overall motivation toward exercise, the relative autonomy indices for the three conditions were not significantly different from one another at post-study, $\chi^2(2, N = 62) = 4.99$, *ns*. However, the interaction of condition with time was marginally significant, $\chi^2(2, N = 62) = 4.99$, $p = .08$, suggesting that there may be some differences amongst the three conditions in how motivation changed over time. I then evaluated the specific regulations comprising the RAI in order to determine if these were differentially affected by the study conditions. I examined the self-determined regulations

(identified, integrated, and intrinsic), controlled regulations (external and introjected), and amotivation separately.

With regards to the self-determined regulations (identified, integrated, and intrinsic), participants in all three conditions improved significantly over time. There were no differences amongst the conditions, nor were there any interactions between condition and time that achieved significance. The tests of the differences for each of the self-determined regulations were: identified, $\chi^2(2, N = 62) = 0.46$, *ns;* integrated, $\chi^2(2, N = 62) = 0.19$, *ns*; and intrinsic, $\chi^2(2, N = 62) = 1.73$, *ns*. Further, the tests of the interactions between condition and time for each of the self-determined regulations were: identified, $\chi^2(2, N = 62) = 0.06$, *ns;* integrated, $\chi^2(2, N = 62) = 2.99$, *ns*, and intrinsic, $\chi^2(2, N = 62) = 0.70$, *ns*, suggesting that there were no significant differences amongst the conditions in how these regulations changed over time. The results for self-determined regulations indicate that exercising regularly promotes growth of self-determined regulations, but none of the conditions had a particular advantage over the other conditions. In particular, the hypothesis that the social partner condition would promote internalization of more self-determined regulations was not supported.

There were indications that the controlled regulations (introjected and external) were differentially affected by exercise condition. Introjection did not significantly change between pre-study and post-study for any of the conditions; however, differences amongst the conditions were significant at post-study, $\chi^2(2, N = 62) = 7.86$, $p < .05$. The interaction of condition with time was non-significant, $\chi^2(2, N = 62) = 2.18$, *ns*, indicating that changes in introjection over time did not significantly differ amongst the three conditions. These results suggest a possibility that exercising with a partner leads to more introjected regulations; however, the three conditions

did not significantly differ at post-study, so the impact of social condition on introjection remains uncertain.

External regulation decreased over time in both the exercise alone and social partner conditions, however, participants in the non-social partner condition did not experience change in external regulation over time. Although the differences amongst the conditions at post-study were not statistically significant, $\chi^2(2, N = 62) = 2.25$, *ns*, the interaction of condition with time emerged as significant, $\chi^2(2, N = 62) = 7.32$, $p = .03$, suggesting that external regulation changed differently over time depending on condition. As illustrated in Figure 5, external regulation decreased in both the social partner and exercise alone conditions, but increased slightly in the non-social partner condition. Exercising with a partner when the relationship is specific to the exercise domain seems to sustain external regulations toward exercise, whereas the other two conditions allowed for a decline in this controlled type of regulation.

The last regulation variable examined was amotivation, which was not included in the RAI, because it is indicative of a lack of regulation, rather than controlled or self-determined regulation (Gaine & La Guardia, 2009). Amotivation toward exercise decreased over time for participants in both the exercise alone and non-social partner conditions, whereas those in the social partner condition did not change significantly on amotivation. However, the differences amongst the three conditions on amotivation at post-study did not reach significance, $\chi^2(2, N = 62) = 2.10$, *ns*, nor did the interaction of condition with time, $\chi^2(2, N = 62) = 2.90$, *ns*. Overall, endorsement of amotivation was low at both pre-study and post-study, which is unsurprising given that the current sample volunteered to participate in an exercise program; however, it is difficult to interpret changes occurring in this relatively under-endorsed variable.

In summary, my hypotheses were partially supported in that the Relative Autonomy Index increased for both the exercise alone and social partner conditions; whereas, the non-social partner condition did not experience overall motivational improvements. The differences amongst the conditions on the RAI at post-study seemed to have arisen primarily through the changes occurring in the controlled regulations. External regulation was reduced in both the social partner and the exercise alone conditions, thereby improving the overall RAI for these conditions. There was also an indication that the partner conditions may experience an increase in introjection. In comparison to the other two conditions, the non-social partner condition seemed to be at somewhat of a disadvantage in reducing controlled regulations, and by extension, improving overall RAI.

Physical/psychological wellbeing. Change in physical and psychological wellbeing was captured using three variables: the distance participants could walk within a 6-minute period, self-reported intensity/duration of exercise over the previous month, and self-reported subjective vitality. Participants in the social partner condition were expected to enjoy the exercise sessions more, and so exert more effort or spend more time exercising together, and consequently experience more improvements in physical and psychological wellbeing. As shown in Table 10, there are a number of significant changes occurring between the pre-study and post-study sessions on these variables.

Subjective vitality is an indicator of greater energy and enthusiasm for life, and was expected to increase with more physical activity, particularly for participants in the social partner condition. In fact, participants in all three conditions endorsed greater vitality at the end of the study than they did at the beginning. In particular, the change was significant for both the exercise alone and non-social partner conditions, and approached significance for the social

partner condition. The differences in vitality amongst the conditions at post-study were not significant, $\chi^2(2, N = 62) = 3.37$, *ns,* and the interaction between condition and time was also not significant, $\chi^2(2, N = 62) = 1.34$, *ns*. As there were no differences in the scores on subjective vitality at post-study, or in how the three conditions changed over time, these results suggest that regular exercise contributes to improved vitality, regardless of whether one engages in social interaction during the exercise sessions.

The distance that participants could walk in a 6-minute interval was an indicator of physical fitness, and was expected to improve between pre-study and post-study, particularly in the social partner condition. In fact, participants in all three conditions improved between pre-study and post-study, with the difference achieving significance for the exercise alone and non-social partner conditions, and being marginally significant for the social partner condition. The three conditions were not significantly different in the distance walked at post-study, $\chi^2(2, N = 62) = .70$, *ns*, and the interaction between time and condition was also not significant, $\chi^2(2, N = 62) = .08$, *ns*). Overall the results regarding walking distance suggest that improvement in physical fitness occurs regardless of the social condition.

Exercise intensity/duration increased between the pre-study and post-study session, in part due the study requirement of regular exercise. I expected that participants would find the social condition more satisfying, and so would spend more time exercising; however, there were no differences among the conditions in the intensity/duration of the past month's exercise at post-study, $\chi^2(2, N = 62) = .89$, *ns*. The interaction between time and condition was also not significant, $\chi^2(2, N = 62) = .15$, *ns*, indicating that exercise intensity/duration changed similarly over time across the three conditions. The findings regarding exercise intensity/duration are consistent with the findings for subjective vitality and distance walked, in that there is an overall

improvement when exercise is engaged in regularly, but the social aspects of the exercise have little impact on these variables.

Change in intraclass correlations between pre-study and post-study. In addition to examining change in means between pre- and post-study, I looked at how correlated partner scores were at pre- and post-study. Intraclass correlations are a measure of similarity in partner's scores, indicating mutual influence between partners. Partners who spend more time socializing with one another, as in the social partner condition, may influence one another more, such that their scores on psychological needs, behavioural regulations in exercise, and physical/psychological wellbeing indicators become more similar.

In order to assess whether partners became more similar over time, the intraclass correlation coefficients were obtained for pre-study and post-study, and the change between pre-study and post-study correlations were calculated. The tables of correlations and differences are presented for the psychological needs related to exercise (Table 11), behavioural regulations related to exercise (Table 12), and physical/psychological wellbeing (Table 13). At the pre-study session, participants had yet to be assigned to condition or to meet their partner, and so their scores on pre-study variables were expected to be uncorrelated at this session, and indeed this was the case. Likewise, partners in the exercise alone condition did not meet at any point during the study, and so their scores were expected to remain uncorrelated at post-study.

Psychological need satisfaction related to exercise. Regarding the psychological needs in exercise (Table 11), there were no variables for which the post-study correlations between partners were significant. There were also no significant differences between pre-study and post-study, indicating that partner's scores were no more correlated with each other at post-study than they were at pre-study. Further, tests of the differences revealed that there were no statistically

significant differences amongst the three conditions in the amount of change between pre-study and post-study: perceived competence, $\chi^2(2, N = 62) = 3.26$, *ns*; perceived autonomy $\chi^2(2, N = 62) = 3.11$, *ns*; and perceived relatedness, $\chi^2(2, N = 62) = 2.16$, *ns*. In sum, partners did not seem to become more similar to each other in perceived need satisfaction, and so changes in satisfaction of psychological needs between pre-study and post-study were likely not due to partner influence.

Behavioural regulations related to exercise. Similar to the psychological needs, behavioural regulations related to exercise were not significantly correlated at post-study (Table 12). The intraclass correlation for intrinsic regulation in the social partner condition approached significance; however, this was in the opposite direction to that expected and likely arose due to sampling error. In one instance the difference between pre-study and post-study achieved significance: partners in the non-social partner condition became more similar to one another on external regulation. In this case, however, the test of differences amongst the conditions for the external regulation variable revealed that the three conditions were not significantly different at post-study, $\chi^2(2, N = 62) = 3.54$, *ns*. Further, tests of differences between the three conditions were not significant for any of the other behavioural regulations in exercise: Relative autonomy index, $\chi^2(2, N = 62) = 1.58$, *ns*; introjected regulation, $\chi^2(2, N = 62) = 0.95$, *ns*; identified regulation, $\chi^2(2, N = 62) = 1.66$, *ns*; integrated regulation, $\chi^2(2, N = 62) = 0.73$, *ns*; intrinsic regulation, $\chi^2(2, N = 62) = 2.93$, *ns*; and amotivation, $\chi^2(2, N = 62) = 1.28$, *ns*. These results seem to suggest that partners did not strongly influence each other's changes in behavioural regulations over the course of the study.

Physical/psychological wellbeing. Lastly, I evaluated the intraclass correlations for the physical and psychological wellbeing variables, and also found limited evidence for mutual

influence between partners (Table 13). However, there was one exception in that partners in the social partner condition walked significantly more similar distances to one another at post-study than at pre-study. As well, partners in the exercise alone condition became significantly more similar to one another in exercise duration/intensity at post-study, which was unexpected given that these partners did not meet one another. In spite of some significant changes occurring in distance walked and exercise duration/intensity, there were no significant differences amongst the three conditions for any of the psychological and physical wellbeing variables: vitality, $\chi^2(2, N = 62) = 0.94$, *ns*; distance walked, $\chi^2(2, N = 62) = 2.78$, *ns*; and exercise intensity/duration, $\chi^2(2, N = 62) = 0.72$, *ns*. As with the psychological needs and behavioural regulations, there was little evidence that partners became more similar to one another on physical and psychological wellbeing.

Surprisingly, the results across all outcome variables indicated that there was little interdependence between the dyad members. It is possible that partners did not become close enough, or spend enough time together, to mutually influence each other. Considering this apparent lack of interdependence, in retrospect, evaluation of change between pre-study and post-study may have been appropriately conducted using ANOVA or regression. However, a note of caution is necessary. The current sample size of 62 dyads across three conditions (with the largest conditions having 22 dyads) may simply lack the necessary power to detect interdependence between partners. According to Kenny, Kashy, and Cook (2006, p. 50), a minimum of 25 dyads is required to be confident that non-significant results indicate a lack of dependence. Given that a number of the correlations presented in the preceding tables are moderate in size (above .30) according to Cohen's (1988) standards, and yet do not achieve

significance, there remains a possibility that the apparent lack of interdependence between partners may partly reflect limited statistical power.

The effect of complementarity on change between pre-study and post-study. Another factor that may affect the outcomes is the degree to which partners have complementary interpersonal styles. The affiliation scores from each partner were utilized to produce a dyad score of correspondence on affiliation, and similarly, the dominance scores from each partner were utilized to produce a dyad score of reciprocity on dominance. These scores were then utilized as predictors of both partners' post-study scores on outcome variables. This model did not include the exercise alone condition, but rather compared the two partner conditions, for a sub-sample of 40 dyads (20 dyads per condition).

The analytic strategy is shown as a two-sample SEM in Figure 6. In the diagram, correspondence on affiliation and reciprocity on dominance are utilized as predictors of the vitality experienced by each partner at the post-study session. Because the partners are interchangeable, both of the path coefficients from correspondence on affiliation are the same, and likewise for reciprocity on dominance. In order to obtain the outcomes for each condition and contrast the differences between the conditions, the path coefficients are labelled differently for each condition; in the social condition, the effect of dyad affiliation correspondence on post-study vitality is labelled 'as', and in the non-social condition it is labelled 'an'. Similarly, the effect of dyad dominance reciprocity on the post-study outcome is labelled as 'ds' in the social condition and 'dn' in the non-social condition. This model was used to test the effect of partner complementarity on post-study psychological needs, behavioural regulations, and physical/psychological wellbeing. Chi-square differences between the path coefficients of the two conditions were examined to determine if the effects of interpersonal complementarity were

different depending upon whether the condition was social or non-social. Please refer to Table 14 for the standardized path coefficients and tests of difference.

Perceived psychological need satisfaction related to exercise. Interpersonal complementarity was expected to be important to satisfaction of the basic needs, because partners would find a complementary relationship more rewarding. First, regarding the effect of correspondence on affiliation on the three basic needs, I found one statistically significant chi-square difference between the two conditions. Correspondence on affiliation significantly predicted an increase in perceived competence in the social partner condition, and further, the difference between the social partner condition and the non-social partner condition was statistically significant, $\chi^2(1, N = 40) = 5.47, p = .02$. This result indicates that, if social partners were similar to each other on affiliation, they felt more competent after one month of exercising than they would if they exercised with a non-social partner. Correspondence on affiliation did not have a statistically significant effect on either perceived autonomy or perceived relatedness.

Turning next to the effect of reciprocity on dominance, I obtained one noteworthy result, in which reciprocity on dominance in the non-social condition significantly predicted greater post-study perceived relatedness. Further, the difference between the two conditions was statistically significant, $\chi^2(1, N = 40) = 4.07, p = .04$, indicating that satisfaction of the need for relatedness is enhanced in the non-social condition when the pairing is complementary on dominance, whereas satisfaction of relatedness was not affected in the social partner condition. Reciprocity on dominance did not predict either perceived competence or perceived autonomy in either condition.

Behavioural regulations related to exercise. Next, the relative autonomy index was assessed to determine the effects of interpersonal complementarity on the behavioural

regulations. There were no significant findings regarding the relative autonomy index, an overall indicator of motivation. These results indicate that the degree to which the members of a dyad have complementary interpersonal styles has little effect on the motivation of participants at the post-study session. This is a surprising result, as I had predicted that a greater connection between participants would be fostered in the social partner condition, and that this would translate into development of more self-determined motivations. Due to the lack of relation between interpersonal complementarity and the relative autonomy index at post-study, I did not analyze the subscales separately.

Physical/psychological wellbeing. Lastly, I examined the effect of interpersonal complementarity on the physical/ psychological wellbeing variables. Correspondence on affiliation did not significantly impact subjective vitality, distance walked, or exercise intensity/duration, and there were no differences between the path coefficients for the two partner conditions.

Reciprocity on dominance impacted two variables in the non-social partner condition: vitality and distance walked. The relation between reciprocity on dominance and vitality was surprising, with reciprocity on dominance leading to a decrease in vitality in the non-social partner condition. The path coefficient for the social condition was non-significant, and the difference between the two conditions was marginally significant, $\chi^2(1, N = 40) = 2.95, p = .09$. Reciprocity on dominance had a positive effect on distance walked in the non-social partner condition, and the difference between the path coefficients of the two conditions was significant, $\chi^2(1, N = 40) = 4.98, p = .03$. In other words, in the non-social partner condition, greater reciprocity (less similarity) on dominance positively affected distance walked.

Overall, the findings provide some limited confirmation of the hypothesis that greater interpersonal complementarity has a positive effect on outcome variables. However, there is little evidence that interpersonal complementarity is more important when participants spend more time interacting in a social manner than when they focus on exercise in their time together. Of note, due to the dyadic nature of these analyses, there were only 20 dyads per condition, and perhaps with more dyads a clearer picture of the effect of interpersonal complementarity on the outcome variables would emerge.

Change between post-study and follow-up. One month after the post-study session, participants were contacted to complete the follow-up session, which consisted of completing electronic versions of the BREQ-2 and Leisure-Time Exercise Questionnaire. I utilized their responses to determine whether exercise motivation and exercise intensity/duration were similar or different one month after the end of the study. The method was the same as that used to evaluate change between the pre-study and post-study sessions.

Change in means between post-study and follow-up. One aspect of change between post-study and follow-up are differences in means.

Behavioural regulations in exercise. Table 15 presents the means of the behavioural regulations toward exercise at post-study and follow-up and also indicates whether there is a significant difference between these time points. The tests of differences between the three conditions at follow-up did not detect any significant differences: Relative autonomy index, $\chi^2(2, N = 62) = 1.41$, *ns*; external regulation, $\chi^2 (2, N = 62) = 0.27$, *ns*; introjected regulation $\chi^2(2, N = 62) = 0.11$, *ns;* identified regulation, $\chi^2(2, N = 62) = 1.79$, *ns;* integrated regulation, $\chi^2(2, N = 62) = 0.06$, *ns*; intrinsic regulation, $\chi^2(2, N = 62) = 1.17$, *ns;* and amotivation,

$\chi^2(2, N = 62) = 0.17$, *ns*. Participants in the three conditions are similar to one another in their behavioural regulations at follow-up.

A closer examination of change between post-study and follow-up for each condition revealed an interesting pattern. For participants exercising alone, scores on the relative autonomy index declined significantly between post-study and follow-up, indicating that they did not retain the motivational benefits of participating in the study. In contrast, the relative autonomy index remained similar between post-study and follow-up for participants in both partner conditions. Further, when looking more closely at the specific regulations, participants in the exercise alone condition experienced a significant increase in external regulation between post-study and follow-up. There was also a tendency for introjected regulation and amotivation to increase, and identified regulation to decrease in the exercise alone condition. These results indicate that exercising with a partner may confer some benefit to long-term motivation in that there is no decline in the relative autonomy index.

Exercise intensity/duration. Post-study and follow-up exercise intensity/duration means and the differences for each condition are presented in Table 16. Interestingly, participants in both the exercise alone condition and the social partner condition reported significant improvements in exercise intensity/duration over the previous month, whereas participants in the non-social partner condition seem to have remained about the same. This difference between conditions in exercise intensity/duration at follow-up approached significance, $\chi^2(2, N = 62) = 5.37$, $p = .07$, suggesting that exercising alone or with a social partner has a longer-term impact on continued exercise behaviour.

Change in intraclass correlations between post-study and follow-up. Similar to the results for intraclass correlations between pre-study and post-study, the intraclass correlations between

post-study and follow-up suggested that partners had little influence on one another (see Tables 17 and 18). In fact, only one intraclass correlation was statistically significant at follow-up, and in the opposite direction to that expected, suggesting that it may have arisen due to sampling error.

Evaluating the effect of exercise on affect, and post-session effort and interest. Four affect variables (positive affect, negative affect, tranquillity, and fatigue) were assessed at each of the 12 exercise sessions. To examine how exercise influenced each of these variables, I computed the change (post-exercise minus pre-exercise) for each exercise session.

Initially, I utilized Latent Curve Models (LCMs) in SEM to examine the linear slope over the twelve exercise sessions in the pre-to-post-session change for each variable in each condition. LCMs produce an intercept and a slope for each condition, allowing change over time to be modelled for each condition. For instance, it would be possible to determine whether there is an increase or decrease in the tendency of exercise to enhance positive affect over time, and whether there are different patterns amongst the three conditions. To reduce the amount of missing data present in these analyses, the 12 exercise sessions were aggregated into four "blocks" consisting of three sessions per block.

Given my expectation that the partners would be interdependent, I allowed the partners to exert mutual influence on one another at each of the four time blocks. However, consistent with results reported earlier, interdependence was generally minor and statistically insignificant. In addition, the models tended not to fit well, and the statistical power appeared to be low. It would seem that the sample size of 62 dyads was insufficient for successful fitting of this type of model.

Given the general absence of interdependence, a simpler analytic strategy, treating the data as independent, was possible. I did this in a two-step process. First, I ascertained whether

exercise did in fact cause improvement in these affect variables during the exercise sessions. In order to do this, I calculated the mean pre-session score and mean post-session score for the four affect variables using the data from the 12 exercise sessions. I utilized paired samples t-tests to compare the mean pre-session scores with the mean post-session scores to determine whether there was within-session change in affect. Second, I used repeated-measures ANOVAs to assess the linear trend in pre- to post-session change over the four time blocks. These tests are described below.

Changes in affect from before exercise to after exercise. On average, positive affect improved from the pre-session score (M = 1.48, SD = 0.73) to the post-session score, (M = 2.02, SD = 0.81), which was a statistically significant difference, $t(122) = -13.02$, $p < .001$. Similarly, exercise led to an improvement in tranquillity from pre-session (M = 1.65, SD = 0.76) to post-session (M = 1.85, SD = 0.81), a significant difference, $t(122) = -5.16$, $p < .001$. These results suggest that participants felt more positive affect and a greater sense of calm after the exercise session than they did prior to exercise.

Regarding negative affect, participants reported a decrease in negative affect from pre-session (M = 0.38, SD = 0.47) to post-session (M = 0.21, SD = 0.35), a difference which was statistically significant, $t(122) = 6.22$, $p < .001$. Similarly, exercise led to a decrease in fatigue from pre-session (M = 1.06, SD = 0.68) to post-session (M = 0.93, SD = 0.67), a difference which also achieved significance, $t(122) = 2.96$, $p < .01$. Therefore, exercise contributed to positive physical and emotional changes both by increasing positive affect and tranquillity, and also by reducing negative affect and fatigue.

Changes in the effect of exercise on affect. Next, I conducted repeated-measures ANOVAs to assess the linear trend in pre-to-post session change over four time blocks in the

three conditions. The main effects of time, and time by condition interactions, are described below for the affect variables (positive affect, tranquillity, negative affect, and fatigue). These analyses address whether the mood benefits of an exercise session changed over the course of the study.

Similarly for the two post-exercise session variables (interest and persistence), I conducted repeated-measures ANOVAs to assess linear change in the three conditions over the four time blocks. These variables were measured only once, post-exercise at each session.

Effect of exercise on positive affect. The effect of an exercise session on positive affect exhibited significant change over time, $F(1, 117) = 10.17$, $p = .002$; however, the improvement in positive affect declined over time, rather than improved. Further, the time by condition interaction was significant, $F(2, 117) = 3.44$, $p = .04$, indicating that change in the mood-boosting effect of exercise was different across conditions. The mood-boosting effect of exercise was strong in the two partner conditions in the early sessions, and then tended to decline across the exercise sessions, whereas participants in the exercise alone condition experienced a more modest mood boost in early sessions, which did not change over time (Figure 7). The results suggest that there is an initial advantage to exercising with a partner, but this advantage gradually decreases so that eventually there is little difference among the conditions.

Effect of exercise on tranquillity. In contrast, the tranquillity-boosting effect of exercise tended to increase across the exercise sessions, $F(1, 118) = 8.84$, $p = .004$. It seems that with more exercise experience, participants felt increasingly calm and relaxed after exercise. The time by condition interaction was not significant, $F(2, 118) = 0.58$, *ns*, suggesting that the improvement in tranquillity occurs regardless of whether one exercises alone or with a partner.

Effect of exercise on negative affect and fatigue. The tendency of exercise to reduce negative affect did not change significantly over time $F(1, 118) = 0.01$, *ns*. As well, the time by condition interaction was not significant $F(2, 118) = 0.27$, *ns*, indicating that reduction in negative affect did not change differently over time depending upon condition. Similarly, the tendency of exercise to reduce fatigue, $F(1, 118) = 1.10$, *ns*, remained similar over time, and the time by condition interaction was not significant, $F(2, 118) = 0.97$, *ns*. Thus, there was no evidence that the effect of exercise on negative affect and fatigue changed over time, or that these variables performed differently under different social conditions.

Effort in the exercise session. Exercise effort was measured once at each session, after participants completed the exercise. Effort did not seem to change over the course of the study, as the main effect of time was not significant, $F(1, 120) = 0.63$, *ns*. As well, there was no time by condition interaction, $F(1, 120) = 0.26$, *ns*. Participants engaged in exercise with the same degree of effort throughout the study, and the conditions did not differentially affect effort.

Interest in the exercise session. Interest in exercise was measured once in each session, after the exercise was completed for that session. Interest in the exercise sessions remained about the same over the exercise sessions, with the main effect of time being non-significant, $F(1, 118) = 0.44$, *ns*. The interaction between time and condition, $F(1, 118) = 0.38$, *ns*, also did not achieve significance, indicating that, contrary to expectation, exercising with a social partner did not enhance interest in the exercise sessions.

Summary of Main Findings

The preliminary analyses did not reveal any problematic patterns in the data, and correlations amongst scales were consistent with previous literature. A SEM revealed that perceived competence was more consistently related to behavioural regulations than were either perceived relatedness or perceived autonomy

The main data analyses focused on differences amongst the three conditions between the pre-study session and the post-study session, in order to determine the effect of social interaction on exercise outcomes. The results showed that participants in all three conditions experienced many benefits of exercise in general. Overall, exercise contributed to improved vitality, fitness, and affect, with few differences amongst the conditions. Regarding change in psychological need satisfaction, participants in all three conditions experienced improvements in satisfaction of competence and autonomy. There were some differences across the conditions; most importantly, the partner conditions yielded greater satisfaction of relatedness than the exercise alone condition.

Patterns of change in affect scores, effort, and interest were examined. Participants in all three conditions seemed to experience more tranquillity after exercise over time. Although positive affect was higher in the two partner conditions early in the study, it decreased over time and became similar to the exercise alone condition. There was no significant change over time in effort or interest. None of the conditions seemed to confer an advantage to changes in affect, effort, and interest in exercise.

Regarding motivation, all three conditions improved similarly in intrinsic, integrated, and identified regulations. Both the exercise alone and social partner conditions also experienced reductions in controlled regulations at post-study. There were no significant reductions in

controlled regulations for the non-social partner condition, putting this condition at a disadvantage in enhancing the overall relative autonomy index. At follow-up, the relative autonomy index remained stable for those who exercised with a social partner during the study; however, participants who exercised alone experienced a decrease in the relative autonomy index, suggesting that there is an overall advantage of exercising with a social partner.

In order to better understand how partners may affect one another, the potential effects of partner mutual influence and interpersonal complementarity were also evaluated. Surprisingly, partners did not become more similar to one another over time on any of the measures, suggesting a lack of mutual influence. Interpersonal complementarity positively impacted competence, relatedness, and fitness, although it had a negative impact on vitality.

In sum, the social partner condition provided some advantage in terms of motivation, although participants in all conditions experienced benefits from exercise.

Discussion

The present study investigated the effect of different social conditions on exercise behaviour and motivation. In particular, in order to fill a gap in the literature, this study investigated how satisfaction of the need for relatedness impacted on exercise outcomes, and also whether experimentally manipulating the social condition in which participants exercised affected outcomes. This study also explored two possible frameworks for understanding the role of socializing on exercise behaviour: Social Facilitation and Self-Determination Theory (SDT). The theory of social facilitation suggests that exercising in the mere presence of others people would result in greater engagement and effort in the exercise sessions, whereas according to SDT, relationships with others are crucial for understanding motivation and engagement in exercise. The discussion will address the five study goals previously described, which were to: 1) gain a better understanding of the role of relatedness in the exercise domain, 2) determine whether different conditions under which people exercise with others lead to differing outcomes, 3) replicate previous work on the general benefits of engagement in exercise by novice exercisers, 4) explore in what way partners influence each other's exercise outcomes, and 5) interpret the results from the perspective of theories about social influence in exercise.

Goal 1: To Better Understand the Role of Relatedness in the Exercise Domain

First, what was the effect of different amounts of socializing during exercise on satisfaction of the need for relatedness, and also, did socializing have any effects on the other basic needs (for competence and autonomy)? Within the exercise domain, some past studies have found that relatedness is less satisfied than the other two needs, and is often less predictive of motivational outcomes (e.g., Wilson et al., 2006); however, the degree of social interaction experienced during exercise has not been manipulated in any previous study. To fill

this gap, three exercise conditions provided different social experiences, and each were expected to affect perceived relatedness differently. Further, novice exercisers were recruited, because it was expected that satisfying the need for relatedness would have the greatest impact for people at the early stages of an exercise program, and potentially contribute to internalization of exercise regulations (Wilson et al., 2006).

As predicted, exercising with another person, rather than alone at a fitness facility, led to an improvement in satisfaction of relatedness. The study manipulation was successful in that the participants who exercised with a partner reported feeling more relatedness satisfaction. Interestingly, a close connection with the partner seemed unnecessary to satisfy the need for relatedness, and rather a shared focus on exercise seemed sufficient to satisfy this need. This may be due to the nature of the measure assessing psychological need satisfaction, in that the questions about satisfaction of relatedness referred only to the exercise domain. It may be that if participants were queried about the nature of the relationship with their partner outside of exercise, there may have been differences in how well their need for relatedness was satisfied by this relationship. Future research may contrast domain-specific relationships (e.g., a teammate) with relationships that cross a number of domains (e.g., a spouse), in order to determine whether these relationships are different or similar in satisfying relatedness within the exercise domain. Vallerand's (1997) Hierarchical Model of Intrinsic and Extrinsic Motivation provides a framework for understanding how global satisfaction of the psychological needs could influence motivation within a specific domain (such as exercise). Future research on this issue may provide insight into how global satisfaction of relatedness may contribute to exercise motivation.

The two other basic needs, competence and autonomy, were also assessed at pre-study and post-study. I had expected that satisfaction of competence would be greatest for those who

exercised with a partner, because these participants had the opportunity to receive more feedback and guidance from each other than did those who exercised alone; however, there were no significant differences amongst the conditions at post-study. It seems that as people acquire more experience in the exercise domain, their sense of competence grows regardless of social opportunities. Regarding the need for autonomy, I had expected that this need would be most satisfied for participants exercising alone, because they had more opportunity for self-direction; however, satisfaction of autonomy was similar across all three conditions at post-study. Interestingly, even with the constraints placed on participants due to their involvement with the study, they experienced overall improvements in autonomy, suggesting that exercising even with some external controls in place does not hinder satisfaction of autonomy.

Second, how did the degree to which satisfaction of the need for relatedness, compared to satisfaction of the other basic needs for competence and autonomy, relate to motivation for exercise (e.g., self-determined versus extrinsic types of motivation)? The study also investigated the relation of the three needs with exercise behavioural regulations. Satisfaction of relatedness predicted more self-determined motivations to exercise, including intrinsic, integrated, and identified regulations, but unexpectedly, did not have a relation with any of the controlled motivations. Similarly, the needs for competence and autonomy were both positively related with self-determined regulations, but unlike the need for relatedness, competence and autonomy were also negatively related with controlled regulations. This finding indicates that competence and autonomy may have a greater overall impact on the relative autonomy index. As expected based on the literature, the need for competence was unrelated to introjection, although, surprisingly, need for autonomy was related to introjection.

It is an interesting and unexpected finding that before beginning the exercise program, the need for autonomy was positively related with introjection, a more controlled regulation. Previous research has noted that introjection is more likely to arise in situations where relatedness is satisfied in the absence of autonomy (Deci & Ryan, 2000). The results of this study suggest that perhaps relatedness may not be the only psychological need that contributes to introjected regulations. Perhaps satisfaction of autonomy was related to introjection in this sample because this novice sample had fluctuating motivations toward exercise at pre-study, and this relation would not be maintained over time. This idea seems to be supported by the fact that after one month of regular exercise, this relation was no longer significant.

To investigate the relations between exercise regulations and psychological needs further, structural equation modelling was used to investigate the simultaneous impact of all three psychological needs on motivation at pre-study, using the full sample to maximize power. When needs for autonomy and competence were held constant, the impact of the need for relatedness became non-significant. Controlling for competence and relatedness, autonomy remained related only to introjection. Consistent with previous research, competence seemed to have the greatest impact on motivation.

The significant impact of competence on behavioural regulations in the sport and exercise domain may in part be due to the performance and self-evaluative components of these activities. In some ways, reliance on competence to promote more self-determined regulations is problematic, especially if participants who view themselves as being less competent are then less motivated to exercise. This may lead to a failure to initiate an exercise program or to poor adherence to exercise. Some individuals may not acquire a strong sense of competence even with experience, perhaps due to an accurate perception of oneself as being unable to complete the

same activities as other people. Satisfying the need for relatedness may be vitally important for individuals who view themselves as lacking competence at exercise, in order to enhance their intrinsic motivation to exercise.

Goal 2: To Evaluate Whether the Degree of Socializing Engaged in During Exercise Contributes to Different Motivational Outcomes

First, did the extent of socializing engaged in during exercise sessions have an effect on motivational outcomes at the end of the study? We now turn to a discussion of differences in motivational outcomes for the three conditions. I had expected there to be an advantage to exercising with a social partner, but surprisingly, participants who exercised alone and those who exercised with a social partner seemed to perform similarly in terms of enhancement of overall motivation. Participants who exercised with a non-social partner seemed to experience the least motivational improvements, suggesting that exercising with a partner with whom one is not socially connected is less advantageous than exercising alone. In particular, a relationship focused on exercise did not seem to have as much of an effect in reducing external regulation as the other two conditions. This finding may have occurred because participants who exercised with partners had to compromise on timing of workouts, and possibly also on the type, intensity, and duration of exercise, thereby increasing their feelings of external controls. However, this type of restriction did not affect participants who socialized with their partner, perhaps because when one feels socially connected to a partner, the inconvenience of scheduling exercise sessions with that person is outweighed by the perceived benefits. This issue could be explored in future research.

Second, did the extent of socializing during exercise have an effect on motivational outcomes at follow-up? One month after the study ended, I investigated whether motivation had changed or stayed similar to how it was at the end of the study. Interestingly, one month after the study ended, participants who had exercised alone became more controlled in their motivations to exercise. Such a finding was surprising since the restrictions associated with participating in the study were no longer applicable. In contrast, there was no significant change one month later for people who had exercised with a partner. Perhaps participants who exercised alone did not internalize self-determined regulations to exercise as strongly as did those who socialized with their exercise partner. Alternatively, participants who socialized with a partner as part of the study may have learned that this strategy is helpful for enhancing motivation, and so they may have continued to implement this strategy after the study ended, thereby maintaining their level of motivation.

In summary, experiencing a social connection during exercise seemed to provide the greatest benefit to motivational enhancement and also to sustaining motivational gains one month after the study ended. However, further study is required to determine whether these benefits are due to internalization of motivations, or to different types of social behaviour during the follow-up period, and whether these patterns are maintained over a longer follow-up period.

Goal 3: To Replicate Previous Work on the General Benefits of Engagement in Exercise by Novice Exercisers

First, were there improvements over the month in physical/psychological wellbeing, and if so, were these improvements affected by the degree of socializing engaged in during exercise? Contrary to expectations that exercising with a social partner would contribute to enhancement in physical and psychological wellbeing, participants in all three conditions

experienced similar improvements in the indicators of physical/psychological wellbeing (that is, exercise intensity/duration, performance on the fitness test, and subjective vitality). Importantly, participants experienced these benefits after just one month of regular exercise, suggesting that even a moderate increase in exercise participation can have a substantial impact on outlook on life, energy, and fitness. Given that few differences emerged amongst the conditions, it seems possible that these kinds of changes can be attributed at least in part to physiological changes occurring due to the increased physical activity, rather than to social factors. Future research may explore this possibility by assessing physiological changes occurring through exercise, and determining whether these relate to outcomes such as subjective vitality.

Second, were there pre-to-post session improvements in affect, and did these pre-to-post session differences become larger over the month? Similarly, do levels of interest and effort for exercise sessions increase over the month? As expected, exercise improved positive affect and increased tranquillity, and reduced negative affect and decreased fatigue. According to Hsiao and Thayer (1998), experienced exercisers report more mood benefits than novice exercisers, possibly due to greater awareness of the impact of exercise on affect, or because increased fitness contributes to less discomfort during physical activity. Interestingly, in the present study, participants experienced improvement in affect in the early sessions, suggesting that even novice exercisers can also attain these mood benefits of exercise. However, in contrast to typical novice exercisers, participants in the present study may have been more aware of their changes in affect due to the completion of affect measures before and after each session. It may be worthwhile for new exercisers to be made aware of the affective improvement induced by exercise, as this immediately experienced benefit may enhance their interest and motivation in exercise. For instance, personal trainers may include a brief assessment of affect and energy level

before and after exercise sessions and provide exercisers with immediate feedback on such improvements, in addition to measuring physical outcomes.

In addition to looking at whether there was improvement in affective states from before to after each session, I also looked at whether the impact of exercise on these states changed over the four-week study period, with the expectation that more exercise experience would contribute to greater mood improvements. Indeed, improvement in tranquillity after exercise increased over the course of the study, indicating a benefit of greater exercise experience. As participants adjusted to their new exercise habit, they felt increasingly calm after exercising. There were no differences amongst the conditions in improvements in tranquillity, suggesting that perhaps this feeling state is achieved through physiological changes occurring during exercise. The results imply that managing stress and feeling more tranquil, at least in the period immediately following the exercise session, is possible through a 30-minute workout. Interestingly, this result was obtained in a university sample, consisting of students who may have been subject to increasing academic demands and stress as the study, and also their term, progressed.

Also interesting was the effect of exercise on positive affect. As expected, participants who exercised with a partner reported more improvement in positive affect following exercise than did participants who exercised alone, which was consistent with other findings that socializing during exercise contributes to improvements in positive affect (e.g., Gauvin, Rejeski, & Norris, 1996). However, this initial enhancement in positive affect in the partner conditions declined over time. At the end of the study, participants exercising alone or with a partner experienced similar improvements in positive affect. Perhaps the initial boost in positive affect occurred because of a "honeymoon" effect, in which partners enjoyed establishing a new relationship, but then eventually became bored or discovered characteristics of their partner they

disliked. Such an effect may not have been obtained if participants exercised with an established friend, rather than a previously unknown person as part of the study. Future research may demonstrate whether exercising with an established friend contributes to higher positive affect over time. Other types of exercise in which there are a number of participants interacting with one another as on a sports team or a running group, may lead to more sustainable enhancements in positive affect.

Exercise also led to reductions in fatigue and negative affect; however, unlike tranquillity and positive affect, these reductions did not change significantly over the course of the study. Nonetheless, it should be noted that, generally, fatigue and negative affect were not strongly endorsed before exercise, reducing the possibility that greater improvement could be detected over the course of the study. Potentially, a greater effect of exercise on negative affect and fatigue could be observed in a sample that typically experiences greater levels of these feeling states (for example, individuals with mood disorders or physical health problems).

Goal 4: To Explore How Partners Influence Each Other's Exercise Outcomes

First, did partners who exercised together become more similar in their motivations and wellbeing outcomes, consistent with the phenomenon of mutual influence? The nature of the relationship between dyad members was expected to have an impact on outcomes. In particular, partners were expected to influence one another's outcomes, particularly when the relationship focused more on developing a social connection. Surprisingly, the evidence overwhelmingly indicated that partners were no more similar after exercising together for one month than they were before they met. Mutual influence was not evident in the pre- and post-study variables (motivation, need satisfaction, and psychological and physical wellbeing), as well as in the exercise session variables (affect, persistence, and interest). In many ways, these results

are surprising and suggest that partners were functioning rather independently, although they were exercising together.

In retrospect, some features of the study may have hindered the development of a close connection between partners. It is possible that partners may have simply not spent enough time with each other to exert mutual influence on one another. Alternatively, partners may not have discussed topics relevant to the variables assessed, and so they were unaware of each other's motivations to exercise. Mutual influence may have occurred more readily if partners had been required to discuss topics relevant to goals and motivations, or if they were made to feel more united, such as by together selecting and working towards a shared goal.

It is also possible that participants were aware of their partner's motivations to exercise, but did not feel sufficiently attached to their partner to be influenced by their partner's values or behaviours. As noted earlier, partners were assigned to exercise together, and this lack of choice in partner may have impacted on mutual influence. Perhaps people who are beginning a new activity prefer to be influenced by an "inspirational" partner – someone who seems to possess the qualities they would like to embody in this domain, such as an experienced exerciser or a personal trainer. The perception of the other person as a similarly inexperienced peer may have led them to discount the value of one another's goals, motivations, or behaviours. Future research may examine whether novice exercisers are differentially open to influence from exercise partners with varying degrees of experience.

Second, did outcomes for exercising pairs depend on the degree to which their interpersonal styles were complementary? Interpersonal complementarity is another way in which partners may influence one another. Greater interpersonal complementarity was expected to promote psychological need satisfaction, improved motivation, vitality, and fitness. Less

complementarity, especially in the social partner condition, was expected to lead to poorer outcomes. There was some support for these hypotheses. In particular, regarding the social partner condition, being more complementary (similar) on affiliation led these participants to feel more satisfaction of the need for competence at the end of the study. Possibly, the highly affiliative partners provided one another with appropriate levels of support, feedback, and encouragement, which led to greater skill development and also confidence in exercise. This was the only significant outcome in the social partner condition, perhaps because in relationships where partners discuss their personal lives, they come to find other areas of similarity, and so interpersonal complementarity becomes less important.

Somewhat unexpectedly, interpersonal complementarity seemed to be more important to outcomes in the non-social partner condition than in the social partner condition. One possible reason for this finding is that interpersonal style carries more weight in a relationship that requires co-operation on a specific task without a close connection. In particular, complementarity on dominance emerged as more relevant than complementarity on affiliation. Partnerships in which one individual was more submissive and the other was more dominant had a positive impact on satisfaction of the need for relatedness and also the distance walked during the walking test, perhaps indicating that these relationships functioned well and were satisfying to both individuals. However, an unexpected and somewhat contradictory finding was that vitality was lower at the end of the study for non-social partners who were complementary on dominance. This finding regarding vitality suggests that there maybe a downside to a complementary relationship, although it is unclear from these findings why this would be the case. These results seem to suggest that interpersonal complementarity does have an impact on the functioning of exercise partnerships, but unfortunately, the sample size available for these

analyses was quite small, and as such may not provide the full picture. Further assessment using a larger sample size is required to obtain a clearer picture of the relationships amongst these variables.

Goal 5: To Interpret the Results from the Perspective of Theories about Social Influence in Exercise

First, how can the results be understood using the framework of social facilitation? According to social facilitation theory, the presence of other people during an activity enhances effort and engagement in a task, and these outcomes are not dependent upon relationships amongst the exercisers. A lack of differences amongst the three conditions would indicate that relationships in the exercise domain do not improve motivation or fitness. In fact, there were a number of instances in which there were few differences amongst the three conditions; for instance, participants in all three conditions experienced positive changes in physical and psychological wellbeing. As well, satisfaction of autonomy and competence improved in all three conditions. Further, the lack of influence between partners could suggest that interpersonal closeness in this domain is not necessary to enhance perceived need satisfaction and motivation. Such findings suggest that the social relationship between partners does not provide additional benefit beyond exercising in a fitness facility amongst other, unknown exercisers. It is possible that partners received from one another the same kind of information that could be obtained from any other person exercising at the gym at the same time – that is, they were simply influenced by observation of others who were exercising close to them. However, there were also findings demonstrating the benefits of exercising with a partner during exercise, which provide support for SDT.

Second, how can the results be understood within the framework of Self-Determination Theory (SDT)? According to SDT and its sub-theory, Basic Psychological Needs Theory (BPNT), interpersonal relationships are critical to the development of self-determined motivations, and impact upon behavioural outcomes. As such, participants exercising with a partner, especially one with whom they have a social relationship, would be expected to experience enhanced motivations, affective changes, and fitness outcomes. Several study findings provide support for SDT. Specifically, exercising at a fitness facility alone with other unknown exercisers did not result in an improvement in relatedness, thereby indicating that participants did not feel close to other exercisers who were simply present exercising at the same time. In contrast, participants in both partner conditions felt that their need for relatedness was more satisfied.

Importantly, participants who socialized with their partner performed better on motivational outcomes than did those who did not socialize with a partner and those who exercised alone. Exercising together without socializing led to less improvement in controlled regulations than did exercising with a social partner or alone. Possibly, participants who exercised together without socializing felt constrained by scheduling exercise sessions with a partner, and did not have the ameliorating effect of socializing during the sessions. This outcome suggests that the nature of the relationship with the partner is an important variable and a relationship specific to exercise is insufficient to reduce controlled regulations. Although participants who exercised alone seemed to have similar motivations to those who socialized with a partner at post-study, at follow-up there was an advantage to having socialized during exercise. Specifically, social partners expressed similar motivations to exercise as they did at post-study, whereas the motivations of those who had exercised alone became more controlled.

Exercising with a social partner seems to be most effective for reducing controlled regulations over time.

Overall, there is convincing evidence that exercising with a partner is most beneficial in satisfying all three of the basic psychological needs, as well as in enhancing motivation over a longer period of time than either of the other two conditions, thereby providing support for Self-Determination Theory. However, it is worth noting the many benefits of exercising alone in the presence of other people, providing partial support for social facilitation, and suggesting that in the absence of an exercise partner, exercising alone should be considered a reasonable alternative.

Limitations and Future Directions

Much of the research to date regarding the importance of relationships in the exercise domain has been survey or naturalistic in nature, and also has not tracked these relationships over time. The present experimentally manipulated the social conditions in which participants engaged in exercise, and also evaluated exercise-related variables at 12 exercise sessions over four weeks. This novel approach filled an important gap in the literature, but was also subject to several limitations. First, the dyadic analyses require complete data from both participants, and also fairly large sample sizes. In spite of the large number of participants in the present study, there is a possibility that some of the analyses suffered from low power, and therefore some important findings may have been missed. Consider, for example, the hypothesis of mutual influence: To detect a correlation of .30 with power = .8 and alpha = .05, a sample size of 67 dyads would be required. By comparison, in the final sample of the present study, the two partner conditions had a combined sample size of 40. For the future, to collect a sufficient sample size, alternative methods of studying the importance of exercise relationships may be

necessary. Naturally occurring exercise relationships could also be examined with the aim of evaluating changes in need satisfaction and motivation over time in novice exercisers. For instance, relationships between new exercisers and their personal trainers may be an opportunity for assessment of how such relationships lead to changes in need satisfaction, motivation, and fitness.

The present research focused on satisfaction of relatedness within the exercise domain. It may also be worthwhile to explore the role of existing relationships outside of exercise as providing a secure relational base from which new physical activities can be more comfortably explored (Deci & Ryan, 2000). There may be other ways in which relationships may support the initiation and maintenance of exercise beyond that which was evaluated in the present study. Greater satisfaction of relatedness outside of the exercise domain may provide more confidence in exploring activities outside of the relationship. For instance, future research may look at the satisfaction of relatedness obtained from important others such as spouses, family members and peers, and how this affects the taking up of physical activity. Relatedness satisfaction in exercise may occur if the exerciser feels that important others are encouraging, supportive, and interested in their activity, although the exerciser may engage in the activity alone. Relationships outside of the activity context may be sufficient to satisfy the need for relatedness, contributing to sustained interest and engagement in the activity.

The study sample presents another potential limitation. This study examined a specific sample of young, generally healthy, female university students, and so may not be representative of the population as a whole. Future studies may evaluate whether relatedness differentially enhances exercise motivation amongst participants who vary in skill, health, age, or physical ability. As well, an examination of different gender pairings could reveal whether male-male or

male-female exercise partners relate to one another differently and experience different outcomes.

Another potential limitation of the present study was the apparent lack of mutual influence and closeness between partners. Participants were assigned to exercise with previously unknown partners, in order to overcome selection biases in terms of condition or partner, with the expectation that, over time, partners would come to know one another well. Although many dyads completed the study, surprisingly, there was little evidence that they influenced one another's outcomes. Additional experimental intervention may have been required to promote a connection between partners. Participants may have influenced one another more if they were reminded of the instructions to exercise together, either socially or focused on exercise, at every exercise session. Future studies could attempt to enhance the relationship between partners by having them work towards a joint fitness goal, or by requiring that they discuss specified topics during each exercise session. Such interventions may improve satisfaction of relatedness and impact on their exercise outcomes.

A further issue that may affect the connection between partners is the role of each partner in the relationship. In the present study, the partnerships were composed of two peers, with similar levels of exercise knowledge and ability. In a domain such as exercise, perhaps the perception of one's partner as more competent than oneself would enhance the connection to that partner. Partners in the present study may not have considered each other to be sources of reliable feedback or encouragement. In future studies, it would be interesting to examine the relationships between novice and experienced exercisers, to determine if more clearly defined roles enhances the relationship and connection.

In terms of improving engagement in physical activity, this research indicates that if people begin a regular exercise program, over time their motivations toward exercise will improve. Such an outcome, from an SDT perspective, suggests that if people have the opportunity to have their needs satisfied within the exercise domain, their motivation to engage in that activity will improve. Importantly, participants were not provided with many incentives to attend exercise sessions, allowing them to develop their own, intrinsic, motivations to exercise. Such an outcome may have broader implications, in suggesting that motivational change may follow behaviour, and if an individual can be prompted to begin an exercise program, over time their motivations will change to match their behaviour, presumably reinforcing continued exercise engagement.

Conclusion

In sum, the current research introduced a novel approach to understanding the role of social factors in exercise motivation and engagement. This research is particularly relevant given that the majority of the population does not engage in regular physical activity, in spite of the established importance of regular exercise in reducing rates of serious illness and improving mental and physical health. Similarly, this study demonstrated that fitness and psychological wellbeing are improved after just one month of exercising three times per week; however, it is also essential to find ways to increase the fun and interest experienced during physical activity, such as exercising with a social partner, in order to encourage the uptake of regular exercise in the general population. Additional research is necessary to fully understand the benefits of exercising with others in promoting sustained engagement and interest in exercise.

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Appendix A

Materials

Material 1

Recruitment Flyer/Poster

Department of Psychology
University of Waterloo

WOMEN 18-30 YEARS NEEDED FOR PSYCHOLOGY RESEARCH ON *EXERCISE BEHAVIOUR*

We are looking for volunteers to participate in a study of factors that contribute to motivation to exercise.

As a participant in this study, you would be asked to:

- *Exercise for a minimum of 30 minutes at the Columbia Ice Fields 3 times per week for 4 weeks (14 sessions total)*
- *Complete a walking test at the beginning and end of the study*
- *Complete questionnaires at the beginning and end of the study and after each work-out*

To be eligible to participate in this study you must:

- Be a female between 18-30 years of age
- Currently exercise on no more than two occasions per week
- Be free of physical injury and health concerns that prevent exercise

In appreciation for your time, you will receive:

- *Entries to a draw to win 1 of 4 iPod Shuffles*
- *Water/juice & granola bars at each session*

For more details about this study, or to volunteer for this study, please contact:

Exercise Behaviour Study
Department of Psychology
519-888-4567 Ext. 38112 or
Email: *exercisepsy@gmail.com*

This study has been reviewed by, and received ethics clearance through the Office of Research Ethics, University of Waterloo.

Material 2

Orientation Session Protocol (5 pages)

Materials Needed for Session 1:

1) Information and Consent Letter
2) Recording Sheets (Session 1)
3) Clipboards, pens
4) Pre-study questionnaire package
5) Stopwatch
6) Cones to mark out walking course
7) Tape to measure every 3 meters on walking course
8) Water & snack bars to give participants at the end of the session

Outline for Session 1 (1.25 hours)

1) Information and Consent Letter (15 minutes)
2) Complete Pre-study questionnaires (20 minutes)
3) 6 Minute Walk Test (10 minutes)
4) Orientation at CIF (30 minutes)

The first session may be run with between 2-8 participants. Before the session begins, arrive at the CIF at least 15 minutes before participants are scheduled to arrive. Set up the walking course(s) in the gymnasium. Meet participants by the Equipment Desk and take them to the gymnasium where the fitness assessment will be completed. If a participant does not arrive on time, wait 5 minutes. Return to the waiting area to check for them after 10 minutes.

2. Information and Consent Letter

When participants are seated say:

"This study is looking into the attitudes, motivation, and behaviour of people who are just starting a new exercise program. In this study we are testing the benefits of several structured exercise programs on fitness. The programs we are evaluating focus on individualized exercise activities (e.g., running on a treadmill, biking, using the elliptical, weights), rather than group class activities (e.g., aerobics, tai chi classes, and so on). If you agree to participate in the study, today you will complete a short walking test to estimate your fitness, questionnaires, and an orientation of the facility. The entire session today should take about 1 hour and 15 minutes. Following today's session, there will be 12 exercise sessions over the next month (that's 3 exercise sessions per week for 4 weeks). Each exercise session lasts at least 30 minutes, although you may decide to exercise for longer. Following exercise session 12, you will have a final session where you complete a

second walking test and questionnaires. Lastly, myself or another researcher will contact you by phone or email one month after the study ends to ask about your continued participation in exercise.

What I have here are Information and Consent Letters detailing the general requirements of the study. Please take your time to carefully read the forms and let me know if you have any questions. When you are finished reading, if you would like to participate in this study, please then sign and date the end of the consent form."

Hand them each a clipboard with two consent forms and a pen. They will return one consent form to us and take one home with them. Allow participants sufficient time to read the forms. Answer any questions and then make sure they sign and date the form and then you can collect the forms.

"I would like to draw your attention to several areas of the consent form. As you read, it is very important that you attend sessions as regularly as possible. Please note that this study is looking at changes that occur through regular participation in exercise, and so this is not structured as a single session study. It is only through regular participation in physical activity that you will start to notice changes in your fitness level. We will take attendance at each session so it is important you come to exercise at the time scheduled for it to be counted toward your attendance and so, with your agreement, you can be entered in to the draw each time you attend. We understand, however, that sometimes you may need to reschedule a session. If that occurs, please contact the researcher at least a day in advance by email (circle Jennifer Boyd's email) in order to reschedule. Also, just so that you are aware, we will contact you by phone or email if we notice that you are frequently missing sessions."

2. Questionnaires

"I am now going to have you fill out several questionnaires assessing your personality, mood, and attitudes about exercise. Try to fill out each question honestly and to the best of your ability. Remember, you may skip any questions you do not feel comfortable answering. Do you have any questions?"

Orientation Session Protocol Continued

3. Six Minute Walk Test (American Thoracic Society, 2002)

The Six Minute Walk Test will take place in the CIF gymnasium. The walking course will be marked in advance using cones and tape. The course should be a square which is 20 metres by 5 metres. Each corner should be marked with a cone (i.e., four cones should be used). Along the long sides (20 metres, place a piece of tape to mark each 5 metre interval).

BORG Scale: Before beginning, show the participant the Borg Scale. Say, "Please grade your level of shortness of breath using this scale." Record the response. Then say, "Please grade your level of fatigue using this scale." Record the response.

Instruct participant as follows:

"The object of this test is to walk as far as possible in 6 minutes. You will walk around the rectangular course that is marked out by the cones. Six minutes is a long time to walk, so you will be exerting yourself. You will probably get out of breath or become exhausted. You are permitted to slow down, to stop, and to rest as necessary, but resume walking as soon as you are able. You will be walking from cone to cone. You should pivot briskly around the cones and continue walking without hesitation. Now I'm going to show you. Please watch the way I turn without hesitation. (Demonstrate by walking one lap yourself. Walk and pivot around a cone briskly). **Are you ready to do that? I am going to take note of the number of laps you complete. I will place a tick mark on the recording sheet each time you turn around at this starting line. Remember that the object is to walk AS FAR AS POSSIBLE for 6 minutes, but don't run or jog. Ready? Start now."**

As soon as the participant starts to walk, start the timer. Stand at the starting line during the test. Do not talk to anyone during the walk. Use an even tone of voice when using the standard phrases of encouragement. Watch the participant. Do not get distracted and lose count of the laps. Each time the participant returns to the starting line, put a tick mark on the recording sheet. Let the participant see you do it.

After the first minute, tell the participant the following. "**You are doing well. You have 5 minutes to go."**

After two minutes say, "**Keep up the good work. You have 4 minutes to go**."

After three minutes, say, "**You are doing well. You are halfway done**."

After four minutes, say, "**Keep up the good work. You have only two minutes left**."

After five minutes, say, "**You are doing well. You have only 1 minute to go."**

Do not use other words of encouragement (or body language to speed up).

Orientation Session Protocol Continued

When the timer is 15 minutes from completion, say, **"In a moment I am going to tell you to stop. When I do, just stop right where you are and I will come to you."**

Post-test: Record the number of laps using the tick marks from the recording sheet. Record the additional distance covered (the number of meters in the final partial lap) using the tape markers as a guide. Calculate the total distance walked, round to the nearest meter, and record it on the Recording Sheet.

BORG Scale: After the participant finishes walking, show the participant the Borg Scale again. Say, "Before, you said that your level of shortness of breath was (provide number). Please grade your level of shortness of breath now." Record the response. Then say, "Before, you said that your fatigue was (provide number). Please grade your level of fatigue now." Record the response.

Weight & Height: Weigh and measure the height of participants using the weight scale and measuring tape. Complete this activity away from other people. Write weight and height in kilograms and centimetres on the Recording Sheet. Show participants the numbers if they are interested.

4. Orientation at CIF

Before participants start the Orientation, remind participants of when they are scheduled to come to the CIF next.

"You will now be given a tour of the fitness facility and instruction on how to use the exercise equipment. Once the tour is complete today's session is over. I will just go through my notes now and confirm with each of you your next session time."

CIF Tour (conducted by Jennifer Boyd)

Show participants the CIF exercise room. Find out if they have ever been to the CIF before and tailor instructions to their knowledge level. Point out the cloths and disinfectant that they should use to wipe down machines after each use.

"Cardiovascular or aerobic fitness is developed by exercise that raises your heart rate and causes you to breath more heavily and perspire. I'm going to show you a few machines that you can use to improve your cardiovascular fitness or to warm up before doing weight training or stretching. The machines that you can use in here to work on cardiovascular fitness are treadmills, exercise bikes, elliptical machines, rowing machines and step climbers (point to each)." Demonstrate briefly any machines that participant(s) have not used before.

Orientation Session Protocol Continued

"The weight machines in the centre of the room are used to improve strength. There are machines here that target all of the major muscle groups – arms and shoulders, back, abs, and legs. All of the machines have a sticker that shows the muscles it works and shows how the machine works" (point this out on a machine no one is using). "For example, this machine works the ____ muscles. In order to use it you sit on the machine like this (demonstrate).

"When you are just starting a weight training program, it is usually a good idea to work on improving form first before adding a lot of weight. This way you will reduce the risk of injury and will learn how to do the exercise properly (show how to adjust weight). Most have knobs that you pull on to adjust the placement of the seat" (demonstrate).

"Most trainers recommend that when you weight train you complete 2-3 sets of 8-12 repetitions, with a 30-60 second break between each set. Usually you will want the first few repetitions of the exercise to be fairly easy, and the last few to be fairly difficult. The exercises should be completed in a smooth motion – if you drop or feel close to dropping the weight then it is likely too heavy for you."

Demonstrate the following 6 machines: bench press, bicep curl, shoulder press (up), tricep extension, leg extension, leg adduction/abduction (whichever is available)

Have each participant try out at least one machine each and answer questions and provide assistance as needed. Demonstrate any additional machines as requested.

"If you are ever unsure of how to use a weight machine or any other equipment, please ask the CIF's personal trainer on duty. The personal trainer usually wears a shirt that says "personal trainer" and will sit at the desk by the door unless she/he is occupied with helping someone else. Please be sure to always perform exercises properly to avoid injury."

"You can do many similar strength training exercises using the free weights. If you are going to use free weights, be sure that you do not select weights that are too heavy because you may injure yourself. Start out with a lighter weight and work your way up as you become more comfortable. Again, please ask for assistance if you are ever unsure, or if you want to learn some new exercises."

"Exercise mats and Pilates balls are also available in this area (point). You can also sign out equipment, such as skipping ropes or smaller balls from the equipment desk with your Watcard (student ID card)."

Show participants the equipment desk and change room facilities if they are unsure of where these are located.

Material 3

Scripts Explaining the Rationale for each Condition

At the second session, participants were provided with different condition rationales depending on the condition they were assigned to. The scripts provided below were utilized by research assistants to explain the rationale for each condition, in conjunction with the Participant Information Sheets (Materials 4, 5, and 6), which participants retained for their own records.

Exercise Alone Condition

Say the following to the participant and provide them with the Participant Information Sheet for the Exercise Alone Condition (Material 4).

"This handout reviews some important aspects of the study that we discussed at the orientation session. Generally, it says that you will be asked to exercise for at least 30 minutes 3 times per week for one month. As well, it specifies that for you will exercise individually over the next 12 sessions. The purpose of this exercise program is for you to concentrate on the exercise you choose and work towards building your fitness level over the course of the month. Please note, while you may listen to music during your workout, because we want you to be solely focused on the exercise, we ask that you do not bring others with you to your workout and do not engage others during your workout. Please look it over carefully now, and ask me any questions you have."

Non-social Partner Condition

Say the following to the participants and provide them with Participant Information Sheet (Material 5).

"This handout reviews some important aspects of the study that we discussed at the orientation session. Generally, it says that you will be asked to exercise for at least 30 minutes 3 times per week for one month. As well, it specifies that for your workout sessions you will be paired together as "exercise buddies". You should consider this buddy role to be like that of a personal trainer – that is, in your interactions with your partner please concentrate on the exercise you choose to do (e.g., both riding bikes next to each other, both lifting weights together) and work towards building your fitness level over the course of the month. Please note, although it may be tempting to interact socially during the workout or after the workout, we would like you to focus your time with this partner on the exercise itself, so that we may best assess how your focus impacts your fitness level over the course of the month. For example, you may notice that you

spend some of your time in session talking about school, relationships, or other important events in your lives. Please try to refrain from doing this as it may be a distraction from exercise. So that your attention is on the exercise and you are able to interact with each other to facilitate your routine, we also ask that you do not listen to music (e.g., personal ipod) during your workout and do not read magazines. You and your partner will push or encourage each other like a coach or personal trainer encourage athletes"

Social Partner Condition

Say the following to the participants and provide them with Participant Information Sheet (Material 6).

"This handout reviews some important aspects of the study that we discussed at the orientation session. Generally, it says that you will be asked to exercise for at least 30 minutes 3 times per week for one month. As well, it specifies that for your workout sessions you will be paired together as "exercise buddies." You should consider this buddy role to be like that of a personal trainer – to encourage each other in the exercise you choose to do (e.g., both riding bikes next to each other, both lifting weights together) and work towards building your fitness level over the course of the month. Personal trainers often get to know their clients well and become friends. We encourage you to interact socially during the workout, or after the workout, so that you can get to know each other and better support each other's workouts. So that your attention is on the exercise and you are able to interact with each other to facilitate your partnership, we also ask that you do not listen to music (e.g., personal ipod) during your workout and do not read magazines."

Material 4

Exercise Alone Condition Participant Information Sheet

Participant Information Sheet

Congratulations on deciding to become more physically active! In order to ensure that you get the most out of participating in this study, be sure to follow these instructions closely.

For the next four weeks you will be participating in 3 exercise sessions every week, for at least 30 minutes at each session. The purpose of this exercise program is for you to concentrate on the exercise you choose and work towards building your fitness level. You may listen to music during your workout, however please do not interact with other people during your workout. This means that you are not to bring others with you, or to have conversations with other exercisers during your workout. Although it may be tempting to meet with friends or chat with others while at the gym, this may be distracting from your exercise routine. Also, do not read magazines while exercising as this may also serve as a distraction. By following this procedure, you will help us to determine whether focusing on your exercise contributes to changes in your fitness.

People often find it challenging to begin a new exercise routine. It helps to plan ahead so that you make time for exercise in your schedule. Please take a few minutes to write down the days and times (between 8 am- 12 pm on weekdays or 12 – 3 pm on Saturdays) when you plan to exercise over the next four weeks. You may find that it helps you to develop a routine if you exercise at the same time each day.

Session	Date and Time
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Session	Date and Time
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Material 5

Non-social Partner Condition Participant Information Sheet

Participant Information Sheet

Congratulations on deciding to become more physically active! In order to ensure that you get the most out of participating in this study, be sure to follow these instructions closely.

For the next four weeks you will be participating in 3 exercise sessions every week, for at least 30 minutes at each session. You and your partner will meet at the CIF and exercise together at these sessions. You should consider your interactions with your partner to be like that of a personal trainer or coach. When exercising together, please concentrate on the exercise you choose to do (e.g., both riding bikes next to each other, both lifting weights together) and work towards building your fitness level over the course of the month.

Please note, although it may be tempting to interact socially during the workout or after the workout, we would like you to focus your time with this partner on the exercise itself. This means that you should refrain from talking about school, relationships, or other important events in your lives with your exercise partner. Engaging in other conversation may be interesting to you, but it may also be distracting from your exercise. To ensure that your attention is on the exercise and you are able to talk to each other about exercise, we also ask that you do not listen to music (e.g., personal ipod) during your workout and do not read magazines. Also, please do not bring other people with you to the exercise sessions.

You and your partner will push or encourage each other like a coach or personal trainer encourages athletes. Interactions with your partner will be focused on exercising or discussing exercise. You and your partner should decide on exercises to complete together, and this may mean exercising side-by-side, completing partner exercises together (e.g., throwing a ball back and forth), assisting each other with exercise (e.g., spotting during weights or holding toes down during sit-ups). By following this procedure, you will help us to determine whether focusing on your exercise with your partner contributes to changes in your fitness.

People often find it challenging to begin a new exercise routine. It helps to plan ahead so that you make time for exercise in your schedule. Please take a few minutes to write down the days and times (between 8 am- 12 pm on weekdays or 12 – 3 pm on Saturdays) when you and your partner plan to exercise together over the next four weeks. You may find that it helps you to develop a routine if you exercise at the same time each day.

Session	Date and Time
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Session	Date and Time
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Material 6

Social Partner Condition Participant Information Sheet

Participant Information Sheet

Congratulations on deciding to become more physically active! In order to ensure that you get the most out of participating in this study, be sure to follow these instructions closely.

For the next four weeks you will be participating in 3 exercise sessions every week, for at least 30 minutes at each session. You and your partner will meet at the CIF and exercise together at these sessions. You should consider your interactions with your partner to be like that of a personal trainer or coach. Please get to know one another better as you exercise together (e.g., both riding bikes next to each other, both lifting weights together) and work towards building your fitness level over the course of the month.

Personal trainers often get to know their clients well and become friends. We encourage you to interact socially during the workout, or after the workout, so that you can get to know each other and better support each other's workouts. So that your attention is on the exercise and you are able to interact with each other to facilitate your partnership, we ask that you do not listen to music (e.g., personal ipod) during your workout and do not read magazines. Also, please do not bring other people with you to the exercise sessions"

You and your partner will get to know each other by talking about topics that are important to you, such as school, relationships, or other important events in your lives. In addition to getting to know each other better, you will also encourage each other like a coach or personal trainer encourages athletes. You and your partner should decide on exercises to complete together, and this may mean exercising side-by-side, completing partner exercises together (e.g., throwing a ball back and forth), assisting each other with exercise (e.g., spotting during weights or holding toes down during sit-ups). By following this procedure, you will help us to determine whether focusing on your exercise with your partner contributes to changes in your fitness.

People often find it challenging to begin a new exercise routine. It helps to plan ahead so that you make time for exercise in your schedule. Please take a few minutes to write down the days and times (between 8 am- 12 pm on weekdays and 12-3 pm on Saturdays) when you and your partner plan to exercise together over the next four weeks. You may find that it helps you to develop a routine if you exercise at the same time each day, but this is not required.

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Appendix B

Tables

Table 1

Pre-study Descriptive Statistics

	N	Minimum	Maximum	Mean	SD	Skew	Kurtosis
Behavioural Regulations							
Amotivation	168	.00	2.50	.32	.54	1.86	2.81
External	168	.00	4.00	.95	.83	.70	.12
Introjected	168	.00	4.00	1.79	.98	.11	-.39
Identified	168	.00	4.00	2.56	.79	-.38	-.10
Integrated	167	.00	3.25	1.15	.75	.53	-.38
Intrinsic	168	.00	4.00	2.35	.91	-.23	-.58
Relative Autonomy Index	167	-1.99	3.29	.77	1.05	-.22	-.22
Psychological Needs							
Competence	168	.50	6.00	3.65	1.26	-.29	-.28
Autonomy	168	.00	6.00	4.48	1.16	-.85	.88
Relatedness	168	.00	5.67	2.46	1.38	.08	-.82
Psychological/ Physical Wellbeing							
Vitality	168	2.00	6.29	4.05	.86	.09	-.37
Exercise intensity/duration	158	.00	96.00	20.31	16.6	1.10	1.90
Distance walked	167	435.0	843.0	617.55	68.50	.36	1.00

Table 2

Pearson Correlations and Reliability Estimates of Pre-Study Behavioural Regulations (N = 168)

	1	2	3	4	5	6
1 Amotivation	.82					
2 External	.49***	.80				
3 Introjected	-.13	.24***	.73			
4 Identified	-.36***	-.16*	.31***	.76		
5 Integrated	.06	-.10	.27**	.56***	.63	
6 Intrinsic	-.30**	-.33***	-.03	.57***	.47***	.88

Note: $^{t}p < .10$ * $p < .05$ ** $p < .01$ *** $p < .001$

Table 3

Pearson Correlations of Post-study Behavioural Regulations (N = 135)

	1	2	3	4	5
1 Amotivation					
2 External	.34 ***				
3 Introjected	.05	.54***			
4 Identified	-.25**	.04	.37***		
5 Integrated	-.03	.02	.20*	.59***	
6 Intrinsic	-.28**	-.22*	-.04	.50***	.44***

Note: $^{t}p < .10$ * p < .05 ** p < .01 *** p < .001

Table 4

Pearson Correlations between Pre-study Behavioural Regulations and Psychological Needs (N = 168)

	Competence	Autonomy	Relatedness
Amotivation	-.36***	-.22**	-.10
External	-.26**	-.18*	-.02
Introjected	.06	.16*	.01
Identified	.54***	.38***	.32***
Integrated	.47***	.32***	.34***
Intrinsic	.63***	.42***	.40***
Relative Autonomy Index	.57***	.34***	.31**

Note: $^{t}p < .10$ * $p < .05$ ** $p < .01$ *** $p < .001$

Table 5

Pearson Correlations between Post-study Behavioural Regulations and Psychological Needs (N = 135)

	Competence	Autonomy	Relatedness
Amotivation	-.23**	-.14	-.13
External	-.13	-.06	.10
Introjected	-.06	-.06	.06
Identified	.44***	.30***	.26**
Integrated	.46***	.26**	.29**
Intrinsic	.58***	.48**	.26**
Relative Autonomy Index	.47***	.33***	.12

Note: $^{t}p < .10$ * $p < .05$ ** $p < .01$ *** $p < .001$

Table 6

Pearson Correlations between Pre-Study Behavioural Regulations and Psychological Needs with Physical/Psychological Wellbeing (N = 168)

	Subjective Vitality	Distance Walked	Exercise Intensity/ Duration
Behavioural Regulations			
Amotivation	-.05	-.17*	-.06
External	-.01	-.13^{t}	.08
Introjected	-.12	.06	.10
Identified	-.18*	.13^{t}	.16*
Integrated	.26**	.10	.16*
Intrinsic	.35**	.15^{t}	.09
Relative Autonomy Index (RAI)	.28**	.14^{t}	.02
Psychological Needs			
Competence	.35**	.15^{t}	.18*
Autonomy	.16*	.20*	.15^{t}
Relatedness	.31**	.04	.05

Note: ^{t}p < .10 * p < .05 ** p < .01 *** p < .001

Table 7

Pearson Correlations between Post-study Behavioural Regulations and Psychological Needs with Physical/Psychological Wellbeing (N = 137)

	Subjective Vitality	Distance Walked	Exercise Intensity/ Duration
Behavioural Regulations			
Amotivation	-.25**	-.03	.02
External	-.14	-.18*	-.05
Introjected	-.03	-.09	-.08
Identified	-.29*	-.06	.11
Integrated	.30***	.05	.14
Intrinsic	.51***	.03	.08
Relative Autonomy Index	.38***	.15 ^{t}	.14
Psychological Needs			
Competence	.41***	.10	.25**
Autonomy	.25**	.23**	.18*
Relatedness	.15 ^{t}	.14 ^{t}	-.02

Note: ^{t}p < .10 * p < .05 ** p < .01 *** p < .001

Table 8

Means and Standard Deviations of Psychological Needs at Pre-study and Post-study and the Difference (N = 62 dyads)

	Pre-Study	Post-Study	Difference
Perceived Competence			
Exercise Alone	3.55 (1.09)	4.43 (0.98)	0.88***
Non-Social Partner	3.62 (1.22)	4.37 (1.08)	0.75***
Social Partner	3.52 (1.39)	4.18 (1.20)	0.66*
Perceived Autonomy			
Exercise Alone	4.24 (1.36)	5.10 (0.78)	0.86***
Non-Social Partner	4.39 (0.99)	4.82 (0.98)	0.43***
Social Partner	4.52 (1.20)	4.89 (1.27)	0.37
Perceived Relatedness			
Exercise Alone	2.28 (1.37)	2.45 (1.30)	0.17
Non-Social Partner	2.36 (1.35)	3.25 (1.40)	0.89***
Social Partner	2.60 (1.47)	3.28 (1.34)	0.68 ^{t}

Note: ^{t} $p < .10$ * $p < .05$ ** $p < .01$ *** $p < .001$

Table 9

Means and Standard Deviations of Behavioural Regulations at Pre-study versus Post-study and the Difference (N = 62 dyads)

	Pre-Study	Post-Study	Difference
Relative Autonomy Index			
Exercise Alone	0.81 (1.01)	1.39 (0.83)	0.58***
Non-Social Partner	0.65 (1.02)	0.83 (1.31)	0.18
Social Partner	0.67 (1.08)	1.31 (1.00)	0.64***
Intrinsic Regulation			
Exercise Alone	2.38 (0.91)	2.84 (0.77)	0.46**
Non-Social Partner	2.23 (0.82)	2.63 (0.94)	0.40*
Social Partner	2.30 (0.94)	2.88 (0.67)	0.58**
Integrated Regulation			
Exercise Alone	1.20 (0.73)	1.43 (0.77)	0.23*
Non-Social Partner	1.12 (0.78)	1.37 (0.81)	0.25 ^{t}
Social Partner	1.04 (0.77)	1.47 (0.80)	0.43***
Identified Regulation			
Exercise Alone	2.60 (0.78)	3.01 (0.75)	0.41**
Non-Social Partner	2.47 (0.67)	2.90 (0.76)	0.43**
Social Partner	2.49 (0.79)	2.92 (0.67)	0.43***
Introjected Regulation			
Exercise Alone	1.65 (0.76)	1.64 (0.98)	-0.01
Non-Social Partner	2.02 (1.05)	2.31 (1.11)	0.29
Social Partner	1.77 (0.99)	1.97 (1.20)	0.20
External Regulation			
Exercise Alone	1.01 (0.75)	0.70 (0.68)	-0.31*
Non-Social Partner	0.94 (0.95)	1.03 (1.10)	0.09
Social Partner	0.98 (0.87)	0.68 (0.76)	-0.30*
Amotivation			
Exercise Alone	.42 (.58)	.16 (.32)	-0.26**
Non-Social Partner	.36 (.57)	.24 (.38)	-0.12*
Social Partner	.23 (.51)	.14 (.26)	-0.09

Note: ^{t} p < .10 * p < .05 ** p < .01 *** p < .001

Table 10

Means and Standard Deviations of Physical/Psychological Wellbeing at Pre-study versus Post-study and the Difference (N = 62 dyads)

	Pre-Study	Post-Study	Difference
Vitality			
Exercise Alone	4.06 (0.82)	4.56 (0.73)	0.50***
Non-Social Partner	3.95 (0.81)	4.29 (0.90)	0.36**
Social Partner	4.12 (1.09)	4.43 (0.82)	0.31 ^{t}
Distance Walked			
Exercise Alone	621.37 (64.56)	638.60 (69.40)	17.23*
Non-Social Partner	606.60 (72.71)	625.18 (65.96)	18.58**
Social Partner	611.54 (53.06)	630.81 (77.44)	19.27 ^{t}
Exercise Duration/ Intensity			
Exercise Alone	22.39 (14.82)	56.40 (27.43)	34.01***
Non-Social Partner	17.88 (14.64)	50.51 (19.33)	32.63***
Social Partner	16.29 (14.81)	50.69 (17.98)	34.40***

Note: ^{t} $p < .10$ * $p < .05$ ** $p < .01$ *** $p < .001$

Table 11

Intraclass Correlations for Psychological Needs at Pre-study and Post-study and the Difference (N = 62 dyads)

	Pre-study	Post-study	Difference
Competence			
Exercise Alone	-0.16	0.28	0.44
Non-Social Partner	-0.45 [t]	-0.15	0.30
Social Partner	0.28	-0.01	0.29
Autonomy			
Exercise Alone	-0.11	-0.09	0.02
Non-Social Partner	-0.34	-0.33	0.01
Social Partner	-0.09	0.12	0.21
Relatedness			
Exercise Alone	-0.16	-0.37	-0.21
Non-Social Partner	0.34	0.08	-0.26
Social Partner	0.13	-0.01	- \0.14

Note: [t] $p < .10$ * $p < .05$ ** $p < .01$ *** $p < .001$

Table 12

Intraclass Correlations for Behavioural Regulations at Pre-study and Post-study and the Difference (N = 62)

	Pre-study	Post-study	Difference
Relative Autonomy Index			
Exercise Alone	-0.08	0.12	0.20
Non-Social Partner	-0.16	0.13	0.29
Social Partner	-0.32	-0.22	0.10
External Regulation			
Exercise Alone	-0.04	-0.15	-0.11
Non-Social Partner	-0.10	0.36	0.46*
Social Partner	-0.12	0.25	0.37
Introjected Regulation			
Exercise Alone	0.00	-0.03	-0.03
Non-Social Partner	-0.07	-0.02	0.05
Social Partner	-0.09	-0.27	-0.18
Identified Regulation			
Exercise Alone	0.04	-0.28	-0.32
Non-Social Partner	0.26	0.13	-0.13
Social Partner	0.12	-0.08	-0.20
Integrated Regulation			
Exercise Alone	0.06	-0.23	-0.29
Non-Social Partner	0.06	0.05	-0.01
Social Partner	0.11	-0.05	-0.16
Intrinsic Regulation			
Exercise Alone	-0.20	0.02	0.22
Non-Social Partner	-0.27	0.15	0.42
Social Partner	-0.14	-0.48 ^{t}	-0.34
Amotivation			
Exercise Alone	0.13	-0.04	-0.17
Non-Social Partner	-0.09	0.14	0.23
Social Partner	-0.10	-0.34	-0.24

Note: ^{t} p < .10 * p < .05 ** p < .01 *** p < .001

Table 13

Intraclass Correlations for Physical/Psychological Wellbeing at Pre-study and Post-study and the Difference (N = 62 dyads)

	Pre-study	Post-study	Difference
Vitality			
Exercise Alone	-.12	-.37	-.25
Non-Social Partner	-.20	-.32	-.12
Social Partner	.12	-.05	-.17
Distance Walked			
Exercise Alone	-.03	.14	.17
Non-Social Partner	-.22	.17	.39
Social Partner	.27	.54*	.26*
Exercise Intensity/Duration			
Exercise Alone	-.39	.33	.72*
Non-Social Partner	-.29	.28	$.57^{t}$
Social Partner	-.11	.27	.38

Note: $^{t}p < .10$ * $p < .05$ ** $p < .01$ *** $p < .001$

Table 14

Standardized Path Coefficients between Complementarity and Psychological Needs and Tests of Difference between Conditions (N = 40 dyads)

	Affiliation (path a)			Dominance (path d)		
	Non-social	Social	χ^2	Non-social	Social	χ^2
Psychological Needs						
Competence	-.20	.30*	5.47*	.10	-.13	1.17
Autonomy	.16	.24	.44	.01	-.19	.88
Relatedness	-.09	-.04	.05	.37*	-.01	4.07*
Behavioural Regulations						
Relative Autonomy Index	.19	.13	.12	-.12	.07	.65
Physical/Psychological Wellbeing						
Vitality	-.01	-.01	.00	-.25*	.05	2.95 ^{t}
Distance Walked	.05	.11	.10	.39*	-.15	4.98*
Exercise Intensity/ Duration	.24	.20	.02	.15	.13	.11

Note: $^t p < .10$ * $p < .05$ ** $p < .01$ *** $p < .001$

Table 15

Means and Standard Deviations of Behavioural Regulations at Post-study and Follow-up and the Difference (N = 62 dyads)

	Post-study	Follow-up	Difference
Relative Autonomy Index			
Exercise Alone	1.39(.83)	0.83 (1.24)	-0.56*
Non-Social Partner	0.83(1.31)	1.00 (1.25)	0.17
Social Partner	1.31(1.00)	1.06 (0.06)	-0.25
External Regulation			
Exercise Alone	0.70(.68)	1.16 (0.92)	0.46*
Non-Social Partner	1.03(1.10)	0.91 (1.01)	-0.12
Social Partner	0.68(0.76)	0.77 (0.71)	0.09
Introjected Regulation			
Exercise Alone	1.64(.98)	2.15 (1.06)	0.51 ^{t}
Non-Social Partner	2.31(1.11)	2.04 (1.08)	-0.27
Social Partner	1.97(1.20)	2.20 (1.11)	0.23
Identified Regulation			
Exercise Alone	3.01(0.75)	2.74 (.71)	-0.27 ^{t}
Non-Social Partner	2.90(0.76)	2.93 (.63)	0.03
Social Partner	2.92(0.67)	2.85 (.75)	-0.07
Integrated Regulation			
Exercise Alone	1.43(0.77)	1.50 (.80)	0.07
Non-Social Partner	1.37(0.81)	1.41 (.77)	0.04
Social Partner	1.47(0.80)	1.48 (.76)	0.01
Intrinsic Regulation			
Exercise Alone	2.84(0.77)	2.73 (.91)	-0.11
Non-Social Partner	2.63(0.94)	2.66 (.96)	0.03
Social Partner	2.88(0.67)	2.70 (.73)	-0.18
Amotivation			
Exercise Alone	0.16(0.32)	0.39 (.54)	0.23 ^{t}
Non-Social Partner	0.24(0.38)	0.38 (.88)	0.14
Social Partner	0.14(0.26)	0.31 (.53)	0.17 ^{t}

Note: ^{t} $p < .10$ * $p < .05$ ** $p < .01$ *** $p < .001$

Table 16

Means and Standard Deviations of Exercise Intensity/Duration at Post-study and Follow-up and the Difference (N = 62 dyads)

	Post-study	Follow-up	Difference
Exercise Intensity/Duration			
Exercise Alone	56.40(27.43)	78.64 (37.36)	22.24*
Non-Social Partner	50.51(19.33)	58.11 (26.95)	7.60
Social Partner	50.69(17.98)	71.87 (35.05)	21.18*

Note: $^{t}p < .10$ * $p < .05$ ** $p < .01$ *** $p < .001$

Table 17

Intraclass Correlations of Behavioural Regulations at Post-study and Follow-up and the Difference (N = 62 dyads)

	Post-study	Follow-up	Difference
Relative Autonomy Index			
Exercise Alone	0.12	0.02	-0.10
Non-Social Partner	0.13	0.00	-0.13
Social Partner	-0.22	0.44	0.66
Amotivation			
Exercise Alone	-0.04	0.14	0.18
Non-Social Partner	0.14	-0.14	-0.28
Social Partner	-0.34	-0.23	0.11
External Regulation			
Exercise Alone	-0.13	0.28	0.41
Non-Social Partner	0.53	-0.04	-0.57
Social Partner	0.23	0.43	0.20
Introjected Regulation			
Exercise Alone	-0.02	-0.03	-0.01
Non-Social Partner	-0.04	-0.68*	-0.64
Social Partner	-0.28	0.47	0.73
Identified Regulation			
Exercise Alone	-0.28	-0.26	0.02
Non-Social Partner	0.16	-0.29	-0.45
Social Partner	-0.08	0.22	0.30
Integrated Regulation			
Exercise Alone	-0.21	-0.37	-0.16
Non-Social Partner	0.05	-0.42	-0.47
Social Partner	-0.05	0.10	0.15
Intrinsic Regulation			
Exercise Alone	0.05	-0.18	-0.20
Non-Social Partner	0.33	-0.30	-0.63 t
Social Partner	-0.48 t	-0.16	0.32

Note: t p < .10 * p < .05 ** p < .01 *** p < .001

Table 18

Intraclass Correlations of Exercise Duration/Intensity at Post-study and Follow-up and the Difference (N = 62 dyads)

	Post-Study	Follow-up	Difference
Exercise Duration/ Intensity			
Exercise Alone	.34	-.09	-.43
Non-Social Partner	.29	.39	.10
Social Partner	.25	.54	.29

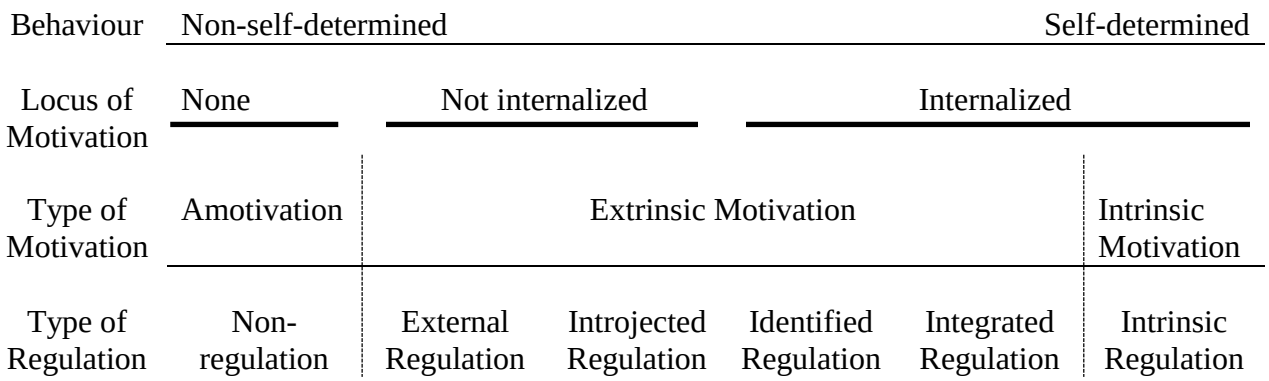
Note: $^{t}p < .10$ * $p < .05$ ** $p < .01$ *** $p < .001$

Appendix C

Figures

Figure 1

Self-Determination Theory continuum.



Source: Adapted from Deci & Ryan (2000)

Figure 2

Pre-study structural equation model of the psychological needs predicting behavioural regulations (N = 168).

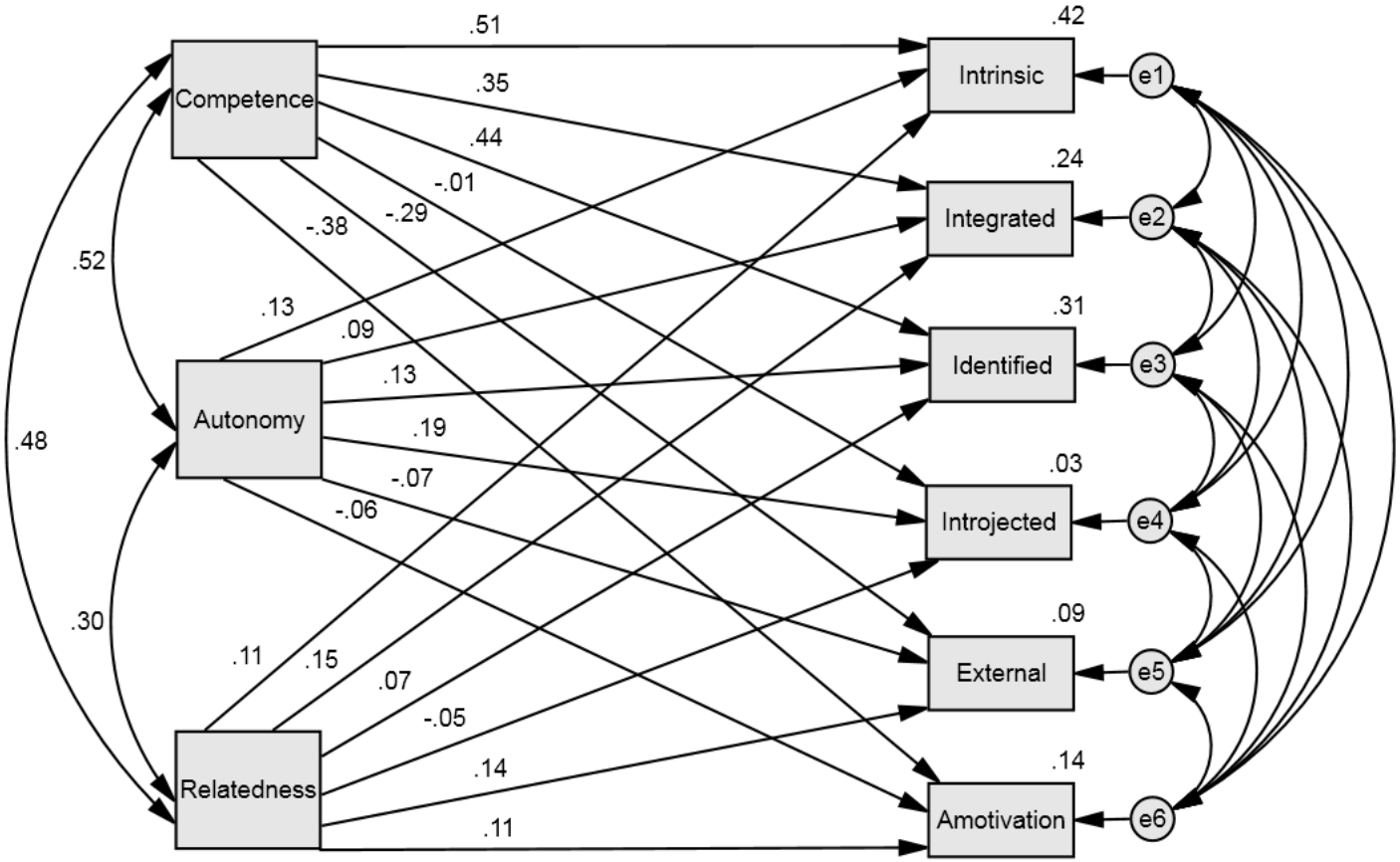
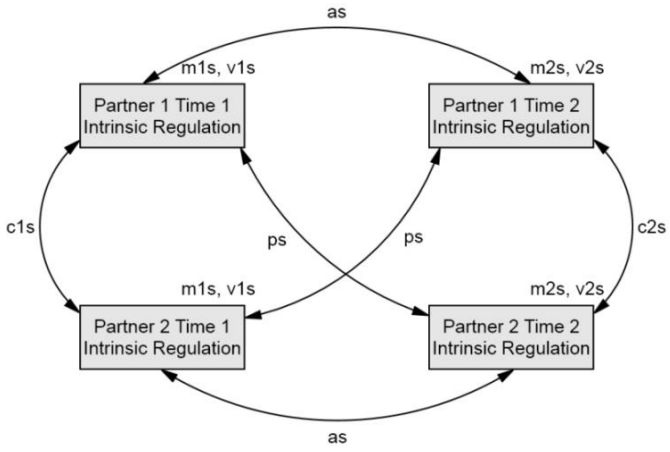


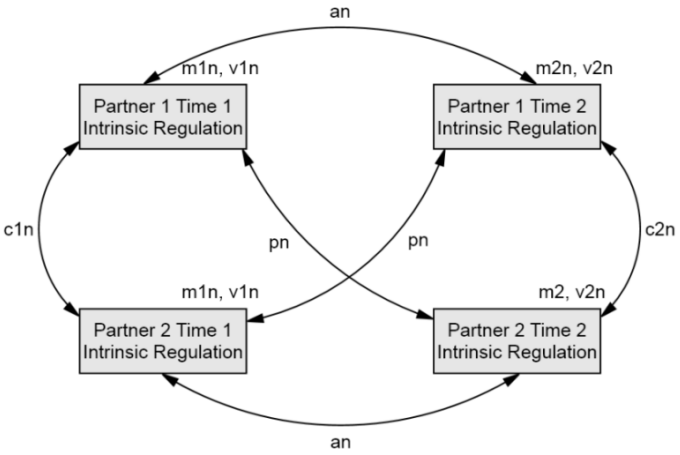
Figure 3

Interdependent data input diagram.

Social Partner Condition



Non-social Partner Condition



Exercise Alone Condition

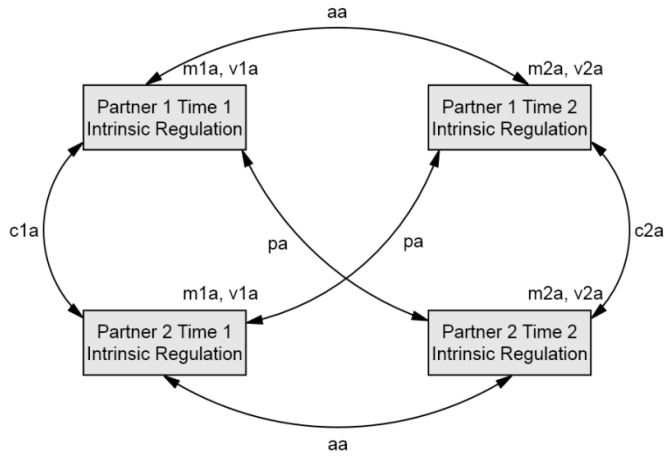


Figure 4

Change in perceived relatedness between pre-study and post-study by condition (N = 62 dyads).

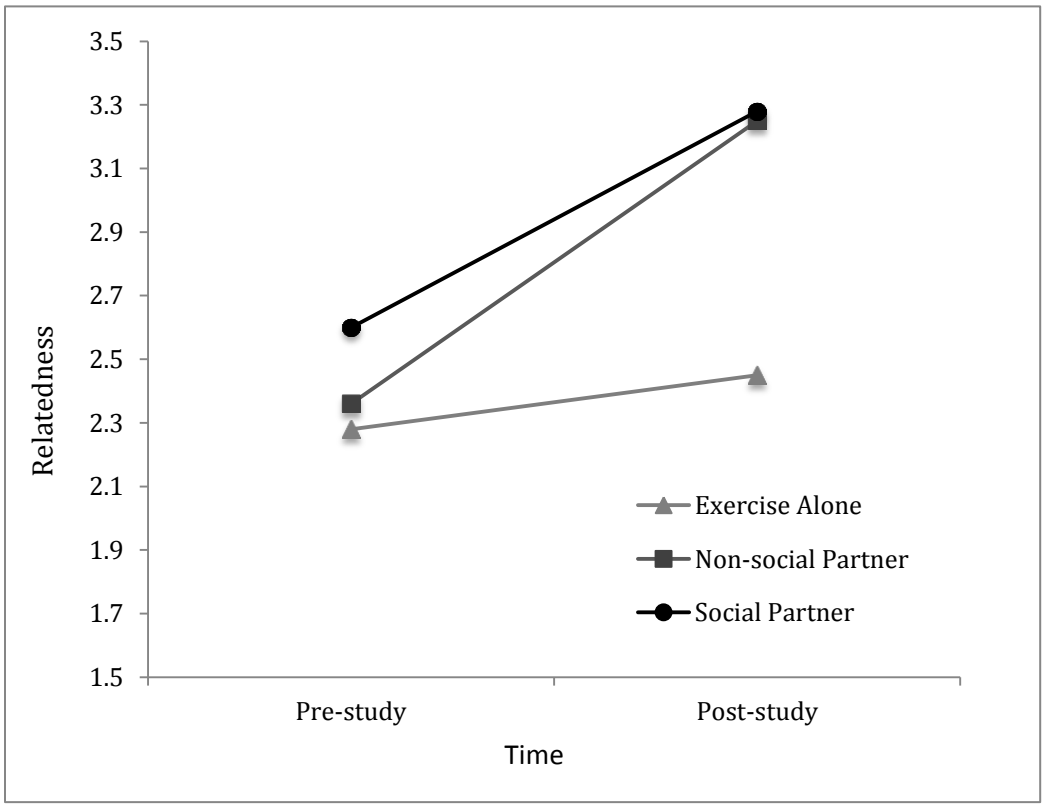


Figure 5

Change in external regulation between pre-study and post-study by condition (N = 62 dyads).

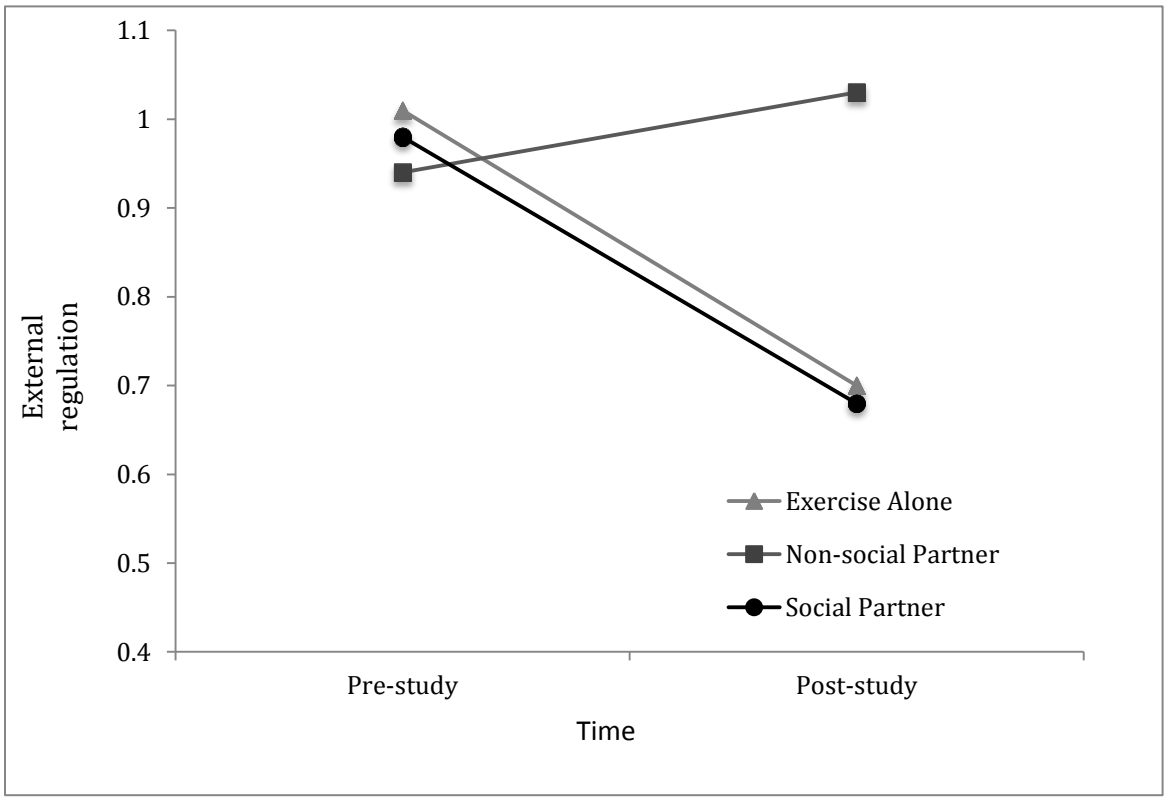
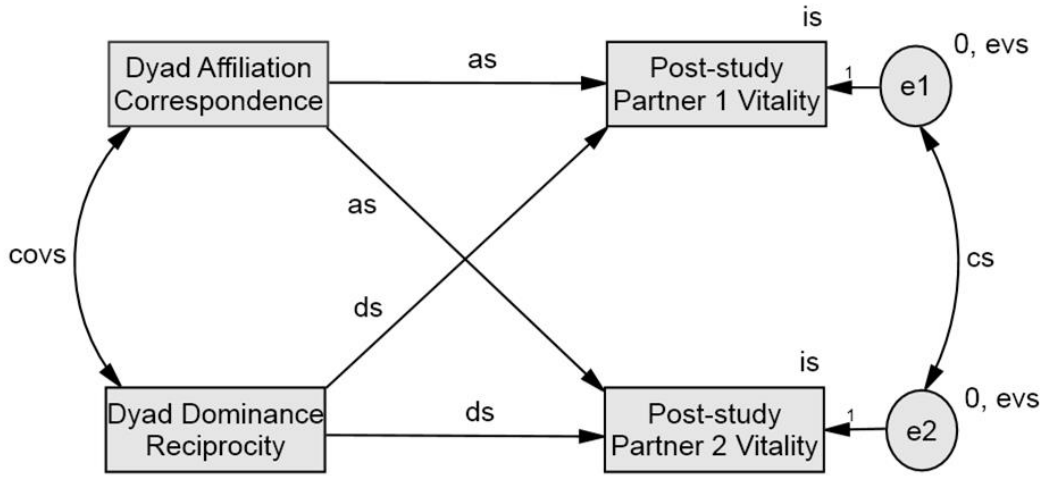


Figure 6

Input model of complementarity analyses for partner conditions.

Social Partner Condition



Non-social Partner Condition

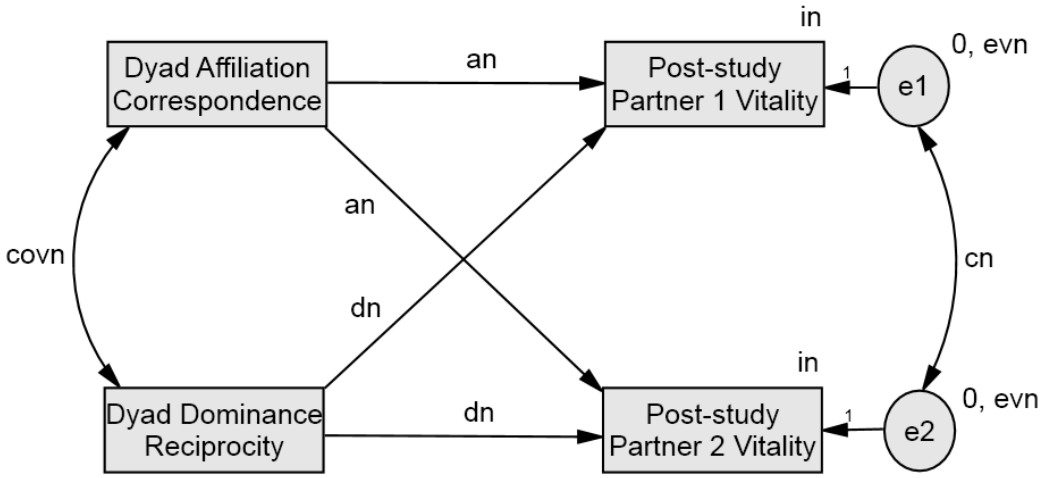


Figure 7

Effect of exercise on positive affect across time blocks by condition.

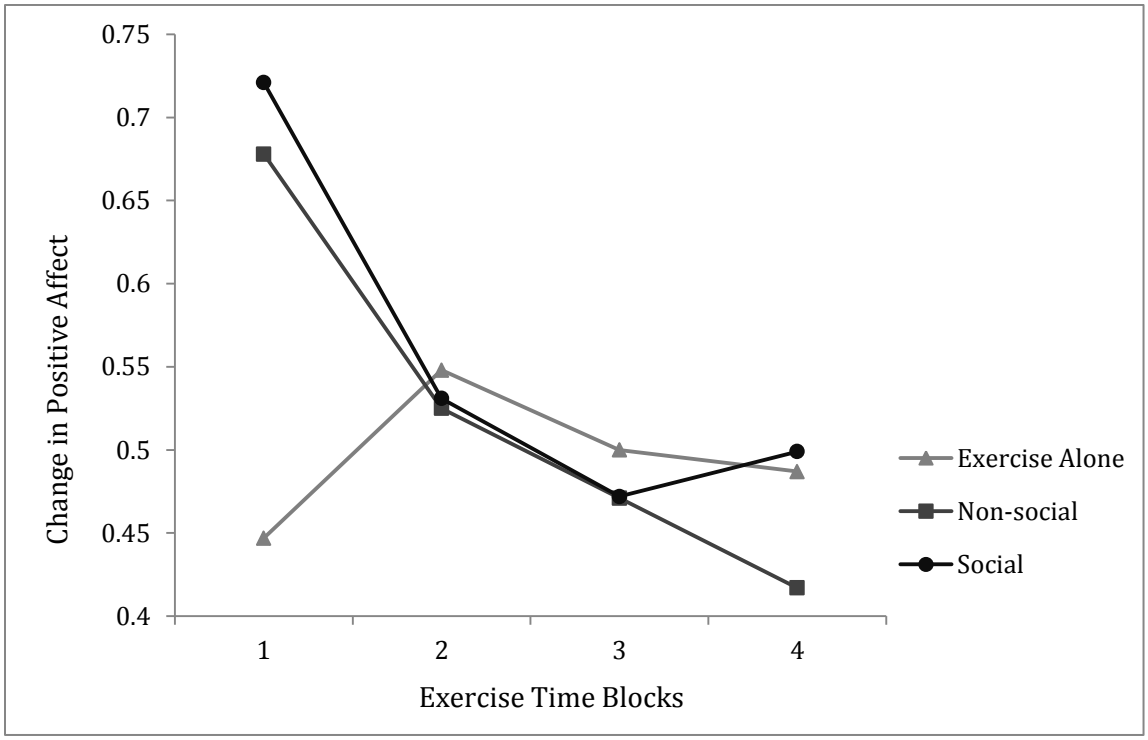


Figure 8

Effect of exercise on tranquillity across time blocks.