PROSOCIAL EXERCISE: DOES EXERCISING FOR CHARITY RESULT IN GREATER WELL-BEING AND PHYSICAL ACTIVITY?

by

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Abstract

Physical inactivity is a prevalent problem, with few Canadians active enough to accrue the health-related benefits associated with exercise (Colley et al., 2011). In response to ineffective physical activity promotion efforts, recent work suggests focussing on well-being as an outcome of exercise to better promote such behaviour (Segar, Eccles, Richardson, 2011; Segar & Richardson, 2014). While hedonic well-being has been reliably linked to increased physical activity behaviour (Rhodes, Fiala, & Conner, 2009), less is understood about the possible effects of eudaimonic well-being on exercise engagement. As prosocial behaviour has been linked to increased hedonic and eudaimonic well-being, and as prosocial motivation has been identified as a powerful means of behaviour change, prosocial exercise (engaging in physical activity to benefit others) may produce increases in well-being and future physical activity behaviour. In order to test this hypothesis, participants were recruited to take part in a six-week experiment, whereby half of the participants were randomly assigned to a *prosocial exercise condition* (and used the prosocial exercise app, 'Charity Miles'), and half were randomly assigned to a *personal exercise condition* (and utilized a standard exercise app, Nike+ Running). Participants' eudaimonic and hedonic well-being was assessed at baseline, two weeks following baseline, and before and after each use of the exercise app (i.e., at the bout-level). Exercise behaviour was assessed at baseline, two and six weeks following baseline, and after each use of the exercise app. It was hypothesized that the participants in the prosocial exercise condition would report greater exercise engagement and eudaimonic and hedonic well-being compared to participants in the personal exercise condition. Multilevel modelling analyses involving data at the bout-level revealed that participants in the prosocial exercise condition reported greater well-being and exercise behaviour compared to those in the personal exercise

condition; however, this relationship was only evident when participation occurred in the winter, and not the summer months. As such, this study pointed to the potential effectiveness of utilizing prosocial exercise interventions when environmental barriers to physical activity engagement are present.

Preface

This thesis is original, unpublished work by the author, Megan Kaulius. This research was approved by UBC Behavioural Research Ethics Board certificate number H14-03018. This study was also registered with the ClinicalTrials.gov Protocol Registration and Results System (clinicaltrials.gov; ID number NCT02573454).

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For Noni.

Introduction

Present Problem

The Canadian population is vastly under-active, with an estimated 15% of adults attaining the nationally recommended 150 minutes of moderate-vigorous activity per week (Colley et al., 2011). Further, nearly 40% of Canadians fail to engage in a minimum of 15 minutes of continuous physical activity in a given day (Colley et al., 2011). As such, a very small proportion of Canadians are active enough to garner the health benefits associated with physical activity (World Health Organization, 2010). With physical activity participation linked to a wide variety of positive health outcomes, including the reduced risk of heart disease, diabetes, osteoporosis, obesity, cancer, weight management issues, and depression (Kesaniemi et al., 2001; Warburton, Nicol & Bredin, 2006), physical activity appears to be an integral component of a healthy lifestyle. In addition, it is estimated that each year physical inactivity costs Canadians $6.8 billion in direct and indirect health-care expenses (Janssen, 2012); thus, indicating an area of both health and economic concern in our country.

To extend beyond Canadian concerns to a more global perspective, the World Health Organization estimates that 3.2 million fatalities a year can be attributed to insufficient physical activity (WHO, 2014), making it the fourth leading cause of death across the globe (WHO, 2010). In fact, being physically inactive is estimated to increase one's risk of dying by 20 to 30% when compared to a sufficiently active individual (WHO, 2014). In response to these findings, the World Health Assembly (the decision making body of the WHO) has sought to increase worldwide physical activity by 10% by 2025, as cited in the most recent Global Action Plan (WHO, 2013). Thus, it is of upmost importance to find ways to promote greater physical activity

adoption and maintenance.

Unfortunately, physical activity interventions have, in general, not proved to be particularly efficacious at increasing physical activity behaviour (Baranowski, Anderson, and Carmack, 1998; Lewis, Marcus, Pate, & Dunn, 2002; Rhodes & Pfaeffli, 2009). To account for this lack of effectiveness, it has been suggested that the *promotion* strategies currently utilized to encourage healthful behaviour may not be particularly effective (Segar & Richardson, 2014). In particular, many traditional methods of exercise promotion have relied on messaging that targets instrumental attitudes instead of messaging that targets affective attitudes (Segar & Richardson, 2014). Instrumental attitudes can be described as a psychological assessment of the utility of a behaviour (e.g., useful versus useless), whereas affective attitudes relate to the psychological assessment of the emotional aspects or feelings associated with a behaviour (e.g., enjoyable versus unenjoyable; Bellows-Riecken, Mark, Rhodes, 2013). As an example, the American College of Sports Medicine's *Exercise is Medicine* initiative clearly appeals to individuals' instrumental attitudes by outlining the medical benefits associated with physical activity as well as the costs associated with physical inactivity (ACSM, 2014). Despite the common use of this strategy, there is much evidence to suggest that the use of instrumentally-based messaging (i.e., "exercise is good for you, so go and exercise") is not as effective as affective-based messaging (Conner, Rhodes, Morris, McEachan, & Lawton, 2011; Segar & Richardson, 2014).

In response to such issues in the domain of exercise and health promotion, recent work has called for a 'rebranding' of exercise behaviour (Segar, Eccles, Richardson, 2011). Specifically, it has been suggested that highlighting well-being as a consequence of exercise (i.e., targeting *pleasure* and *meaning* attainment) would be a more successful means of physical activity

promotion (Segar & Richardson, 2014). To further explore this notion, a discussion of well-being is elaborated on below.

Well-Being

Well-being has been generally explored from two distinct perspectives related to *hedonia* and *eudaimonia* (Delle Fave, Brdar, Freire, Vella-Brodrick, Wissing, 2011; Ryan & Deci, 2001). Broadly speaking, well-being from a hedonic view is outcome-focussed in that it is concerned with the experience of pleasure and the avoidance of pain (Huta & Deci, 2010; Peterson, Park & Seligman, 2005; Ryan, Huta & Deci, 2008), and is reflected in work by prominent researchers such as Kahneman (1999). Hedonic well-being is often equated to happiness (Ryan & Deci, 2001) and assessed through evaluation of Subjective Well-Being (SWB; Diener & Lucas, 1999). Specifically, subjective well-being is conceptualized as the absence of negative affect, the presence of positive affect, as well as higher levels of life-satisfaction (Ryan & Deci, 2001).

While hedonic well-being is related to feeling states, eudaimonic well-being is tied to more existential concerns (Keyes, Shmotkin, & Ryff, 2002). Eudaimonia is rooted in Aristotelian philosophy (i.e., *Nichomachean Ethics*, 2014), and is more content- and process-focussed, with pursuing a life of virtue and excellence descriptive of eudaimonic well-being (Huta & Deci, 2010; Ryan et al., 2008). This pursuit is purported to provide the self with a sense of *meaningfulness* (Ryff, 1989). There are a number of prominent eudaimonic theories of well-being, all which define the concept of eudaimonia in a myriad of ways. For example, from a self-determination theory (SDT) standpoint, eudaimonic well-being is purportedly attained through the satisfaction of the basic psychological needs for autonomy, competence and relatedness (Ryan & Deci, 2001; Ryan et al., 2008). As a cornerstone of SDT, Basic Psychological Needs

Theory suggests that the satisfaction of such needs will lead to flourishing, whereas the thwarting of these needs will lead to suffering (Deci and Ryan, 2000). Relatedly, Ryff and colleagues define eudaimonic well-being through the conceptualization of psychological well-being which is argued to be comprised of personal acceptance, positive interpersonal relationships, autonomy, environmental mastery, having purpose in life, and personal growth (Ryff, 1989; Ryff & Singer, 1996). Related still, Waterman (1993) singled out self-actualization, as signified by personal expressiveness, as the embodiment of eudaimonic well-being. Perhaps the most encompassing description of eudaimonia comes from Seligman's (2002) description of the meaningful life which largely reflects being connected to something greater than the self. Similarly, meaning has been defined by others as an understanding of and feeling the significance of one's existence (Steger, Frazier, Oishi, & Kaler 2006), and has been depicted as an important and central indicator of global well-being (Huta & Ryan, 2010; Ryan & Deci, 2001).

As illustrated through a call for the 'rebranding' of exercise, a particular focus on the *affective* and *meaningful* aspects of this behaviour has been identified as being particularly important, which may provide an effective avenue for physical activity promotion (Segar et al., 2011; Segar & Richardson, 2014). As such, a discussion of the current findings on well-being and physical activity will be outlined, and my research topic will be discussed.

Well-being and Physical Activity

In the domain of physical activity, one particular dimension of hedonia is the focus of much attention in physical activity research. Specifically, explorations of affect and exercise behaviour have been prominent in the literature. Affect (also referred to as "core affect"; Ekkekakis, 2013) can be described as the most basic, valenced (positive or negative), discernible

feeling state (Ekkekakis, 2013; Russell & Feldman Barrett, 1999). Specific examples of affect include "a sense of pleasure or displeasure, tension or relaxation, and depression or elation" (Russell & Feldman Barrett, 1999, p. 806). While affect provides the underpinnings for mood and emotion, affect is said to be more general than these constructs, and involves a lack of cognitive processing (Ekkekakis, 2013; Fredrickson, 2001; Russell & Feldman Barrett, 1999). Additionally, affect is constantly detectable, and hypothesized to orient oneself to desirable (through the experience of positive affect) and undesirable (through the experience of negative affect) stimuli (Ekkekakis, 2013).

As would be predicted by hedonic theory (e.g., Kahneman, 1999), research suggests that experiencing positive affect (e.g., enjoyment) during physical activity bouts is predictive of future exercise engagement (Kwan & Bryan, 2010; Schneider, Dunn, & Cooper, 2009; Williams et al., 2008; Williams, Dunsiger, Jennings, & Marcus, 2012). To illustrate the real-world application of such findings, novel work that has utilized positive affective judgements associated with exercise, such as through the use of video game biking (Warburton et al., 2007) and music (see Karageorghis & Priest, 2012a and 2012b for a review), has been successful in demonstrably increasing physical activity behaviour. Furthermore, in a recent meta-analysis, the presence of affective judgments (e.g., enjoyment) in exercise settings revealed a medium-to-large effect size in relation to elevated physical activity behaviours (Rhodes, Fiala, & Conner, 2009). Additionally, when compared to instrumental judgements (e.g., cognitions about exercise pertaining to increased health), affective judgements had a larger effect on physical activity outcomes (Rhodes et al., 2009).

Conversely, eudaimonia has been explored considerably less than hedonic forms of well-being in health contexts (Roepke, Jayawickreme, & Riffle, 2013). However, recent research has provided preliminary evidence to suggest that the pursuit of exercise-related hedonic *and* eudaimonic well-being outcomes may lead to greater exercise behaviour. For example, middle-aged women that reported exercising in order to decrease stress and attain a general sense of well-being were more likely to plan to engage in exercise, and actually engage in physical activity behaviour compared to individuals that reported engaging in exercise to attain other goals (Segar, Eccles, & Richardson, 2008). As such, it was suggested by these researchers that the varying psychological values associated with exercise-related goals will differentially affect motivation and behaviour. In particular, motives related to hedonic and general well-being were implied to be highly effective in producing desired exercise behaviour.

Similarly, in a longitudinal mixed-methods study that explored middle-aged women's reasons for being physically active, participants reported equally valuing quality of life, aging, and current health goals in their exercise-related pursuits, with appearance goals reported as significantly less valued (Segar et al., 2011). However, well-being goals (i.e., quality of life) emerged as the strongest predictor of exercise behaviour compared to aging, current health, and appearance goals at baseline, one month, and one year following baseline. Thus, as argued by Segar et al. (2011), exercise could be more compelling when made personally meaningful for the individual, and exercise adherence would be made greatest by promoting a focus on outcomes that directly impact the general well-being of individuals.

The need to consider *both* eudaimonic and hedonic well-being in exercise contexts is warranted for a number of reasons. First, as evident above, while the relationship between affect

and exercise engagement has been well-documented, considerably less is known about the relationship between eudaimonic well-being and future exercise behaviour. Second, there is evidence to suggest that eudaimonia and hedonia contribute to overall well-being in distinctive ways (Huta & Ryan, 2010; Keyes et al., 2002). Third, as the attainment of both hedonia and eudaimonia have been demonstrated to lead to greater overall well-being (Peterson et al., 2005), researchers have argued that explorations of well-being should include both hedonic and eudaimonic considerations (Henderson & Knight, 2012; Seligman, 2002; Ryan & Deci, 2001). Finally, as mentioned previously, greater physical activity engagement may occur if both the eudaimonic and hedonic aspects of exercise are highlighted and pursued.

As previous research has provided evidence to suggest that increasing positive affect in novel ways may be a successful strategy to increase physical activity (Karageorghis & Priest, 2012a & 2012b; Warburton et al., 2007), research appears warranted to explore other novel methods to promote well-being in exercise-related contexts. Furthermore, research should work towards developing a greater understanding of the relationship between eudaimonia and physical activity. In doing so, we may be able to ascertain whether the experience of both hedonic and eudaimonic well-being is effective in increasing exercise engagement (Segar et al., 2011; Segar & Richardson, 2014). As such, it would be of interest to explore the effects of novel methods designed to increase both hedonic and eudaimonic well-being in individuals within physical activity contexts. The novel method of intervention utilized in the current study (described in greater detail in the Methods section) involved examining the extent to which a mobile application (app), that allows participants to both log the amount of exercise they have performed and also raise money for charity in the process, could increase physical activity

behaviour. Specifically, by testing the efficacy of this app as a method of intervention, it was possible to examine the extent to which the app is able to differentially foster improvements in hedonic and eudaimonic well-being, as well as physical activity behaviour, when compared to a standard exercise monitoring app. This intervention was identified as a potentially viable method of enhancing both well-being and physical activity behaviour, by virtue of 'harnessing' the power of prosocial behaviour. *Prosocial behaviour*, or behaviour undertaken voluntarily with the aim of aiding or benefitting others (Bierhoff, 2005; Penner, Dovidio, Piliavin, & Schroeder, 2005), has many forms, and has been linked to the experience of hedonic and eudaimonic well-being in a wide range of studies.

Prosocial Behaviour

One popular form of prosocial behaviour is volunteering, which by the United Nation's definition must be undertaken free of obligation or financial reward, and must benefit the common good (Hockenos, 2011). Volunteering is a prevalent activity, with approximately half of the Canadian population aged 15 years or older engaging in some form of volunteerism in 2010 (Vezina & Crompton, 2012). In fact, these 13 million volunteers served as many hours as a staggering 1 million full-time jobs, with the vast majority (93%) citing altruistic motives for their volunteer engagement (Vezina & Crompton, 2012). Despite these altruistic motives to engage in prosocial behaviour, volunteering is correlated with a wide variety of positive intra-individual mental health outcomes (see Jenkinson et al., 2013). Of particular interest, increased well-being has been highlighted as a consequence of volunteering.

In an early study by Magen and Aharoni (1991), a link between volunteer engagement and the experience of positive psychological states was demonstrated. Through this work, it was

shown that high school students involved in volunteer work reported greater intensity in their positive experiences when compared to students who were not prosocially involved. Furthermore, Thoits and Hewitt (2001) explored the benefits of volunteering on well-being by looking at data from the *Americans' Changing Lives* study at baseline, and again three years later. In addition to an increase in reported mastery and physical health and a decrease in depression, hours of volunteering at baseline was associated with increased happiness three years later. This relationship remained even after controlling for baseline well-being and other community-based participation (i.e., belonging to a church or secular organization). More recently, it was demonstrated that volunteer engagement resulted in increased happiness, whereas significant decreases in well-being were detected in individuals that stopped volunteering (Meier & Stutzer, 2008). Additionally, findings by Borgonovi (2008) supported the positive relationship between increased volunteering and positive emotional outcomes. In this research, a dose-response relationship between volunteering and happiness was evident, with more time spent volunteering associated with an increased likelihood of reporting happiness. For example, individuals that reported volunteering on a monthly basis were 7% more likely to be very happy over those that did not volunteer, and weekly volunteers were 16% more likely to report being very happy over non-volunteers.

While the link between general and hedonic well-being and volunteerism is apparent, the association between volunteering and *eudaimonic* well-being is also evident in the literature. For example, in a German sample, volunteers reported greater feelings of meaning in their lives compared to non-volunteers from the general population (Schnell & Hoof, 2012). Additionally, longitudinal data from the *National Survey of Midlife* in the United States indicated that

eudaimonic, but not hedonic, well-being was predicted by volunteering (Son & Wilson, 2012). Further longitudinal evidence corroborates these findings, as volunteering during college years was found to have a positive relationship with eudaimonic well-being thirteen years later (Bowman, Brandenberger, Lapsley, Hill, & Quaranto, 2010). As such, in addition to producing hedonic gains, volunteering has been linked to producing long-lasting eudaimonic outcomes as well.

In addition to organized volunteerism, various other forms of prosocial behaviour have been linked to similar well-being outcomes. While the possible eudaimonic consequences are not well understood, there are a multitude of studies that have explored the relationship between hedonia and engaging in other forms of prosocial behaviour. For example, in Harris' (1977) seminal study, it was demonstrated that participants who helped a confederate pick up a piece of paper reported an increase in their mood relative to the pre-helping incident and when compared to participants that were not given the opportunity to provide assistance to others. Additional research provides further evidence for the postulate that a wide range of helping behaviours result in an increase in intra-personal positive affect, including aiding in a sorting task (Williamson & Clark, 1989), filling out questionnaires (Batson, Coke, Jasnoski, & Hanson, 1978; Yinon & Landau, 1987), and committing five random acts of kindness per day (Lyobomirsky, Sheldon, & Schkade, 2005). In sum, it appears that engaging in behaviour to benefit others often results in positive personal experiences for the benefactor.

Interestingly, there is some evidence to suggest that a certain type of relatively simple helping behaviour could provide increased emotional gains. To illustrate, a study that examined the effects of volunteering and charitable donations on well-being for older adults indicated that

while there was a positive relationship between volunteering at baseline and well-being nine years later, the effect of charitable donations (in any amount) on well-being was even greater (Choi & Kim, 2011). In line with this finding, there has been much recent research to suggest that spending money on other people (i.e., prosocial spending) results in greater happiness than spending money on oneself (i.e., personal spending; Dunn, Aknin, & Norton, 2008). This finding has been demonstrated in both correlational and experimental work, across various contexts, and with a wide range of individuals.

Prosocial Spending: Correlational Evidence

Cross-sectional research by Dunn et al. (2008; Study 1) indicated that prosocial, and not personal, spending was predictive of happiness for a large sample of Americans. When asked to estimate how much of their last month's income was spent on personal expenses (such as bills and personal gifts) and prosocial expenses (such as purchases for others and donations to charity) only prosocial spending was linked to greater happiness (i.e., hedonic well-being). Additionally, employees that spent their annual bonuses in a prosocial manner experienced greater increases in happiness, whereas personal spending, bonus size and annual income did not have an effect on happiness (Dunn et al., 2008; Study 2).

These findings were advanced through the demonstration that this was not a solely North American phenomenon. In order to test the universality of the emotional benefits of prosocial spending, Gallup World Poll data were analyzed from 136 countries around the world, with over 230,000 participants (Aknin et al., 2013a). The relationship between prosocial spending (as indicated by a 'yes' or 'no' response to a question inquiring whether an individual made a charitable donation in the previous month) and well-being was assessed. The results indicated a

positive relationship between prosocial spending and well-being in a large proportion of countries (120), although this effect was not statistically significant in all instances, possibly due to issues of low statistical power in certain countries (Aknin et al., 2013a). However, when amalgamated into seven distinct geographic regions (i.e., Africa; Asia; Western Europe; Eastern Europe; Latin America; the Middle East; and the United States, Canada, Australia, and New Zealand) to maximize statistical power, this relationship was found to be statistically significant. Interestingly, from analyzing these multinational data, Aknin and colleagues (2013a) were able to determine that a non-prosocial spender would have to earn twice that of a prosocial spender to attain similar levels of well-being. As such, the correlational data suggest a clear relationship between prosocial spending and hedonic well-being.

Prosocial Spending: Experimental Evidence

Although the correlational findings discussed above are certainly intriguing, these studies do not allow for causal claims pertaining to prosocial spending and happiness. However, experimental findings do provide evidence to suggest a direct causal link between prosocial spending and greater positive emotional outcomes when compared to the emotional consequences of personal spending.

In the first study to experimentally test this phenomenon, Canadian university students were presented with money in the morning, and through random assignment, were instructed to spend their money on themselves or on another person within the day (Dunn et al., 2008; Study 3). The participants in the prosocial spending condition reported greater happiness at the end of the day compared to those in the personal spending condition. Extending beyond participants from a relatively wealthy nation, this relationship was also demonstrated with individuals from

more economically disadvantaged countries (Aknin et al., 2013a). For example, university students in both Canada and Uganda reported greater happiness when they reminisced about a prosocial spending experience compared to a personal spending experience (Aknin et al., 2013a). Additionally, adults in India also reported greater happiness after recalling a prosocial purchase over a personal one. Furthermore, students in Canada and South Africa reported greater happiness when they donated a gift to an anonymous child in a hospital, over receiving the gift for themselves (Aknin et al., 2013a). Despite the vast economic differences between the two countries' participants (e.g., over one-fifth of the South African participants reported struggling to afford food within the last year, whereas less than four percent of Canadians reported this issue), the connection between prosocial spending and happiness remained.

Furthermore, a separate research team was able to replicate and extend the above findings (Geenen, Hoheluchter, Langholf, & Walther, 2014). In this study, German students were either informed that they would be given money based on completing a task (i.e., expected gain) or unexpectedly given money following the task (i.e., unexpected windfall), and assigned to spend money prosocially or on themselves. Supporting earlier findings, the results of this study indicated that participants that spent money prosocially reported greater happiness compared to participants that spent money on themselves, regardless of earning condition.

Finally, in addition to this cross-cultural evidence, a study with children also demonstrated the positive effects of prosocial giving at a young age (Aknin, Hamlin & Dunn, 2012). Toddlers that gave some of their own treats to a puppet showed greater expressions related to happiness, over and above receiving the treat themselves, or handing treats to a puppet from the researcher's collection. With this work, it was demonstrated that personally costly giving resulted in greater

hedonic well-being for young children when compared to giving that was not personally costly.

When taken together, the experimental evidence indicates that the positive outcomes of prosocial spending are not simply momentary, and can persist through recall of such experiences as demonstrated with such studies in Uganda, India, and Canada (Aknin et al., 2013a). Additionally, it appears that experiencing a social connection in relation to the recipient (i.e., personally knowing the recipient of the altruistic behaviour) is not necessary to garner the emotional benefits of prosocial spending, as evidenced throughout the anonymous nature of the study conducted with participants in Canada and South Africa. (Aknin et al., 2013a).

Finally, evidence for a "positive feedback loop" (Aknin, Dunn, & Norton, 2011, p. 352) linking prosocial spending and increased happiness has been detected (Aknin et al., 2011). When randomly assigned to recall an instance of prosocial or personal spending, those that reminisced about a prosocial spending experience reported greater happiness compared to those that remembered a personal spending occurrence, supporting previous research. Interestingly, happier participants were more likely to choose to spend prosocially in the future, regardless of their original recall condition. Thus, while the experience of prosocial spending promotes hedonic well-being, the experience of hedonic well-being also appears to promote prosocial spending (Aknin et al., 2011). In sum, as the positive emotional outcomes of prosocial spending have been detected across cultural settings (Aknin et al., 2013a) and age groups (Aknin, et al., 2012), it appears that the benefits garnered from prosocial spending have the potential to impact a wide range of individuals across different contexts. When considered in concert, the correlational and experimental evidence reported in these studies suggest that the relationship between prosocial spending and positive emotional outcomes appears to be robust, and could be self-sustaining by

promoting such future behaviour through the experience of hedonic well-being. Thus, utilizing prosocial spending may be a viable mode to promote future behaviour engagement.

Prosocial Motivation

Research in the field of organizational behaviour provides additional support for the proposition that prosocial activity may lead to behaviour change. As well as increasing positive affect, prosocial acts have been examined in the literature as a source of enhancing motivation. Research from Grant and colleagues revealed that prosocial motivation, or being driven to have a positive effect on others (Grant, 2007; Grant & Berg, 2010), can affect behaviour in workplace settings. Through early demonstrations of this phenomenon, it was revealed that employees both persisted longer during work tasks and were objectively more successful after undergoing a prosocial intervention (Grant et al., 2007). Specifically, employees that met with individuals believed to be impacted by their efforts showed markedly increased job performance. For example, university call-centre employees that met with a student that received a scholarship through alumni donations (i.e., a beneficiary of the employees' work) doubled the time spent on the phone with potential donors compared to pre-intervention averages. Furthermore, these employees went from raising, on average, under $200 in donations one week pre-intervention to collecting over $500 in a week one-month post-intervention. The ease of implementation and cost-effectiveness of this strategy has been highlighted by experts in the field as particularly noteworthy and impactful (Dominus, 2013).

Further work by Grant and colleagues provided additional support for the effectiveness of prosocial motivation in a variety of work and volunteer contexts. For example, hospital employees increased hand washing behaviour following a simple prosocial priming intervention

(Grant & Hoffman, 2011), and reflecting on experiences as a benefactor increased both exerted effort at work and the likelihood of making voluntary donations when compared to reflecting on the experiences of being a beneficiary (Grant & Dutton, 2012). Taken together, prosocial motivation appears to have a powerful effect on future behaviour.

Interestingly, work done by these researchers highlights a potential explanatory mechanism of perceived *prosocial impact* that links prosocial acts to the positive outcomes reported in the literature. Perceived prosocial impact can be defined as the subjective belief that one is benefiting others (Grant & Campbell, 2007), and was found to predict increased well-being in an organizational setting (i.e., job satisfaction), as well as protect individuals from burnout derived from high perceived antisocial impact (Grant & Campbell, 2007). Specifically, Grant and Campbell (2007) reported that burnout was found to occur when employees' believed that they caused harm to others, but not when these employees also perceived that their actions benefited others as well (i.e., a nurse giving an injection to a toddler could evoke feelings of both antisocial and prosocial impact). In a separate study, the relationships between (a) low intrinsic motivation, (b) negative self-evaluations and (c) negative task-evaluation in relation to the experience of negative affective outcomes was buffered by perceived prosocial impact (Grant & Sonnentag, 2010). The protective nature of perceived prosocial impact also translated into improved objective job performance ratings (Grant & Sonnentag, 2010). Additionally, perceived prosocial impact does not only appear to protect against the experience of negative affect, but appears to boost the likelihood of positive affective experiences as well. For example, firefighters that perceived their own prosocial impact during the working day experienced greater positive affect at bedtime (Sonnentag & Grant, 2012). This observed spillover effect is of particular interest as

perceived prosocial impact did not contribute to increased positive affect immediately after work, perhaps suggesting that the emotional outcomes of such acts may take longer to emerge (Sonnentag & Grant, 2012).

Building on this finding, a couple of studies have demonstrated that prosocial impact may account for the relationship between prosocial spending and the emotional outcomes of the act (Aknin, Dunn, Whillans, Grant & Norton, 2013b). Specifically, participants experienced greater subjective well-being when they made large donations to a charity that was explicit about the impact of those donations (i.e. Spread the Net, http://plancanada.ca/spreadthenet) compared to large donations to a charity that was vague about how donors' funds were used (i.e. UNICEF, http://www.unicef.ca; Aknin et al., 2013b, Study 1). In this study, prosocial impact was found to moderate the relationship between prosocial spending and hedonic well-being. In a separate study, participants that were randomly assigned to reminisce about a time when their spending positively impacted someone experienced greater hedonic well-being (i.e., happiness) compared to participants that recalled experiences of spending on the self or when prosocial spending failed to make and impact (Aknin et al., 2013b, Study 2). As such, this finding indicated that in situations where perceived prosocial impact is not felt, happiness does not differ significantly from individuals that do not engage in prosocial spending at all. In summary, it appears to be of great importance to feel like one's spending makes a difference for a prosocial spender to reap the emotional rewards of such an act.

When taken together, this work provides convincing evidence for the effects of prosocial motivation on human behaviour, even in cases of low intrinsic motivation or negative self or task evaluations, and may shed further light on the emotional consequences of prosocial acts.

Prosocial Exercise: A Novel Means of Intervention?

The use of prosocial motivation has been used in more physical domains as well. In particular, the effect of prosocial spending on strength tasks was recently assessed.
First, it was revealed through a pilot study that participants held a free weight for longer when given the opportunity to raise money for a charity compared to participants that were given the opportunity to raise money from themselves (Gray, 2010). Second, participants that had a prosocial spending experience prior to a strength test (squeezing a hand dynamometer or holding a free weight) persisted for longer compared to participants that experienced a personal financial gain (Gray, 2010). Third, in a related study, participants that were given the opportunity to raise money for others squeezed a hand dynomometer longer than when given the opportunity to earn money for themselves in a low-financial stakes situation (Imas, 2014). Contrary to previous findings, participants that were given the opportunity to earn greater sums for themselves persisted for a greater duration than participants who were given the opportunity to earn a larger amount of money for charity (Imas, 2014). Thus, when considered in tandem, these studies highlight that prosocial motivation may be effective in increasing persistence when performing *certain* physical tasks.

The exploration of the possible relationship between prosocial acts and exercise is pertinent, as the occurrences of "prosocial exercise" are common and popular. To illustrate, exercising for the financial benefits of charitable organizations (such as *Relay for Life* and *Run for the Cure*) are effective fundraisers, with these popular events raising nearly $74 million in Canada in 2014 (Canadian Breast Cancer Foundation, 2014; Canadian Cancer Society, 2014). Even more compelling from an exercise promotion point of view, these two foundations reported

that in Canada over 290,000 individuals participated in their events in 2013 (Canadian Breast Cancer Foundation, 2014; Canadian Cancer Society, 2014).

Relatedly, a recently published trial protocol paper incorporated a prosocial component in a self-efficacy physical activity intervention for older adults (Foy et al., 2013). In this study, participants are provided the opportunity to earn food donations through their physical activity behaviour, in addition to participating in a myriad of additional group-based activities. Outcomes in this study include physical activity participation, physiological outcomes, quality of life, and affect. Although the results of the study have not yet been revealed, this study indicates the potential usefulness of incorporating prosocial acts in promoting exercise adherence.

Current Gaps in Knowledge

Although the Foy et al. (2013) trial does involve the use of prosocial exercise, their design prevents garnering an understanding of the direct relationship between prosocial behaviour and any possible outcomes. First, the use of various strategies (i.e., group-based physical activity) in tandem with prosocial incentives makes it difficult to disentangle the potential effects of either factor on exercise. Second, as the control group and intervention group partake in different procedures (e.g., the control group meets 21 times whereas the intervention group meets 39 times), comparing the effectiveness of the exercise intervention to the control group becomes difficult to discern (e.g., perhaps the increased meetings in the intervention will result in a greater sense of cohesion compared to the control group, which might differentially affect the outcome variables). Third, Foy et al. (2013) only target older adults, and as such, the generalizability of the results of this study will be limited to this cohort. Finally, eudaimonic well-being (i.e., meaning) is not assessed in this study.

Extending beyond the Foy et al. (2013) paper, the potential relationship between eudaimonia and prosocial spending has yet to be addressed in the prosocial spending literature as a whole (cf. Aknin et al., 2013a; Aknin et al., 2011; Aknin et al., 2013b; Aknin et al., 2012; Dunn et al., 2008; Geenen et al., 2014). As it is conceivable that engaging in such prosocial behaviour would lead to increases in eudaimonic well-being (i.e., perceptions of meaning), this highlights an important avenue to consider within any future research.

To summarize, it has yet to be discovered whether prosocial exercise, or exercising for the benefit of others, leads to differences in well-being and physical activity behaviour when compared to personal exercise, or exercising for non-prosocial reasons. As such, three pertinent questions arise. First, would engaging in prosocial exercise lead to an increase in hedonic and eudemonic well-being when compared to personal exercise? Furthermore, would this increase in well-being lead to increased exercise behaviour? Finally, could perceived prosocial impact provide a link between prosocial exercise and well-being?

Hypotheses

In order to explore these questions, well-being was tested both immediately before and after exercise (i.e., at the bout level), and pre-intervention, post-intervention, and at 6-week follow-up (i.e., at the program-level). Exercise behaviour was also assessed at the bout- and program-level. By taking both the bout- and program-level outcomes into consideration, it is possible to analyze both the potential momentary (i.e., bout-level) and longer-term (i.e., program-level) effects of prosocial exercise on well-being and physical activity behaviour. Furthermore, this provides an opportunity to garner a greater understanding of potential

mechanisms at play (e.g., whether outcomes are detectable at the bout- and program-level, and whether the outcomes are similar at both levels).

Primary Hypotheses

Bout

Hypothesis 1: Participants in the prosocial exercise condition will experience greater post-bout eudaimonic well-being compared to participants in the personal exercise condition.

Hypothesis 2: Participants in the prosocial exercise condition will experience greater post-bout hedonic well-being compared to participants in the personal exercise condition.

Hypothesis 3: Participants in the prosocial exercise condition will exhibit greater duration of exercise bouts compared to participants in the personal exercise condition.

Program

Hypothesis 4: Participants in the prosocial exercise condition will experience greater increases in eudaimonic well-being from pre- to post-program compared to participants in the personal exercise condition.

Hypothesis 5: Participants in the prosocial exercise condition will experience greater increases in hedonic well-being from pre- to post-program compared to participants in the personal exercise condition.

Hypothesis 6: Participants in the prosocial exercise condition will report greater health-enhancing physical activity (i.e., more time spent in moderate-to-vigorous physical activity) compared to participants in the personal exercise condition.

Secondary Analyses

Program

Hypothesis 7: Eudaimonic and hedonic well-being will mediate the relationship between the prosocial exercise condition and exercise behaviour over the course of the program.

Hypothesis 8: Participants in the prosocial exercise condition will report greater perceived prosocial impact compared to participants in the personal exercise condition.

Hypothesis 9: Perceived prosocial impact will mediate the relationship between the prosocial exercise condition and hedonic and eudaimonic well-being.

Methods

Sample Size Estimation

Multilevel modeling was used to analyze the data at the bout level, whereas analyses of covariance were used to analyze the data at the program level. With regard to the bout-level analyses, a number of principles have been suggested to guide sample size determination for conducting multilevel models (see Bell, Morgan, Komrey, & Ferron, 2010, Hox, 2010, Maas & Hox, 2005). To estimate our bout-level *a priori* sample-size for our multilevel models, we considered previous research that suggests level-2 units (in this case, number of participants) are more influential on unbiased model estimates than level-1 units (in this case, number of bouts; Bell et al., 2010; Maas & Hox, 2005). Simulation studies by Maas and Hox (2005) suggest that including a minimum of 30 level-2 and 5 level-1 units are acceptable for multilevel modelling (Maas & Hox, 2005). In the current study, each exercise bout represents the level-1 unit that is nested within each participant, which represents the level-2 unit. Thus, according to Maas and Hox (2005), a minimum of 30 participants would be required, with each participant contributing 5 observations.

With regard to the program-level analyses, previous prosocial spending studies (Aknin et al., 2011, Aknin et al., 2012, Geenen et al., 2014), reported medium to very large effect sizes (i.e., Cohen's $f = 0.31$ to $f = 0.68$) when comparing hedonic well-being between personal and prosocial spending conditions. To be conservative, $f = 0.31$ was utilized in estimating an appropriate sample size for a one-way ANCOVA. As such, using the software program G*Power 3.1 (Faul, Erdfelder, Buchner, & Lang, 2009) it was determined that a total of 104 participants would be needed for this analysis, with $\alpha = .05$, $1\text{-}\beta = .80$.

Considering the sample size requirements for the bout- and program-level analysis, 117 participants were recruited for the study to be appropriately powered to utilize multilevel modelling analytic procedures and ANCOVAs, and account for a10% participant attrition.

Participants

A total of 117 participants were recruited for this study. Participants were predominantly female (n = 91; 78% of the sample), and ranged in age from 18 to 45 (M = 20.64, SD = 3.30). Just under half of the participants reported Canada as their country of birth (46.2%), and most reported that they had used an exercise app before (54.7%). The majority of the participants (60.7%) were recruited through a University Psychology Department's Human Subject Pool. See Table 1 for further demographic information. Two participants were excluded from the analyses for not adhering to the study protocol, as one participant reported concurrently participating in another physical activity intervention, and a separate participant did not attend their post-test (T2) appointment for 3.5 weeks following the pre-test appointment. This resulted in a sample of n = 115 participants who took part in the study.

Table 1

Participant demographic information (N = 117)

	Prosocial App	Personal App	Total
Participants	58	59	117
Gender (F)	44 (75.9%)	47 (79.7%)	91 (77.8%)
Age (M [SD])	20.62 (4.08)	20.66 (2.32)	20.64 (3.30)
Country of Birth			
• Canada	28 (48.3%)	26 (44.1%)	54 (46.2%)
• China	14 (24.1%)	13 (22.0%)	27 (23.1%)
• Other Asian	8 (13.8%)	13 (22.0%)	21 (17.9%)
• Other	8 (13.8%)	7 (11.9%)	15 (12.8)
App usage (Y)	29 (50.0%)	35 (59.3%)	64 (54.7%)
Recruitment type (HSP)	38 (65.5%)	33 (55.9%)	71 (60.7%)

Procedures

Underactive undergraduate students (i.e., individuals that participated in a maximum of three 30 minute bouts of moderate-to-vigorous physical activity per week) were targeted for recruitment from a university campus through the use of social media and a University Psychology Department Human Subject Pool. The recruitment material indicated to potential participants that this study aimed to test the effectiveness of smart phone exercise apps. Participants were required to be 18 years of age or older, and own a smart phone (e.g., an iPhone or an android). To participate, it was also required that each individual needed to indicate that it was safe for him or her to engage in physical activity (through an electronic version of the Physical Activity Readiness Questionnaire [PAR-Q+; Warburton, Jemnik, Bredin, & Gledhill, 2014]). Participants that did not pass the PAR-Q+ were redirected to the electronic Physical

Activity Readiness Medical Examination (ePARmed-X+; Warburton et al., 2014). Those that did not pass the ePARmed-X+ were required to obtain their physician's approval before proceeding with the study.

Upon attending the first in-person laboratory session, participants were provided with a broad overview of the study (including predicted time and commitment from each participant), as well as consent forms. Participants recruited via the Human Subject Pool were informed that they would receive a total of 3 course credits (one for each in-person meeting attended). All participants were informed that they would receive an exercise armband to hold their phones in place during app usage. See Appendix A for the Human Subject Pool consent form and Appendix B for the general consent form. After providing consent, participants were provided with a pre-program questionnaire, including questions pertaining to participants' demographic variables, physical activity, well-being, and empathy (in order to account for any trait-level responses to prosocial impact as a relationship between prosocial behaviour and empathy has been detected by researchers; Eisenberg & Miller, 1987). See Appendix C for the full questionnaire at Baseline (Time 1: T1). T1 meetings occurred in the Winter semester (i.e., in February and March), in the Spring/Summer and Fall semesters (i.e., in May, June, and September, respectively) of 2015.

Following the completion of the baseline questionnaire, participants were provided with information outlining the national guidelines (for adults) of attaining 150 minutes of moderate-to-vigorous intensity physical activity (MVPA) per week in a minimum of 10-minute bouts (Canadian Society for Exercise Physiology, 2014). In order to reach these recommendations,

participants were encouraged to run, jog, or walk briskly while utilizing the app for two weeks in order to increase physical activity levels to reach national recommendations.

Participants were then provided with material explaining their randomly assigned app. Those assigned to the 'personal exercise' condition were presented with an information sheet describing the Nike+ Running app (http://www.mapmyrun.com/http://www.nike.com/us/en_us/c/running/nikeplus/gps-app). In the 'prosocial exercise' condition, participants were assigned to use the Charity Miles app (http://charitymiles.org/). While both apps use GPS technology to provide the user with information regarding the duration and distance of exercise bouts, Charity Miles allows the user to earn up to 25 cents per mile ran or walked. Both apps keep a log of users' exercise bouts, including distance covered, duration in minutes, and in the case of Charity Miles, the amount of money raised for charity. See Appendices H and I for app information sheets.

Participants were then shown how to download and use the app for exercise bouts. As both the Charity Miles and Nike + Running apps provide users with the opportunity to share their exercise information through social media sites, all participants were asked to refrain from posting any information from the apps to any social media site for the duration of the two-week trial period. This particular procedure was included as some participants may receive more positive feedback (through "likes" or "shares") than others, which may in turn increase positive emotions when using the app (and thus act as a potential confound).

Participants were then instructed to complete an online questionnaire via edudata (UBC webportal) to assess well-being immediately prior to and following every usage of the app. The links to the questionnaires were provided to participants in an e-mail, and participants were

asked to access this link and complete the appropriate questionnaire either by computer or smart phone within 5-10 minutes of beginning the exercise bout, and 15-20 minutes following the exercise bout. Finally, participants were asked to wear their smart phone (that housed the mobile app) during the course of each respective exercise bout, and use the app to monitor their physical activity for each bout.

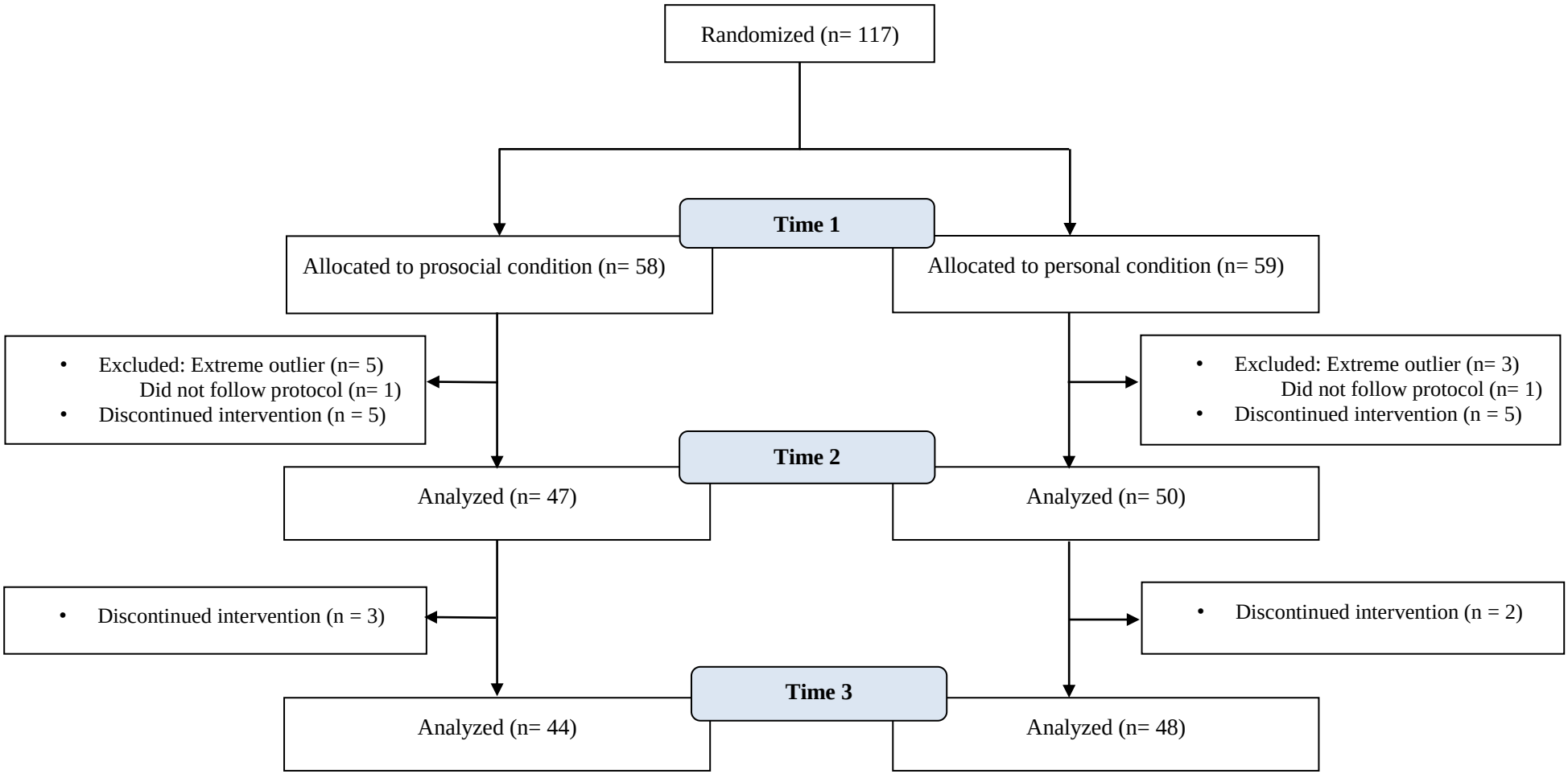
During the two-week 'testing phase', the participants had the opportunity to complete a total of six pre- and post-bout online questionnaires. Both the pre- and post-bout questionnaires assessed eudaimonic and hedonic well-being with a total of 15 items (see Measures Section). The post-bout questionnaire additionally asked participants to record the duration of the exercise bout as recorded by the app, miles covered, and whether any problems were experienced with the app. Participants in the prosocial exercise condition were also asked to list the charity that they chose to exercise for, and how much money was raised during the bout. See Appendices D and E for the full pre- and post-bout questionnaires.

Two weeks following the initial laboratory visit, participants were scheduled to return to the lab to complete post-test questionnaires. Participants in both conditions were asked to provide the distance, duration, and date of each exercise bout recorded by their respective app, and participants in the prosocial condition were also asked to list the donations generated for each exercise bout. Once these details were provided, participants were asked to complete a self-report measure of physical activity. While participants completed the physical activity measure, the researcher totaled the participants' miles and minutes of the exercise bouts, and when applicable, donations earned, and multiplied the bi-weekly totals to represent a possible yearly total (i.e., the totals were multiplied by 26). Once participants completed the physical activity

measure, the researcher provided the participants with their 'projected' yearly totals. As an example, participants in the prosocial condition would be informed, "over the past two weeks you walked or ran a total of 15 miles, and raised a total of $3.75 for charity. At this pace, you would walk or run a total of 390 miles and donate $97.50 to charity within a year". Participants in the personal condition were informed, "Over the past two weeks you walked or ran a total of 15 miles. At this pace, you would walk or run a total of 390 miles within a year". Following this disclosure, participants' perceived prosocial impact, well-being, and social interactions regarding the app were assessed. See Appendix F for the full post-program questionnaire (Time 2: T2).

Participants were then informed that the testing procedure had been completed, and they were explicitly told that they were no longer requested to reach a certain activity goal, nor use their assigned app, nor complete any pre- or post-bout surveys. Participants were reminded that they were welcome to continue using their app, but that it was not a requirement of the study. Four weeks following the second meeting, participants attended the final in-person follow-up (Time 3: T3). At this time, participants were asked to self-report their physical activity, and the extent to which participants were still using their randomly assigned app. See Appendix E for the full questionnaire at T3. Upon the completion of questionnaires, participants were debriefed, and thanked their participation. Participants who were recruited from the HSP were provided with a voluntary study summary sheet (See Appendix J). See Figure 1 for the Participant Flow Diagram. This study was also registered with the ClinicalTrials.gov Protocol Registration and Results System (clinicaltrials.gov; ID number NCT02573454).

Figure 1: Participant Flow Diagram



Measures

Program-Level Measures

Physical Activity. Self-reported physical activity was assessed through the use of a modified version of the Leisure Score Index (LSI; as per Courneya, Jones, Rhodes, & Blanchard, 2004) derived from Godin's Leisure Time Exercise Questionnaire (GLTEQ; Godin & Shephard, 1985). Specifically, participants were asked to report the number of strenuous, moderate, and mild bouts of exercise (lasting for a minimum of 10 minutes) that they had engaged in within the last seven days, and the average length of the activity bouts in minutes. Physical activity was computed by multiplying the number of bouts (of vigorous and moderate) by the average minutes recorded per bout. For example, if a participant reported 3 bouts of 10 minutes of strenuous physical activity, the number of vigorous minutes would equal 30. The 'metabolic equivalent of task' (MET) minutes were computed by multiplying the total vigorous minutes by 7.5 and the moderate minutes by 4.0, and summing these values together (as per Plotnikoff et al., 2006). Measures derived from the LSI of the GLTEQ have shown acceptable reliability and validity in relation to scores derived from objective measures of physical activity (Jacobs, Ainsworth, Hartman, & Lean, 1993).

Eudaimonic Well-Being. Eudaimonic well-being was assessed using the Meaning in Life Questionnaire (MLQ; Steger et al., 2006**).** For the purpose of this study, the five-item 'Presence of Meaning' scale (e.g., "I have discovered a satisfying life purpose") of the MLQ was utilized as a measure of eudaimonic well-being. The MLQ requires participants to rate statements on a one (absolutely untrue) to a seven (absolutely true) scale, with items summed as per recommendations outlined by Steger at al. (2006). Higher scores of 'Presence of Meaning' are

indicative of higher eudaimonic well-being. Acceptable reliability has been demonstrated for scores derived from this instrument (Stegar, et al., 2006), with Cronbach alphas in the current study ranging between 0.846 (at T1) and 0.895 (at T2).

Hedonic Well-Being. In this study, hedonic well-being was assessed through the use of a happiness measure and a satisfaction with life measure. As per Dunn et al. (2008), happiness was measured utilizing the 10 positive affect items from the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) along with a single-item measure of happiness (Dunn et al., 2008). For each of these 11 items participants were asked to provide responses, on a one to five-point scale ("very slightly or not at all" to "extremely"), to various happiness feeling states (such as interested, inspired, and proud) that they had experienced in the past few weeks. Internal consistency values derived from Dunn et al. (2008) demonstrated evidence of sound reliability with Cronbach alphas ranging from 0.81 to 0.87. Similar values were derived from scores in the current study ($T1\alpha = 0.832$; $T2\alpha = 0.890$). Satisfaction with life was measured utilizing the Satisfaction with Life Scale (SWLS; Diener, Emmons, Larsen, & Griffin, 1985). The SWLS is comprised of five items, ranging from one ("strongly disagree") to seven ("strongly agree"), and includes statements such as "The conditions of my life are excellent". Measures derived from the SWLS have demonstrated acceptable reliability and validity (Pavot, Diener, Colvin, & Sandvik). Measures derived from this instrument in the current study were found to be internally consistent, with Cronbach alpha values ranging from 0.839 (T1) to 0.880 (T2).

Empathy. Empathy was measured using the 16-item Toronto Empathy Questionnaire (TEQ; Spreng, McKinnon, Mar, & Levine, 2009). Responses to items within this questionnaire

are anchored from 0 (never) to 4 (always), with an example item being “I get a strong urge to help when I see someone who is upset”. Scores derived from the TEQ have been found to demonstrate sound psychometric properties (Spreng et al., 2009), with measures derived in this study displaying good internal consistency (Cronbach alpha = 0.778).

Perceived Prosocial Impact. Perceived prosocial impact was measured using an adapted version of the four items developed by Grant et al. (2007). Specifically, participants were asked to report their perceived impact on others, and the degree to which they felt they were benefitting others. Responses to items were anchored on a 7-point scale, with anchors ranging from one (“not at all”) to seven (“very much”), and included items such as “I felt capable of benefitting others”. Measures derived from this instrument in the current study were found to be internally consistent (Cronbach alpha = 0.861).

App Appeal. Participants were asked to rate their assigned app on a scale from one (not at all) to five (extremely) on four separate single items related to how ‘useful’, ‘interesting’, ‘motivating’, and ‘novel’ the app was perceived to be.

Social Media Fidelity. In order to assess whether participants followed the request to refrain from social media sharing, participants were asked whether they had posted app information to a social media site (i.e., online sharing) in the past two weeks (e.g., Twitter or Facebook). If participants answered yes, they were asked to list how many times they posted on a social media outlet, and to rate the feedback that was received from such sharing (as positive, neutral, or negative).

App Sharing. Participants were asked whether they had discussed their app usage with anyone. If the participant indicated that they had, they were asked to indicate with whom they

had shared their app (e.g., friends, family, romantic partner, classmates/coworkers, or other), and how many people they had discussed the app with in total.

Continued App Use. In order to assess participants' app usage at the six-week final meeting, participants were asked whether or not they were still using their assigned app on a binary scale (i.e., a yes or no response).

Bout-Level Measures

Physical Activity. Minutes of physical activity were utilized as the physical activity measure at the bout level. Participants were asked to report the minutes and seconds that they had spent exercising (as recorded by their app).

Eudaimonic Well-Being. Eudaimonic well-being was assessed through the Purpose in Life Scale Short Form (4 items), which specifically assesses the presence or absence of goals, meaning in life, feelings of purpose, as well as attainment of goals (Schulenberg, Schnetzer & Buchanan, 2010). Measures derived from this scale have shown to demonstrate sound reliability and validity (Schulenberg, Schnetzer & Buchanan, 2010). Cronbach alpha for this measure was 0.796 in the current study.

Hedonic Well-Being. Similar to the program-level measures, hedonic well-being was assessed using the happiness measure from Dunn et al. (2008), which included the positive affect items from the PANAS (Watson, Clark, & Tellegen, 1988) and a single-item measure of happiness. Cronbach alpha for this 11-item measure in the current study was 0.928.

Time Difference. The difference in time between pre- and post-bout survey completion excluding the time spent exercising (referred to as "time difference" for brevity) was calculated from the time stamp data retrieved from the edudata website (www.edudata.ca. To illustrate this

particular variable, a participant would have a ‘time difference’ of 10 minutes if they finished the pre-bout survey at 9:00AM, finished the post-bout survey at 9:40AM, and reported exercising for 30 minutes.

Season. In order to account for any potential seasonal effects (reflected in temperature and rainfall differences, as per the Environment Canada daily data report for 2015; http://climate.weather.gc.ca/), the data were coded in terms of whether participants completed the two-week program in the ‘winter’ or ‘summer’. Specifically, individuals that commenced participation in February and March (with total rainfalls of 113.4mm and 159.0mm and average temperatures of 7.4°C and 8.5°C, respectively) were considered ‘Winter’ participants, and individuals that commenced participation in May, June, and September (with total rainfalls of 4.2mm, 11.0 mm, and 41.88mm and average temperatures of 14.7°C, 17.9°C, and 14.1°C, respectively) were considered ‘Summer’ participants.

Results

Data Analysis

In order to assess both the program- and bout-level research questions outlined in the Introduction chapter, analysis of covariance (ANCOVAs) and multilevel modelling analytic procedures were utilized, respectively. For the bout-level analyses, data were downloaded from the UBC edudata bank, and entered into SPSS (Version 21). For the program-level analyses, data were entered into SPSS (Version 21), and screened for any potential entry errors through double-checking hard-copy questionnaires, and through analysis of descriptive and frequency outputs.

Bout-Level Results

Preliminary Analyses

Bout-level responses were included if (a) 'time difference' was less than three hours (b) they fell within the two-week sampling frame (for example, if participants completed 3 bouts within the two week sampling frame and three bouts outside of that two-week window, then only those that fell within the 2-week window were included), (c) time exercising was at least 10 minutes long, and (d) the participants did *not* report an issue with the app in their post-bout survey. This resulted in a total of 220 pre- and post-bout survey responses from a total of 80 participants. Twenty-four participants (30.00%) completed a total of one pre-and post-survey, 22 (27.50%) completed two, seven (8.75%) completed three, nine (11.25%) completed four, 13 (16.25%) completed five, and five participants (6.25%) completed all six pre-and post-bout surveys. Thirty-three individuals (with a total of 94 pre- and post-bout responses) were classified as 'Winter' participants, and 47 individuals (with a total of 126 pre- and post-bout responses) were classified as 'Summer' participants[1].

[1] It was not possible to include season as a moderator in the program-level analyses as we were underpowered (due to the sample size) at the program level. We could only conduct such moderator analyses at the bout level.

Normality was then assessed by examining kurtosis and skewness values for each variable (see Table 2 for a full list of descriptive statistics). It has been suggested that kurtosis and skewness values within +/- 2 are acceptable (George & Mallery, 2003). As can be seen in Table 2, all skewness and kurtosis values were less than 2, with the exception of the Time Exercising variable which displayed slight kurtosis (2.535). Pearson's bivariate correlations were conducted between all measures related to the bout-level variables, and are presented in Table 3.

Table 2

Bout-Level Descriptive Statistics

Variable	N	Mean	SD	Skewness Statistic	Skewness SE	Kurtosis Statistic	Kurtosis SE
Pre-Bout Eudaimonic Well-Being	220	3.418	0.564	0.093	0.164	-0.360	0.327
Pre-Bout Hedonic Well-Being	219	2.815	0.700	0.315	0.164	0.507	0.327
Post-Bout Eudaimonic Well-Being	220	3.568	0.565	-0.085	0.164	-0.447	0.327
Post-Bout Hedonic Well-Being	218	3.456	0.662	0.223	0.165	-0.178	0.328
Time Exercising (Minutes)	219	27.036	16.294	1.478	0.164	2.535	0.327

Table 3

Bivariate Pearson Correlations among Bout-Level Variables

Variable	2	3	4	5
1. Pre-Bout Eudaimonic Well-Being	.480**	.797**	.473**	-.008
2. Pre-Bout Hedonic Well-Being		.384**	.675**	.019
3. Post-Bout Eudaimonic Well-Being			.603**	.079
4. Post-Bout Hedonic Well-Being				.090
5. Time Exercising (Minutes)				

** $p < .001$

Bout-Level Analyses: Primary

Due to the non-independent, nested nature of the data (as participants had the opportunity to respond up to six times), data at the bout level were analyzed through use of multilevel modelling procedures (i.e., participants' bout responses as level-1, that were nested within participants at level-2), with a random intercept and fixed slopes. The use of multilevel modelling with repeated-measures data allows for more measurement flexibility than utilizing repeated-measures ANOVA (Hayes, 2006).

In order to assess whether the intervention (prosocial versus personal exercise) significantly influenced participant well-being, post-bout well-being measures (separate models for eudaimonic and hedonic well-being) were specified as dependent variables, gender and the corresponding pre-bout well-being measures were entered as covariates, and experimental condition, season, and the interaction between experimental condition and season were entered as independent variables. In order to assess whether the intervention significantly affected time spent exercising, gender was entered as a covariate, and experimental condition, season, and the interaction between experimental condition and season were entered as independent variables. Both 'experimental condition' and 'season' variables were dummy coded (i.e., 0 and 1), and gender was effect coded (Alkharusi, 2012), with males coded as '-1' and, females coded as '1' (as gender was not a variable of interest and rather a variable to control for, it was necessary to centre the dummy scores so that the mean was zero). As such, results are reported while controlling for gender, and in the case of well-being, while also controlling for pre-bout hedonic and eudaimonic well-being. All variables were entered as fixed effects, and ICCs were calculated by first specifying an unconditional model (i.e., a model without any predictor variables), using

the equation $\tau_0 / (\tau_0 + \sigma^2)$ to assess between-group and within-group variation as per Hayes (2006). See Table 4 for the multilevel model equations predicting eudaimonic and hedonic well-being, and exercise behaviour.

Table 4

Description of Multilevel Model Equations

Dependent Variable	Equation
Eduaimonic Well-Being	$EWB_{ij} = \gamma_{00} + \gamma_{10}PreEWB_j + \gamma_{01}Gender_j + \gamma_{02}Condition_j + \gamma_{03}Season_j + \gamma_{04}Condition*Season + u_{0j} + r_{ij}$
Hedonic Well-Being	$HWB_{ij} = \gamma_{00} + \gamma_{10}PreHWB_j + \gamma_{01}Gender_j + \gamma_{02}Condition_j + \gamma_{03}Season_j + \gamma_{04}Condition*Season + u_{0j} + r_{ij}$
Time Exercising	$TE_{ij} = \gamma_{00} + \gamma_{01}Gender_j + \gamma_{02}Condition_j + \gamma_{03}Season_j + \gamma_{04}Condition*Season + u_{0j} + r_{ij}$

Note: *i* refers to individuals, *j* refers to groups, γ_{0n} refers to level-2 predictors, γ_{n0} refers to level-one predictors, u_{0j} refers to error at the group level, and r_{ij} refers to error at the individual level

Hypothesis 1: Participants in the prosocial exercise condition will experience greater post-bout eudaimonic well-being compared to participants in the personal exercise condition.

Within the unconditional/empty model, the ICC for post-bout eudaimonic well-being was 0.776, which indicated that 77.6% of the variance in this measure of well-being was observed at the person-level (i.e., level-2), and 22.4% of the variance was observed at the bout-level (i.e., level-1). Summer was initially included as the referent season (i.e., coded as zero), and the personal exercise group was included as the referent condition (i.e., coded as zero). As such, the intercept in the results presented in Table 5 refers to the estimated mean of post-bout EWB for summer participation in the personal exercise condition. Specifically, the estimated mean for EWB in the summer months for the personal exercise condition was 1.495 (SE= 0.187). The significant interaction effect suggests that there were different condition by season effects in relation to EWB (γ_{04} = 0.304, t(55.485)= 2.290, p = 0.026). The independent, direct effect estimate for condition was not significant (γ_{02} = -0.090, t(54.499)= -1.061, p = 0.294); therefore, in can be intrepreted that the difference between EWB in the personal program (1.495, SE= 0.187) was not significantly different from the estimated EWB in the prosocial program (1.405, SEE = 0.185) *during the summer months*. Next, the referent group was switched from summer to winter, such that the intercept and direct effect for exercise program can now be interpreted as the estimated EWB during the winter months for the personal program and the difference between the prosocial and personal exercise condition during the winter months, respectively (see Table 6). Here, it can be seen that there was a significant effect of the exercise program *in the winter months* (γ_{02} = 0.214, t(53.453)= 2.118, p = 0.039), such that the estimated EWB for participants in the prosocial exercise program (M = 1.454, SE = 0.193) was significantly higher than for participants in the personal exercise program (M = 1.240, SE = 0.172).

Table 5

Parameter Estimates for the Fixed Effects Predicting Eudaimonic Well-Being with Summer Specified as the Referent Group

						95% Confidence Interval	
Parameter	Estimate	Std. Error	*df*	*t*-value	*p*-value	Lower bound	Upper bound
Intercept (γ_{00})	1.495	0.187	136.523	7.982	< 0.001	1.125	1.865
Pre-Bout EWB (γ_{10})	0.635	0.050	150.360	12.642	< 0.001	0.535	0.734
Gender (γ_{01})	-0.011	0.039	45.612	-0.280	0.781	-0.089	0.067
Condition (γ_{02})	-0.090	0.085	54.499	-1.061	0.294	-0.260	0.080
Season (γ_{03})	-0.255	0.090	52.839	-2.818	0.007	-0.436	-0.073
Season*Condition(γ_{04})	0.304	0.133	55.485	2.290	0.026	0.038	0.569

Note: Condition: personal exercise condition was entered as 0 and the prosocial exercise condition was entered as 1; Season: summer was entered as 0 and winter was entered as 1

Table 6

Parameter Estimates for the Fixed Effects Predicting Eudaimonic Well-Being with Winter Specified as the Referent Group

						95% Confidence Interval	
Parameter	Estimate	Std. Error	*df*	*t*-value	*p*-value	Lower bound	Upper bound
Intercept (γ_{00})	1.240	0.172	118.355	7.214	< 0.001	0.900	1.581
Pre-Bout EWB (γ_{10})	0.635	0.050	150.360	12.642	< 0.001	0.535	0.734
Gender (γ_{01})	-0.011	0.039	45.612	-0.280	0.781	-0.089	0.067
Condition (γ_{02})	0.214	0.101	53.453	2.118	0.039	0.011	0.416
Season (γ_{03})	0.255	0.090	52.839	2.818	0.007	0.073	0.436
Season*Condition(γ_{04})	-0.304	0.133	55.485	-2.290	0.026	-0.569	-0.038

Note: Condition: personal exercise condition was entered as 0 and the prosocial exercise condition was entered as 1; Season: winter was entered as 0 and summer was entered as 1

Hypothesis 2: Participants in the prosocial exercise condition will experience greater post-bout hedonic well-being compared to participants in the personal exercise condition.

The ICC for post-test measures of hedonic well-being was 0.708, indicating that 70.8% of the variance in this measure of well-being was observed at the person-level (i.e., level-2), and 29.2% of the variance was observed at the bout-level (i.e., level-1). Summer was initially included as the referent season (i.e., coded as zero), and the personal exercise group was included as the referent condition (i.e., coded as zero). As such, the intercept in the results presented in Table 7 refers to the estimated mean of post-bout HWB for summer participation in the personal exercise condition. Specifically, the estimated mean for HWB in the summer months for the personal exercise condition was 2.193 (SE = 0.162). The significant interaction effect suggests that there were different condition by season effects in relation to HWB (γ_{04} = 0.622, t(64.606)= 3.547, p = 0.001). The independent, direct effect estimate for condition was significant (γ_{02} = -0.379, t(65.932)= -3.335, p = 0.001), and as such, it can be interpreted that the the difference between HWB in the personal program (2.193, SE = 0.162) was significantly higher than the estimated HWB in the prosocial program (1.814, SE = 0.164) *during the summer months.* Next, the referent group was switched from summer to winter, such that the intercept and direct effect for exercise program can now be interpreted as the estimated HWB during the winter months for the personal program and the difference between the prosocial and personal exercise condition during the winter months, respectively (see Table 8). Here, it can be seen that the effect of the exercise program *in the winter months* approached statistical significance (γ_{02} = 0.244, t(62.889)= 1.827, p = 0.072), such that the estimated HWB for the participants in the prosocial exercise program (M = 2.071, SE = 0.181) was higher than the participants in the personal exercise program(M = 1.827, SE = 0.164) .

Table 7

Parameter Estimates for the Fixed Effects Predicting Hedonic Well-Being with Summer Specified as the Referent Group

						95% Confidence Interval	
Parameter	Estimate	Std. Error	*df*	*t*-value	*p*-value	Lower bound	Upper bound
Intercept (γ_{00})	2.193	0.162	147.587	13.515	< 0.001	1.873	2.514
Pre-Bout HWB (γ_{10})	0.544	0.049	190.893	10.990	< 0.001	0.446	0.641
Gender (γ_{01})	-0.139	0.052	56.644	-2.675	0.010	-0.243	-0.035
Condition (γ_{02})	-0.379	0.114	65.932	-3.335	0.001	-0.606	-0.152
Season (γ_{03})	-0.367	0.118	60.602	-3.102	0.003	-0.603	-0.130
Season*Condition (γ_{04})	0.622	0.175	64.606	3.547	0.001	0.272	0.973

Note: Condition: personal exercise condition was entered as 0 and the prosocial exercise condition was entered as 1; Season: summer was entered as 0 and winter was entered as 1

Table 8

Parameter Estimates for the Fixed Effects Predicting Hedonic Well-Being with Winter Specified as the Referent Group

						95% Confidence Interval	
Parameter	Estimate	Std. Error	*df*	*t*-value	*p*-value	Lower bound	Upper bound
Intercept (γ_{00})	1.827	0.164	132.830	11.152	< 0.001	1.503	2.151
Pre-Bout EWB (γ_{10})	0.544	0.049	190.893	10.990	< 0.001	0.446	0.641
Gender (γ_{01})	-0.139	0.052	56.644	-2.675	0.010	-0.243	-0.035
Condition (γ_{02})	0.244	0.133	62.889	1.827	0.072	-0.023	0.510
Season (γ_{03})	0.367	0.118	60.602	3.102	0.003	0.130	0.603
Season*Condition(γ_{04})	-0.622	0.175	64.606	-3.547	0.001	-0.973	-0.272

Note: Condition: personal exercise condition was entered as 0 and the prosocial exercise condition was entered as 1; Season: winter was entered as 0 and summer was entered as 1

Hypothesis 3: Participants in the prosocial exercise condition will exhibit greater duration of exercise bouts compared to participants in the personal exercise condition.

The ICC for time spent exercising was 0.526, indicating that 52.6 % of the variance in time spent exercising was observed at the person-level (i.e., level-2), and 47.4% of the variance was observed at the bout-level (i.e., level-1). Summer was initially included as the referent season (i.e., coded as zero), and the personal exercise group was included as the referent condition (i.e., coded as zero). As such, the intercept in the results presented in Table 9 refers to the estimated mean of time spent exercising for summer participation in the personal exercise condition. Specifically, the estimated mean for time spent exercising in the summer months for the personal exercise condition was 25.148 minutes (SE= 2.959). The non-significant interaction effect suggests that there were no season by condition effects, (γ_{04} = 8.972, t(70.121)= 1.422, p = 0.159). That is, participants in the personal condition did not differ on time spent exercising in the summer when compared to the winter (γ_{03} = -5.173, t(66.934)= -1.210, p = 0.231). The independent, direct effect estimate for condition was also not significant (γ_{02} = 3.003, t(72.458)= 0.731, p = 0.467); therefore, in can be intrepreted that the difference between time spent exercising in the personal program (25.148, SE = 2.959) was not significantly different from the estimated time spent exercising in the prosocial program (28.151, SE = 3.263) *during the summer months.* Next, the referent group was switched from summer to winter, such that the intercept and direct effect for exercise program can now be interpreted as the estimated time spent exercising during the winter months for the personal program and the difference between the prosocial and personal exercise condition during the winter months, respectively (see Table 10). Here, it can be seen that there was a significant effect of the exercise program *in the winter months* (γ_{02} = 11.975, t(68.249)= 2.502, p = 0.015), such that the estimated time spent exercising for the prosocial

exercise program (M = 31.950, SE = 3.607) was significantly higher than for the personal exercise program (M = 19.975, SE = 3.434).

Table 9

Parameter Estimates for the Fixed Effects Predicting Time Exercising with Summer Specified as the Referent Group

						95% Confidence Interval	
Parameter	Estimate	Std. Error	*df*	*t*-value	*p*-value	Lower bound	Upper bound
Intercept (γ_{00})	25.148	2.959	64.230	8.499	< 0.001	19.237	31.059
Gender (γ_{01})	2.335	1.885	63.183	1.239	0.220	-1.431	6.101
Condition (γ_{02})	3.003	4.108	72.458	0.731	0.467	-5.185	11.191
Season (γ_{03})	-5.173	4.277	66.934	-1.210	0.231	-13.710	3.364
Season*Condition (γ_{04})	8.972	6.310	70.121	1.422	0.159	-3.612	21.556

Note: Condition: personal exercise condition was entered as 0 and the prosocial exercise condition was entered as 1; Season: summer was entered as 0 and winter was entered as 1

Table 10

Parameter Estimates for the Fixed Effects Predicting Time Exercising with Winter Specified as the Referent Group

						95% Confidence Interval	
Parameter	Estimate	Std. Error	*df*	*t*-value	*p*-value	Lower bound	Upper bound
Intercept (γ_{00})	19.975	3.434	64.935	5.817	< 0.001	13.117	26.833
Gender (γ_{01})	2.335	1.885	63.183	1.239	0.220	-1.431	6.101
Condition (γ_{02})	11.975	4.787	68.249	2.502	0.015	2.423	21.526
Season (γ_{03})	5.173	4.277	66.934	1.210	0.231	-3.364	13.710
Season*Condition (γ_{04})	-8.972	6.310	70.121	-1.422	0.159	-21.556	3.612

Note: Condition: personal exercise condition was entered as 0 and the prosocial exercise condition was entered as 1; Season: winter was entered as 0 and summer was entered as 1

Program-Level Results

Preliminary Analyses

Normality was assessed through examining skewness and kurtosis values for all eligible participants (N = 115). The self-report physical activity (MET minute) variables measured through the LSI of the GLTEQ (Godin & Shephard, 1985) were extremely skewed and kurtotic (e.g., the kurtosis value for T1 MET minutes exceeded 50). As such, the interquartile range was calculated for each condition at each time point for the self-report MET minute variables. Extreme outliers were deleted when a value exceeded three times the interquartile range beyond the third quartile, or three times the interquartile range below the first quartile (see Dawson, 2011). Following this procedure, a total of eight extreme outliers where detected and deleted from the analyses (five from the prosocial condition, and three from the personal condition). Table 2 presents the descriptive statistics for the remaining 107 individuals. As can be seen in Table 1 and Table 11, the demographics remain largely unchanged with the removal of the ten aforementioned participants (i.e., 2 participants excluded for not following the protocol, and 8 extreme outliers).

Table 11

Participant demographic information (N = 107)

	Prosocial App	Personal App	Total
Participants	52	55	107
Gender (F)	42 (80.8 %)	44 (80.0%)	86 (80.4%)
Age (M [SD])	20.75 (4.26)	20.72 (2.33)	20.73 (3.39)
Country of Birth			
• Canada	26 (50.0%)	23 (41.8%)	49 (45.8%)
• China	14 (26.9%)	12 (21.8%)	26 (24.3%)
• Other Asian	8 (15.4%)	13 (23.6%)	21 (19.6%)
• Other	4 (7.7%)	7 (12.7%)	11 (10.3%)
App usage (Y)	28 (53.8%)	32 (58.2%)	60 (56.1%)
Recruitment type (HSP)	34 (65.4%)	32 (58.2%)	66 (61.7%)

As can be seen from examining the program-level descriptive statistics in Table 12, none of the skewness statistics exceeded 2, and all but two of the kurtosis statistics were less than 2. The exception to this corresponded to the Time 1 and Time 3 MET minute variables whereby Time 1 $MET_{kurtosis}$ = 2.172, and Time 3 $MET_{kurtosis}$ = 3.477.

Little's Missing Completely at Random (MCAR) test was performed to assess any discernable pattern of missingness in the data. The results from the test indeed indicated that the data were Missing Completely at Random (MCAR), X^2 (2608, N = 107) = 2498.07, p = .938. Pearson's bivariate correlations were conducted between all measures related to the program-level variables, and are presented in Table 13

Table 12
Program-Level Descriptive Statistics

Variable	N	Mean	SD	Skewness Statistic	Skewness SE	Kurtosis Statistic	Kurtosis SE
MET Minutes (T1)	102	447.61	344.617	1.453	0.239	2.172	0.474
MET Minutes (T2)	98	918.26	612.597	1.308	0.244	1.600	0.483
MET Minutes (T3)	92	870.24	605.599	1.607	0.251	3.477	0.498
Satisfaction with Life (T1)	107	23.15	5.734	-0.498	0.234	-0.424	0.463
Satisfaction with Life (T2)	98	24.27	5.298	-0.810	0.244	0.209	0.483
Happiness (T1)	104	34.33	6.035	-0.021	0.237	0.328	0.469
Happiness (T2)	94	38.14	6.470	-0.317	0.249	-0.383	0.493
Presence of Meaning (T1)	107	23.27	5.387	-0.364	0.234	-0.148	0.463
Presence of Meaning (T2)	98	24.23	5.247	-0.477	0.244	0.005	0.483
Empathy (T1)	107	46.97	5.818	-0.130	0.234	-0.180	0.463
Prosocial Impact (T2)	98	18.30	4.509	-0.409	0.244	-0.186	0.483
App Apeal							
Useful (T2)	97	3.45	0.986	-0.354	0.245	-0.618	0.485
Interesting (T2)	97	3.54	1.051	-0.454	0.245	-0.252	0.485
Motivating (T2)	97	3.44	1.108	-0.226	0.245	-0.872	0.485
Novel (T2)	97	3.31	0.924	-0.206	0.245	-0.446	0.485

Note: T1 = Time 1; T2 = Time 2; T3 = Time 3

Table 13

Bivariate Pearson Correlations among Program-Level Variables

Variable	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. T1 METs	.143	.146	.075	.056	.160	-.123	-.017	-.010	-.029	-.144	-.157	-.025	-.288**	-.022
2. T2 METs		.344**	.014	.154	.112	.275**	.061	.096	.073	.220*	.023	.047	.078	-.033
3. T3 METs			-.168	-.174	.096	-.092	-.086	-.115	.029	-.003	-.094	-.280**	-.097	-.095
4. T1 SWLS				.792**	.438**	.302**	.359**	.238*	.140	.119	-.004	.010	.130	.089
5. T2 SWLS					.451**	.581**	.345**	.385**	.080	.272**	.091	.131	.203*	.197
6. T1 PA						.566**	.420**	.413**	.286**	.312**	.152	.076	.213*	.166
7. T2 PA							.360**	.536**	.216*	.519**	.364**	.276**	.440**	.233*
8. T1 Presence								.808**	.284**	.284**	.163	-.046	.114	.194
9. T2 Presence									.390**	.409**	.194	.032	.155	.140
10. T1 Empathy										.174	.044	.004	-.002	.091
11. T2 Pro. Impact											.384**	.263**	.345**	.164
12. T2 Useful												.433**	.631**	.146
13. T2 Interesting													.604**	.343**
14. T2 Motivating														.324**
15. T2 Novel														

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

App Sharing and Appeal

No participants reported sharing app activity to social media outlets; thus, not requiring participant exclusion based on this fidelity check. Most participants reported talking about their app usage with others (67 of 98 participants at T3; 68.37%), with the majority of these participants telling their friends (54 of 98; 55.10%), followed by family (37 of 98; 37.76%), romantic partners (17 of 98; 17.35%), and classmates/coworkers (14 of 98; 14.29%).

Independent-samples t-tests were conducted to examine whether there were any differences in participants' ratings of how 'useful', 'interesting', 'motivating', and 'novel' they perceived each app to be. There were no differences in how useful ($t(95) = 1.218$, $p = 0.226$), interesting ($t(87.495) = 0.228$, $p = 0.820$), or motivating ($t(95) = 0.301$, $p = 0.764$) each app was appraised to be. However, participants did perceive the prosocial app (M = 3.57, SD = 0.827) to be more novel when compared to the personal app (M = 3.02, SD = 0.937), $t(95) = 3.082$, $p = 0.003$.

Pearson's Chi-Square was calculated to determine if there was a difference between app conditions on whether or not participants reported talking to others about their app (i.e., a binary yes or no outcome). The Chi-Square test was not significant, $X^2(1, N = 97) = 0.657$, $p = 0.417$, with 35 out of 48 participants in the prosocial exercise group reporting talking to others, and 32 out of 49 reporting the same in the personal exercise group. An independent-samples t-test was conducted to evaluate whether there was a difference between groups in the *number of people* that the participants discussed the app with. The results indicated no significant difference between conditions ($t(65) = 1.249$, $p = 0.216$).

Pearson's Chi-Square was calculated to compare the number of participants that reported still using their assigned app at T3 based on app condition. Thirteen of 45 participants in the

prosocial exercise condition reported still using the Charity Miles app, and 12 of 47 participants in the personal exercise condition reported still using the Nike + Running app. The result of Pearson's Chi-Square was non-significant, $X^2(1, N = 92) = 0.131$, $p = 0.717$, indicating no difference on continued app use across conditions.

Program-Level Analyses: Primary

Hypothesis 4: Participants in the prosocial exercise condition will experience greater increases in eudaimonic well-being from pre- to post-program compared to participants in the personal exercise condition.

A one-way ANCOVA was performed to examine whether those in the prosocial exercise condition (adjusted M = 23.817, SE = 0.435) reported greater presence of meaning (eudaimonic well-being) compared to those in the personal exercise condition (adjusted M = 24.756, SE = 0.426), with T2 presence of meaning as the dependent variable, and T1 presence of meaning and gender as covariates. There was no significant difference between the app conditions, $F(1, 94) = 2.371$, $p = 0.127$, $\eta_p^2 = 0.025$.

Hypothesis 5: Participants in the prosocial exercise condition will experience greater increases in hedonic well-being from pre- to post-program compared to participants in the personal exercise condition.

A one-way ANCOVA was performed to examine whether those in the prosocial exercise condition (adjusted M = 37.463, SE = 0.825) reported greater happiness compared to those in the personal exercise condition (adjusted M = 38.324, SE = 0.781), with T2 happiness as the dependent variable, and T1 happiness and gender as covariates. There was no significant difference between the app conditions, $F(1, 87) = 0.571$, $p = 0.452$, $\eta_p^2 = 0.007$.

A one-way ANCOVA was performed to examine whether those in the prosocial exercise condition (adjusted M = 23.953, SE = 0.472) reported greater satisfaction with life compared to those in the personal exercise condition (adjusted M = 24.405, SE = 0.463), with T2 satisfaction with life as the dependent variable, and T1 satisfaction with life and gender as covariates. There was no statistically significant difference between the app conditions, $F(1, 94) = 0.465$, $p = 0.497$, $\eta_p^2 = 0.005$.

Hypothesis 6: Participants in the prosocial exercise condition will report greater health-enhancing physical activity (i.e., more time spent in moderate to vigorous physical activity) compared to participants in the personal exercise condition.

Physical Activity: T1 to T2

A one-way ANCOVA was performed to examine whether those in the prosocial exercise condition (adjusted M = 843.989, SE = 92.116) reported greater physical activity behaviour compared to those in the personal exercise condition (adjusted M = 907.005, SE = 91.122), with T2 MET minutes as the dependent variable, and T1 MET minutes and gender as covariates. There was no significant difference between the app conditions, $F(1, 89) = 0.234$, $p = 0.629$, $\eta_p^2 = 0.003$.

Physical Activity: T2 to T3

A one-way ANCOVA was performed to examine whether those in the prosocial exercise condition (adjusted M = 846.918, SE = 85.438) reported greater physical activity behaviour compared to those in the personal exercise condition (adjusted M = 678.111, SE = 81.764), with T3 MET minutes as the dependent variable, and T2 MET minutes and gender as covariates. There was no significant difference between the app conditions, $F(1, 88) = 2.017$, $p = 0.159$, $\eta_p^2 = 0.022$.

Physical Activity: T1 to T3

A one-way ANCOVA was performed to examine whether those in the prosocial exercise condition (adjusted M = 828.997, SE = 93.212) reported greater physical activity behaviour compared to those in the personal condition (adjusted M = 659.241, SE = 90.036), with T3 MET minutes as the dependent variable, and T1 MET minutes and gender as covariates. There was no statistically significant difference between the app conditions, $F(1,83) = 1.707$, $p = 0.195$, $\eta_p^2 = 0.020$.

Program-Level Analyses: Secondary

Hypothesis 7: Eudaimonic and hedonic well-being will mediate the relationship between the prosocial exercise condition and exercise behaviour.

Based on the fact that participants in the prosocial exercise condition did not report higher levels of hedonic or eudaimonic well-being when compared to those in the personal exercise condition (Hypotheses 4 and 5), we were precluded from assessing well-being as a mediator of the relationship between exercise condition and exercise behaviour.

Hypothesis 8: Participants in the prosocial exercise condition will report greater perceived prosocial impact compared to participants in the personal exercise condition.

A one-way ANCOVA was performed to determine if those in the prosocial exercise condition reported elevated perceptions of prosocial impact at Time 2 compared to those in the personal exercise condition, after controlling for empathy at Time 1. The results indicated no significant effect of app type on prosocial impact at Time 2, with no difference between the prosocial exercise group (adjusted M= 18.201, SE = 0.648), and the personal exercise group (adjusted M= 18.647, SE = 0.634), $F(1, 94) = 0.243$, $p = 0.624$, $\eta_p^2 = 0.003$.

Hypothesis 9: Perceived prosocial impact will mediate the relationship between the prosocial exercise condition and hedonic and eudaimonic well-being.

On the basis that the participants in the prosocial exercise condition did not report greater perceived prosocial impact when compared to participants in the personal exercise condition (Hypothesis 8), we were precluded from examining prosocial impact as a mediator of the relations between intervention condition and (hedonic and eudaimonic) well-being.

Discussion

The purpose of this Master's thesis was to evaluate the efficacy of an exercise intervention that sought to increase hedonic and eudaimonic well-being, and in turn, physical activity behaviour, through prosocial behaviour engagement. As such, a standard exercise app and a prosocial exercise app (Nike + Running and Charity Miles, respectively) were utilized in an attempt to explore these factors. Undergraduate students were recruited and randomly assigned to 'test' the efficacy of a prosocial exercise app (when compared to a personal exercise app) for a period of two weeks, and participants' well-being and exercise behaviour were assessed at both momentary (i.e., bout level) and longer-term (i.e., program-level) time points.

Bout-Level Data

Participants were asked to complete surveys before and after utilizing their respective exercise app, including up to of six pre- and post-bout responses. In order to assess the effects of prosocial and personal exercise, in relation to well-being, and time spent in each exercise bout, multilevel modelling procedures were utilized as an analytic strategy. As evident in the results, season played a considerable role in the outcome variables based on condition. In the winter season, participants in the prosocial exercise condition reported higher levels of post-bout eudaimonic well-being and time spent exercising, as well as post-bout hedonic well-being that approached statistical significance, when compared to the participants in the personal exercise condition. Conversely, in the summer season, no differences were detected between conditions in post-bout eudaimonic well-being or time spent exercising; however, participants in the personal exercise condition reported greater post-bout hedonic well-being compared to those in the prosocial exercise condition.

In disentangling the bout-level results, the effects of season are notable and require further consideration. That is, why did the participants assigned to the prosocial exercise condition in the winter report heightened well-being and exercise behaviour when compared to the participants assigned to the personal exercise condition, whereas participants in the summer did not? As previously highlighted, the temperature and rainfall differed quite substantially between the summer and winter seasons within this study (indeed, seasonal groups were created on the basis of this distinction). Individuals that participated in the winter season began the study during the months with an average temperature of 8.0°C and rainfall of 136.2mm. Conversely, individuals that participated in the summer season began the study during the months with an average temperature of 15.6°C and average total rainfall of 19.0 mm. Based on the difference in weather associated with the seasons, it is reasonable to suggest that exercising outdoors would be more pleasant in the warmer and drier conditions present in the summer when compared to the winter season. Indeed, participants in the winter season would have to *endure* the conditions while exercising outside, whereas participants exercising outside in the summer season would be more likely to *enjoy* the conditions.

Taking these factors into consideration, and looking to previous research, it may be that exercising in the winter season is more *personally costly* for participants. To illustrate, consider the different environmental settings of running or walking outside in the summer and winter. While the participants in the summer would arguably be comfortable while exercising outside, participants in the winter would have had to expose themselves to colder and wetter elements to the detriment of their comfort. In other words, participants in the winter would face greater environmental barriers to engaging in physical activity compared to participants in the summer.

In line with research by Aknin et al. (2012), it was found that infants were rated as showing greater hedonic well-being when engaging in a more personally costly prosocial transaction, when compared to infants that completed a prosocial transaction that did not present the same costly barrier to them. Specifically, young children were happier when they gave a puppet a treat out of their own stash compared to giving a puppet a "found" treat that did not deplete their own supply. In a similar fashion, engaging in prosocial exercise may be more rewarding (in a hedonic and eudaimonic sense) when facing obvious barriers to behaviour engagement. Perhaps exercising outside when the weather is colder and wetter is similar to a toddler sharing a treat from their personal stash: *personal sacrifice* within a prosocial act may result in increased well-being, and in the case of prosocial exercise, increased physical activity behaviour. As suggested by the results of this study, it may also be that when such barriers are not present, increased *hedonic* well-being may be garnered from engaging in personal, as opposed to prosocial, exercise. While this is a plausible explanation of the data, we cannot confirm this hypothesis, as we did not explicitly measure any perceived 'personal costs' associated with exercising at these different times of year. Future research could test the potential effects of 'personal costs' in prosocial exercise settings to gain a better understanding of this potential phenomenon in relation well-being outcomes.

Program-Level

In order to assess the program-level effects of the intervention, participants attended an in-person meeting to complete surveys at baseline (T1), two weeks following baseline (T2), and six weeks following baseline (T3). Participants were asked to report on a wide range of behaviours, including app usage and sharing, app appeal, well-being, perceived prosocial impact, and physical activity behaviour.

With regard to the hedonic and eudaimonic well-being outcomes examined at the program-level in this study, there were largely no differences between the two conditions. Firstly, participants in the personal and prosocial exercise conditions did not report divergent levels of presence of meaning following the intervention; thus, indicating that eudaimonic well-being was not higher among participants in the prosocial exercise condition. Furthermore, as can be seen through the analyses regarding satisfaction with life and happiness, hedonic well-being was not different between the app conditions following the intervention. As the participants in the prosocial exercise condition did not report increased hedonic or eudaimonic well-being over and above that reported by participants in the personal exercise condition, the *a priori* proposed mediation analyses described in Hypothesis 7 was not pursued.

Similarly, physical activity behaviour also did not differ between conditions following the intervention. Specifically, no differences were detected in MET minutes at T2, holding T1 and gender constant, between the two conditions. The same result was found for MET minutes at T3, holding T1 MET minutes and gender constant, and holding T2 MET minutes and gender constant. These program-level findings were in direct contrast to the bout-level results in the winter. While this may be due to the inclusion of season as a moderator within the analyses at the bout- and not at the program-level, other factors may have contributed to this difference. Firstly, it may be that the effects of prosocial exercise on eudaimonic and hedonic well-being are only detectable immediately following an exercise bout, and not upon reflection at a more distal time point. Previous research has outlined the complexity and variability of affective outcomes within an exercise bout (e.g., Ekkekais, 2003), and as such, different sampling timeframes utilized within exercise studies may reveal different results.

It is also notable that the physical activity results across the program from Time 1 to Time 2 and bout-levels (across the same two-week window) were incongruent, as they should reflect the same underlying construct (i.e., moderate-to-vigorous physical activity across the same timeframe). It may be the case that the more objective measure of exercise (i.e., reporting minutes of exercising directly from an app) immediately following a bout of exercise is a more sensitive measure of physical activity than utilizing a more subjective measure of exercise (i.e., self-reporting based on recall of previous events). As subjective measures of physical activity have been shown to be problematic (i.e., (Salis & Saelens, 2000), future should continue to utilize more objective measures of physical activity when assessing program-level results (e.g., accelerometers).

Perceived prosocial impact also did not differ between the prosocial and personal exercise conditions. As highlighted above, Hypothesis 9 was not tested as participants within the prosocial exercise condition did not report increased perceived prosocial impact when compared to the participants in the personal exercise condition. It is conceivable that the lack of difference in perceived prosocial impact between conditions may explain why enhanced well-being was not detected at the program-level in the prosocial exercise condition when compared to the personal exercise condition. As demonstrated by Aknin et al. (2013b), the experience of perceived prosocial impact is important in the experience of hedonic well-being. Specifically, during a prosocial spending experience, participants that donated money to a charity in which the effect of their contribution was not well understood reported lower hedonic well-being compared to participants that donated to a charity where their impact was more evident (Aknin et al., 2013; Study 1). Furthermore, when recalling a prosocial spending experience, participants that reported a ‘blocked’ prosocial spending experience (i.e., when an individual failed to make an impact

through prosocial spending) did not differ in hedonic well-being when compared to participants recalling a *personal* spending experience (Aknin et al., 2013; Study 2). As explained by Aknin et al. (2013b), "…helping is most likely to lead to happiness when helpers know they have assisted another person in a meaningful way," (p. 94). In the current study, participants assigned to the prosocial exercise condition reported the same levels of perceived prosocial impact at T2 as those in the personal exercise condition. As such, this lack of perceived prosocial impact at the program-level may have contributed to the lack of difference in well-being, and subsequently, physical activity behaviour between the prosocial and the personal exercise groups at the program-level.

It is important to consider that perceived prosocial impact was measured directly after the participants were presented with their yearly projected mileage and, in the case of the prosocial exercise condition, projected charitable contribution. Although this procedure was implemented with the aim of enhancing perceived prosocial impact for Charity Miles users, it may have failed to do so. That is, after seeing the total of one's financial contribution based on one's physical activity behaviour (e.g., contributing just over $30 to charity for walking or running 5 miles every week for a year), participants' may have felt that their physical activity behaviour was inconsequential in raising money to impact others. Indeed, following the study debrief, a number of participants in the prosocial exercise condition mentioned that the money raised through the Charity Miles app felt too small to make a meaningful difference for others. While this does provide interesting insight into the participants' experience, this potential explanation cannot be directly tested and verified as the study did not specifically assess whether participants in the prosocial exercise condition felt that the donations earned through Charity Miles were impactful.

Given this, it may also be necessary to consider whether a minimum "dose" of prosocial behaviour is required to experience an increase in perceived prosocial impact and subsequent well-being. It has been demonstrated that there is no difference in hedonic well-being when participants were asked to spend $5 or $20 prosocially (Dunn et al., 2008), but these authors did not assess the emotional consequences (i.e., perceived prosocial impact and well-being) of a prosocial spending event with less than $5. Similarly, while Imas (2014) demonstrated that participants were more likely to persist for longer in a physically strenuous and prosocial task when the financial incentive was low (less than $1), prosocial impact and well-being were not considered in that study design. In the current study, participants often raised much less than $1 during their exercise bouts. Even when participants were presented with the cumulative amount of money earned over the two weeks, only three participants raised more than $5. As such, the design of this current study may not have included a large enough dose of prosocial behaviour to trigger a substantively different amount of perceived prosocial impact and well-being at the program-level when compared to the personal exercise condition. The results of this study, whilst considering previous research, suggest that intervention efforts to bolster perceived prosocial impact might be necessary in order to foster increases in well-being within prosocial interventions.

In addition, app 'sharing' behaviour did not differ between the personal and prosocial exercise groups in terms of whether or not participants talked to others about their app usage and the number of people that the participants shared their app usage with. Further, at the T3 follow-up, there was no difference between the prosocial and personal exercise groups regarding their continued use of either the Charity Miles or Nike + Running apps, respectively.

App appeal (i.e., how novel, interesting, useful, and motivating the apps were) was also assessed in this study. While participants in the prosocial exercise group rated the Charity Miles app as more novel when compared to the novelty ratings of the Nike + Running app from the participants in the personal exercise group, there was no difference between conditions on ratings of how interesting, useful, or motivating the apps were. It is important to note that app appeal was measured through use of single-item measures whose psychometric properties have not yet been established. As such, future research would be needed to further explore the appeal of apps such as Charity Miles and Nike + Running through psychometrically robust measures.

Nevertheless, the app appeal results suggest a possibly beneficial application for exercise interventionists and researchers. Specifically, the novelty of the Charity Miles app may point to the potential usefulness of prosocial exercise for marketing purposes. While novelty may fade over time (as the prosocial exercise program becomes more familiar) the novelty of prosocial exercise may be a potentially attractive feature to entice users to begin this type of exercise program. In support of this notion, previous work has demonstrated the attractiveness of engaging in a prosocial physical activity act. Specifically, research has shown that when participants were given the option to engage in a physically strenuous activity for prosocial or personal financial gain, substantially more individuals chose prosocial engagement when the financial stakes were low (Imas, 2014), similar to that of the Charity Miles app. Taken together, prosocial exercise may act as an effective marketing tool for physical activity engagement. Further research could assess whether the novelty of engaging in a prosocial exercise program/intervention may be more appealing to underactive individuals, and perhaps lend to increased participation in such a physical activity program.

As a final consideration, although we were able to examine the differential effects of the two exercise apps in the winter and summer at the bout-level, we were unable to examine season as a moderator at the program-level due to sample size limitations. Indeed, any app by season interactions that could have emerged at the program-level may have been masked by the need to amalgamate our data across seasons (i.e., winter and summer participants were not differentiated at the program level). Future research could attempt to clarify this issue through use of a larger sample size.

Implications

The results of this study indicated that, in winter, participants that underwent a prosocial exercise intervention were found to display improved hedonic and eudaimonic well-being (after each exercise bout), along with elevated time spent exercising, when compared to individuals that participated in a personal exercise intervention. This points to the possible utility of employing app-based prosocial exercise initiatives at times when people may be facing barriers to increased physical activity participation (i.e., environmental barriers). In future, research should look to explore potential reasons for this seasonal (by condition) effect, and perhaps aim to understand the link between personal costs experienced while exercising, prosocial behaviour, and well-being related to exercise.

A recent overview of health-related apps has highlighted that the widespread usage of smart phones presents a promising avenue for garnering a greater understanding of physical activity engagement and promotion (Servick, 2015). However, despite the popularity, reach, and cost-effective nature of this technology, little is understood about how to effectively utilize apps to lead to healthy behaviour change (Servick, 2015). Taken together, it is of upmost importance to continue to assess theory-based app interventions to gain an understanding of effective ways

of harnessing this technology. Prosocial exercise represents a theory-driven and potentially effective way to increase exercise behaviour in underactive individuals through app usage. As such, future research could continue to examine the conditions in which prosocial exercise apps (such as Charity Miles) are effective, and in doing so, provide a greater understanding of the utility of app-based exercise interventions.

Strengths

There are a number of noteworthy aspects of this study that provide novel contributions to the literature. To my knowledge, this is the first study to examine the relationship between prosocial exercise, well-being, and physical activity behaviour. In doing so, this extends the literature in a number of ways. First, this study aimed to assess whether a prosocial exercise intervention would lead to an increase in exercise-related well-being, and as such, replicate similar findings of previous research that have linked well-being to prosocial behaviour. As reflected in the bout-level data in the winter, it appears that prosocial exercise has the potential to effect subsequent hedonic *and* eudaimonic well-being.

In addition, this was a randomized control trial in an ecologically-valid setting. That is, participants were randomly assigned to a condition without knowledge of the existence of the other condition. Through implementing a study as a randomized control trial, one can make causal claims about the effects of an intervention (Sibbald & Roland, 1998). A further strength of this study was that it occurred in the 'real world' (i.e., in the participants' daily lives). As such, the results of this study can be generalized beyond that of a highly-controlled laboratory study, and into 'everyday' situations. Furthermore, the intervention itself was both cost-effective (as the only expense in the study was the exercise armbands) and has the potential to reach a wide number of individuals (as the intervention could be implemented with anyone with a smart

phone). In sum, this intervention could be easily implemented by others with little relative cost to the interventionist, and be available to a range of participants.

Limitations

Despite the strengths outlined above, there are a number of weaknesses to this study that should be noted. The prosocial exercise app (i.e., Charity Miles) had a number of technical malfunctions, and subsequently, a number of updates throughout the study. Conversely, the personal exercise app (i.e., Nike + Running) remained largely the same throughout. Additionally, the Nike + Running app had many more features than the Charity Miles app, such as the ability to sync one's music with the app, view many statistics about each run (such as average pace, road conditions, elevation covered, map of the route, and calories burned), as well as informing the user when certain milestones were reached (such as setting a personal best for time or distance covered). It is possible that the features of the app could have contributed to elevated user engagement, and potentially, well-being, for those that were assigned to use the personal exercise app when compared to the prosocial exercise app. Thus, considering that the Nike + Running was a technically superior app with more (likely attractive) features compared to the Charity Miles app, the potential increase in well-being as a result of prosocial behaviour when compared to the personal exercise condition may have been restricted by the quality of technology that was utilized in the prosocial exercise condition in this study.

As a second broad limitation, and as explained above, it should be noted that we were underpowered to examine the potential moderation effects of season at the program-level. Given that we were unable to assess the program-level data in the same way as the bout-level data, we were precluded from garnering an understanding of why the program- and bout-level results differed. We presented three possible explanations for why the program-level and winter bout-

level results did not align. First, it may be that the sampling timeframe and measures utilized at the bout- and program-levels may have contributed to these divergent results. Specifically, it is possible that the emotional consequences of prosocial exercise are only detectable immediately following an exercise bout, and tend to fade over time. Second, it is possible that the bout-level physical activity measure was more sensitive than that of the program-level physical activity measure. Finally, it is also possible that *not* including season as a moderator at the program-level could have 'washed out' any potential effects of the prosocial exercise intervention. Future studies could address this issue by utilizing a larger sample size, and accordingly, employ the requisite moderation analyses at the program-level.

A final drawback to the design of this study was that physical activity at the program-level was assessed through self-report methods, and the accuracy of such self-report data may be problematic (Salis & Saelens, 2000). While the bout-level data used a more objective form of data collection by requesting participants to directly record time exercising from their app, it is possible that the participants could have falsely reported this measure. Future studies may attempt to utilize more objective measures of this behaviour, potentially though the use of accelerometers.

Conclusion

In summary, prosocial behaviour was explored as a possible method to increase eudaimonic and hedonic well-being in exercise settings, and in turn, a viable strategy to increase physical activity. 117 undergraduate students, primarily from a University Psychology Department Human Subject Pool, were recruited to participate in this six-week experimental study. Participants were randomly assigned to a personal exercise condition (and utilize the Nike + Running app) or a prosocial exercise condition (and utilize the Charity Miles app). Participants were asked to attend in-person laboratory-based meetings to complete surveys at baseline, two weeks following baseline, and six weeks following baseline. Additionally, participants were also asked to complete surveys immediately before and after utilizing their assigned app. Despite the technological superiority of the Nike + Running app, participants that utilized the Charity Miles app reported higher levels of well-being and time spent exercising at the bout-level when compared to participants in the personal exercise condition in the winter months. In the summer months, hedonic well-being was higher for participants in the personal exercise condition; however, eudaimonic well-being and time exercising did not differ between conditions. Similarly, no differences were detected in hedonic and eudaimonic well-being, nor perceived prosocial impact, nor exercise behaviour, between exercise conditions at the program-level. The results of this study suggest that prosocial exercise may be an effective method of increasing well-being and outdoor exercise behaviour among underactive undergraduates during a time when there are barriers to exercising outside (i.e., unpleasant weather). Consequentially, it is apparent that the role of season might be important to consider when analyzing the effectiveness of an exercise intervention that targets outdoor physical activity behaviour. As such, future work could focus on the potential role of season at the program-level, and should look to further

examine whether the experience of personal costs interacts with prosocial exercise to influence physical activity adherence behaviour.

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Appendices

APPENDIX A: HSP Consent Form

Exercise App Study

Principal Investigator: Mark R. Beauchamp, PhD
Associate Professor
The University of British Columbia
Office Telephone: (604) xxx-xxxx
E-mail Address: xxxx

Primary Contact: Megan Kaulius
Graduate Student
The University of British Columbia
E-mail Address: xxxx

Purpose of the Project: The overall purpose of this project is to evaluate the effectiveness of exercise apps. This research is being conducted as partial fulfillment of a Masters Thesis (i.e., this is graduate research). The research collected in this project will help to inform a greater understanding of the potential mechanisms that may influence participation in physical activity.

Participation: If you agree to participate in this research program, we would like you to test the effectiveness of an exercise app on your smartphone for a two week period, for a minimum of 6 exercise bouts in total. In addition to testing the app, we would like you to fill out an in-person questionnaire at the beginning of the study (after signing this consent form), two weeks following the beginning of the study, and 6 weeks following the beginning of the study. At the final in-person questionnaire (6 weeks following baseline), you will be debriefed as to the purposes of the study. Additionally, we'd like you to fill out online surveys before and after using the app. There are no anticipated risks associated with this study.

Confidentiality: Any information provided within this project will be made anonymous, whereby no personal information that can identify you will be made available within any reports that may result from this research. Any information that you provide to the research team will be made anonymous and will be kept in a locked cabinet in the laboratory of the principal investigator.

Remuneration: If you choose to participate in this study we will provide you with a free exercise armband to hold your phone in place while you exercise. You can keep this accessory for your own use after the study has ended.

Course Credit: You will be provided with 3 course credits for your participation in the course, awarded at the final in-person questionnaire.

Your Rights: Your participation in this research is entirely voluntary and you may withdraw from the study at any time without having to give any reason for doing so and without experiencing any negative consequences. Alternatively, if you have any concerns or complaints about your rights as a research participant and/or your experiences while participating in this study, contact the Research Participant Complaint Line in the UBC Office of Research Ethics at 604-822-8598 or if long distance e-mail RSIL@ors.ubc.ca or call toll free 1-877-822-8598 (Toll Free: 1-877-822-8598)

Consent: I consent to take part in this research, designed to evaluate the effectiveness of exercise apps. The study has been explained to me and I understand what is involved.

I understand that my participation in this study is entirely voluntary and that I may withdraw from the study at any time without having to give any reason for doing so, and without experiencing any negative consequences. I understand that that if I do not wish to answer any question, I may skip any question in the questionnaires. If I withdraw from the study, the information I have supplied (i.e., questionnaires) will be destroyed.

I am willing to take part in three in-person questionnaires, and online questionnaires before and after using the exercise app. I understand that the in-person questionnaires will take approximately 10 - 15 minutes each, and the online questionnaires will take approximately 2 minutes each.

I have received a copy of this consent form for my own records. I also understand that any identifying characteristics will be removed from the information I supply so that my anonymity is protected.

By signing this form you have consented to participate in this study.

SIGNED.....……

NAME IN BLOCK LETTERS..... …….....

DATE.....

APPENDIX B: General Consent Form

Exercise App Study

Principal Investigator: Mark R. Beauchamp, PhD
Associate Professor
The University of British Columbia
Office Telephone: (604) xxx xxxx
E-mail Address: xxxx

Primary Contact: Megan Kaulius
Graduate Student
The University of British Columbia
E-mail Address: xxxx

Purpose of the Project: The overall purpose of this project is to evaluate the effectiveness of exercise apps. This research is being conducted as partial fulfillment of a Masters Thesis (i.e., this is graduate research). The research collected in this project will help to inform a greater understanding of the potential mechanisms that may influence participation in physical activity.

Participation: If you agree to participate in this research program, we would like you to test the effectiveness of an exercise app on your smartphone for a two week period, for a minimum of 6 exercise bouts in total. In addition to testing the app, we would like you to fill out an in-person questionnaire at the beginning of the study (after signing this consent form), two weeks following the beginning of the study, and 6 weeks following the beginning of the study. Additionally, we'd like you to fill out online surveys before and after using the app. There are no anticipated risks associated with this study.

Confidentiality: Any information provided within this project will be made anonymous, whereby no personal information that can identify you will be made available within any reports that may result from this research. Any information that you provide to the research team will be made anonymous and will be kept in a locked cabinet in the laboratory of the principal investigator.

Remuneration: If you choose to participate in this study we will provide you with a free exercise armband to hold your phone in place while you exercise. You can keep this accessory for your own use after the study has ended.

Your Rights: Your participation in this research is entirely voluntary and you may withdraw from the study at any time without having to give any reason for doing so and without experiencing any negative consequences. Alternatively, , if you have any concerns or complaints about your rights as a research participant and/or your experiences while participating in this study, contact the Research Participant Complaint Line in the UBC Office of Research Ethics at 604-822-8598 or if long distance e-mail RSIL@ors.ubc.ca or call toll free 1-877-822-8598 (Toll Free: 1-877-822-8598)

Consent: I consent to take part in this research, designed to evaluate the effectiveness of exercise apps. The study has been explained to me and I understand what is involved.

I understand that my participation in this study is entirely voluntary and that I may withdraw from the study at any time without having to give any reason for doing so, and without experiencing any negative consequences. I understand that that if I do not wish to answer any question, I may skip any question in the questionnaires. If I withdraw from the study, the information I have supplied (i.e., questionnaires) will be destroyed.

I am willing to take part in three in-person questionnaires, and online questionnaires before and after using the exercise app. I understand that the in-person questionnaires will take approximately 10 - 15 minutes each, and the online questionnaires will take approximately 2 minutes each.

I have received a copy of this consent form for my own records. I also understand that any identifying characteristics will be removed from the information I supply so that my anonymity is protected.

By signing this form you have consented to participate in this study.

SIGNED.....……

NAME IN BLOCK LETTERS..... …….....

DATE.....

APPENDIX C: Pre-Program Questionnaire

PRE-PROGRAM QUESTIONNAIRE

PART A

1. First three letters of your FIRST NAME: ___ ___ ___

2. First three letters of your LAST NAME: ___ ___ ___

3. Date of Birth: _____ (Day)_____(Month) 19_____(Year)

4. Place of Birth:_____(City)_____(Country)

5. Gender (check one): Male ☐ Female ☐ Prefer not to disclose ☐

6. Have you ever used an exercise app before? If so, which ones have you used?

_____

_____

_____

_____

_____

PART B

1. Considering the past **7-day period** (last week), how many times did you do the following kinds of exercise for **more than 10 minutes** during your free time (write in each square the appropriate number).

TIMES PER WEEK

A. STRENUOUS EXERCISE
(HEART BEAT RAPIDLY)
(i.e. running, jogging, hockey, football, soccer, squash, basketball, netball, judo vigorous swimming, vigorous long distance, cycling, roller skating) ☐

How many minutes was each strenuous intensity exercise session (approximately)? _____ minutes

MODERATE EXERCISE
(NOT EXHAUSTING)
(i.e. fast walking, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, dancing) ☐

How many minutes was each moderate intensity exercise session (approximately)? _____ minutes

MILD EXERCISE
(MINIMAL EFFORT)
(i.e. yoga, archery, bowling, golf, fishing from river bank, easy walking) ☐

How many minutes was each mild intensity exercise session (approximately)? _____ minutes

2. Considering the past 7-day period (last week), during your leisure-time, how often did you engage in any regular exercise long enough to work up a sweat (heart beats rapidly)?

OFTEN SOMETIMES NEVER/RARELY

PART C

This scale consists of a number of words that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent you have felt this way during the past few weeks. Use the following scale to record your answers.

1	2	3	4	5
very slightly or not at all	a little	moderately	quite a bit	extremely

_____ interested

_____ alert

_____ excited

_____ strong

_____ enthusiastic

_____ inspired

_____ determined

_____ active

_____ attentive

_____ proud

Do you feel happy, in general? _____

PART D

Below are five statements with which you may agree or disagree. Using the 1-7 scale below, indicate your agreement with each item by placing the appropriate number on the line preceding that item. Please be open and honest in your responding.

1	2	3	4	5	6	7
Strongly Disagree	Disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Agree	Strongly agree

1. In most ways my life is close to my ideal _____
2. The conditions of my life are excellent _____
3. I am satisfied with my life _____
4. So far I have gotten the important things I want in life _____
5. If I could live my life over, I would change almost nothing _____

PART E

Please take a moment to think about what makes your life feel important to you. Please respond to the following statements as truthfully and accurately as you can, and also please remember that these are subjective questions and that there are no right or wrong answers. Please answer according to the scale below:

1	2	3	4	5	6	7
Absolutely untrue	Mostly untrue	Somewhat untrue	Can't say true or false	Somewhat true	Mostly true	Absolutely true

1. ____ I understand my life's meaning.
2. ____ I am looking for something that makes my life feel meaningful.
3. ____ I am always looking to find my life's purpose.
4. ____ My life has a clear sense of purpose.
5. ____ I have a good sense of what makes my life meaningful.
6. ____ I have discovered a satisfying life purpose.
7. ____ I am always searching for something that makes me feel significant.
8. ____ I am seeing a purpose or mission for my life.
9. ____ My life has no clear purpose.
10. ____ I am searching for meaning in my life.

PART F

Below is a list of statements. Please read each statement carefully and rate how frequently you feel or act in the manner described. Circle your answer on the response form. There are no right or wrong answers or trick questions. Please answer each question as honestly as you can.

1. When someone else is feeling excited, I tend to get excited too

0	1	2	3	4
Never	Rarely	Sometimes	Often	Always

2. Other people's misfortunes do not disturb me a great deal

0	1	2	3	4
Never	Rarely	Sometimes	Often	Always

3. It upsets me to see someone being treated disrespectfully

0	1	2	3	4
Never	Rarely	Sometimes	Often	Always

4. I remain unaffected when someone close to me is happy

0	1	2	3	4
Never	Rarely	Sometimes	Often	Always

5. I enjoy making other people feel better

0	1	2	3	4
Never	Rarely	Sometimes	Often	Always

6. I have tender, concerned feelings for people less fortunate than me

0	1	2	3	4
Never	Rarely	Sometimes	Often	Always

7. When a friend starts to talk about his/her problems, I try to steer the conversation towards something else

0	1	2	3	4
Never	Rarely	Sometimes	Often	Always

8. I can tell when others are sad even when they do not say anything

0	1	2	3	4
Never	Rarely	Sometimes	Often	Always

9. I find that I am "in tune" with other people's moods

0	1	2	3	4
Never	Rarely	Sometimes	Often	Always

10. I do not feel sympathy for people who cause their own serious illnesses

0	1	2	3	4
Never	Rarely	Sometimes	Often	Always

11. I become irritated when someone cries

0	1	2	3	4
Never	Rarely	Sometimes	Often	Always

12. I am not really interested in how other people feel

0	1	2	3	4
Never	Rarely	Sometimes	Often	Always

13. I get a strong urge to help when I see someone who is upset

0	1	2	3	4
Never	Rarely	Sometimes	Often	Always

14. When I see someone being treated unfairly, I do not feel very much pity for them

0	1	2	3	4
Never	Rarely	Sometimes	Often	Always

15. I find it silly for people to cry out of happiness

0	1	2	3	4
Never	Rarely	Sometimes	Often	Always

16. When I see someone being taken advantage of, I feel kind of protective towards him/her

0	1	2	3	4
Never	Rarely	Sometimes	Often	Always

APPENDIX D: Pre-Bout Questionnaire

PRE-BOUT QUESTIONNAIRE

PART A

Write the number (1 to 5) next to the statement that is most true for you right now.

1. In life I have:

1	2	3	4	5
no goals or aims				clear goals and aims

2. My personal existence is:

1	2	3	4	5
utterly meaningless, without purpose				Purposeful and meaningful

3. In achieving life goals, I've,

1	2	3	4	5
made no progress whatsoever				progressed to complete fulfillment

4. I have discovered:

1	2	3	4	5
no mission or life purpose				a satisfying life purpose

PART B

This scale consists of a number of words that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent you feel this way right now, that is, at the present moment. Use the following scale to record your answers.

1	2	3	4	5
very slightly or not at all	a little	moderately	quite a bit	extremely

_____	interested	_____	inspired
_____	alert	_____	determined
_____	excited	_____	active
_____	strong	_____	attentive
_____	enthusiastic	_____	proud

Do you feel happy, in general? _____

APPENDIX E: Post-Bout Questionnaire

POST-BOUT QUESTIONNAIRE

PART A

1. How long did you exercise for (minutes:seconds)? _____
2. How many miles did you exercise for? _____

PROSOCIAL CONDITION ONLY

3. What charity did you choose to exercise for? _____
4. How much money did you raise? _____

PART B

Write the number (1 to 5) next to the statement that is most true for you right now.

1. In life I have:

1	2	3	4	5
no goals or aims				clear goals and aims

2. My personal existence is:

1	2	3	4	5
utterly meaningless, without purpose				Purposeful and meaningful

3. In achieving life goals, I've,

1	2	3	4	5
made no progress whatsoever				progressed to complete fulfillment

4. I have discovered:

1	2	3	4	5
no mission or life purpose				a satisfying life purpose

PART C

This scale consists of a number of words that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent you feel this way right now, that is, at the present moment. Use the following scale to record your answers.

1	2	3	4	5
very slightly or not at all	a little	moderately	quite a bit	extremely

_____ interested

_____ alert

_____ excited

_____ strong

_____ enthusiastic

_____ inspired

_____ determined

_____ active

_____ attentive

_____ proud

Do you feel happy, in general? _____

PART D

Did you experience any difficulty with using the exercise app? If so, please describe below

_____

_____

_____

_____

_____

APPENDIX F: Post- Program Questionnaire

POST-PROGRAM QUESTIONNAIRE

PART A

A1. First three letters of your FIRST NAME: ___ ___ ___

A2. First three letters of your LAST NAME: ___ ___ ___

A3. Date of Birth: _____ (Day)_____(Month) 19_____(Year)

PART B

Open your exercise app, and record the following details for each bout:

Date	**Miles**	**Duration (minutes and seconds)**	**Money raised (***PROSOCIAL CONDITION ONLY)*

Please hand in to the research assistant before continuing on.

PART C

3. Considering the past **7-day period** (last week), how many times did you do the following kinds of exercise for **more than 10 minutes** during your free time (write in each square the appropriate number).

TIMES PER WEEK

A. STRENUOUS EXERCISE
(HEART BEAT RAPIDLY)
(i.e. running, jogging, hockey, football, soccer, squash, basketball, netball, judo vigorous swimming, vigorous long distance, cycling, roller skating) ☐

How many minutes was each strenuous intensity exercise session (approximately)? _____ minutes

MODERATE EXERCISE
(NOT EXHAUSTING)
(i.e. fast walking, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, dancing) ☐

How many minutes was each moderate intensity exercise session (approximately)? _____ minutes

MILD EXERCISE
(MINIMAL EFFORT)
(i.e. yoga, archery, bowling, golf, fishing from river bank, easy walking) ☐

How many minutes was each mild intensity exercise session (approximately)? _____ minutes

4. Considering the past 7-day period (last week), during your leisure-time, how often did you engage in any regular exercise long enough to work up a sweat (heart beats rapidly)?

OFTEN SOMETIMES NEVER/RARELY

PART D

[Nike+ Condition only]

Based on your answers provided in the previous table, you have run _____ miles in the past two weeks. If you continued like this for a year, you would run a total of _____ miles.

[Charity Miles Condition only]

Based on your answers provided in the previous table, you have run _____ miles in the past two weeks, and donated a total of $_____. If you continued like this for a year, you would run a total of _____ miles, and donate a total of _____.

Please answer the following questions using the scale below.

1	2	3	4	5	6	7
Not at all						Very much

I was having positive impact on others _____

I felt capable of benefitting others _____

I was focussed on benefitting others _____

I tried to make others better off _____

PART E

This scale consists of a number of words that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent you have felt this way during the past few weeks. Use the following scale to record your answers.

1	2	3	4	5
very slightly or not at all	a little	moderately	quite a bit	extremely

_____ interested

_____ alert

_____ excited

_____ strong

_____ enthusiastic

_____ inspired

_____ determined

_____ active

_____ attentive

_____ proud

Do you feel happy, in general? _____

PART F

Below are five statements with which you may agree or disagree. Using the 1-7 scale below, indicate your agreement with each item by placing the appropriate number on the line preceding that item. Please be open and honest in your responding.

1	2	3	4	5	6	7
Strongly Disagree	Disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Agree	Strongly agree

1. In most ways my life is close to my ideal _____
2. The conditions of my life are excellent _____
3. I am satisfied with my life _____
4. So far I have gotten the important things I want in life _____
5. If I could live my life over, I would change almost nothing _____

PART G

Please take a moment to think about what makes your life feel important to you. Please respond to the following statements as truthfully and accurately as you can, and also please remember that these are subjective questions and that there are no right or wrong answers. Please answer according to the scale below:

1	2	3	4	5	6	7
Absolutely untrue	Mostly untrue	Somewhat untrue	Can't say true or false	Somewhat true	Mostly true	Absolutely true

1. ____ I understand my life's meaning.
2. ____ I am looking for something that makes my life feel meaningful.
3. ____ I am always looking to find my life's purpose.
4. ____ My life has a clear sense of purpose.
5. ____ I have a good sense of what makes my life meaningful.
6. ____ I have discovered a satisfying life purpose.
7. ____ I am always searching for something that makes me feel significant.

8. ____ I am seeing a purpose or mission for my life.
9. ____ My life has no clear purpose.
10. ____ I am searching for meaning in my life.

PART H

To what extent did you find the app you used:

Useful?

1	2	3	4	5
not at all	a little	moderately	quite a bit	extremely

Interesting?

1	2	3	4	5
not at all	a little	moderately	quite a bit	extremely

Motivating?

1	2	3	4	5
not at all	a little	moderately	quite a bit	extremely

Novel?

1	2	3	4	5
not at all	a little	moderately	quite a bit	extremely

PART I

1. Did you post your app activity to a social media site (i.e., online sharing) in the past two weeks (e.g., Twitter or Facebook)? Please circle one. If yes, please continue to question 2. If no, please continue to question 4.

   Y / N

2. How many times did you post to a social media site? _____

3. Overall, how would you describe the feedback you received from your online sharing? Please circle one.

POSITIVE NEUTRAL NEGATIVE

4. Did you discuss your app usage with anyone else in your life? Please circle one. If yes, please continue to question 5. If no, you have completed the survey.

Y / N

5. Who did you discuss the app with? Please select all that apply.

____ Friends ____ Family ____Romantic partner

____ Classmates/Coworkers ____ Others (please specify: _____)

6. How many people did you discuss the app with? _____

APPENDIX G: Follow-Up Questionnaire

FOLLOW-UP QUESTIONNAIRE

PART A

A1. First three letters of your FIRST NAME: ___ ___ ___

A2. First three letters of your LAST NAME: ___ ___ ___

A3. Date of Birth: _____ (Day)_____(Month) 19_____(Year)

PART B

1. Considering the past **7-day period** (last week), how many times did you do the following kinds of exercise for **more than 10 minutes** during your free time (write in each square the appropriate number).

TIMES PER WEEK

A. STRENUOUS EXERCISE
(HEART BEAT RAPIDLY)
(i.e. running, jogging, hockey, football, soccer, squash, basketball, netball, judo vigorous swimming, vigorous long distance, cycling, roller skating) ☐

How many minutes was each strenuous intensity exercise session (approximately)? _____minutes

MODERATE EXERCISE
(NOT EXHAUSTING)
(i.e. fast walking, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, dancing) ☐

How many minutes was each moderate intensity exercise session (approximately)? _____minutes

MILD EXERCISE
(MINIMAL EFFORT)
(i.e. yoga, archery, bowling, golf, fishing from river bank, easy walking) ☐

How many minutes was each mild intensity exercise session (approximately)? _____ minutes

2. Considering the past 7-day period (last week), during your leisure-time, how often did you engage in any regular exercise long enough to work up a sweat (heart beats rapidly)?

OFTEN SOMETIMES NEVER/RARELY

PART C

1. Are you still using the app that you tested for this study? Please circle one. If yes, continue to question 2. If no, continue to question 3.

Y / N

2. How many times per week do you use your app, on average?_____

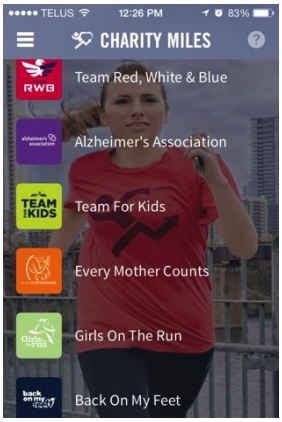
3. How many miles have you walked or run, in total, since you started using this app?

_____

APPENDIX H: Charity Miles Information Sheet

The Canadian Guidelines for physical activity state that we should get 150 minutes of moderate-vigorous activity each week, in 10 minute bouts or greater. In order to encourage people to get meet the recommended amount of exercise, we are conducting a study to see if certain exercise apps are effective in increasing physical activity.

For the next two weeks, we'd like you to try to attain 150 minutes of moderate-vigorous activity each week, in 10 minute bouts or greater, by using Charity Miles.



Charity Miles is an exercise app that allows users to earn donations for charitable organizations through walking, biking or running. Charity Miles uses GPS technology to track the users' physical activity, and allows users to donate up to 25 cents for every mile walked or run, or up to 10 cents for every mile biked. For the testing purposes of this study, we will ask that you only use the app to or run or walk (at a moderate-intensity pace, so that you are beginning to sweat or breathe a little harder) *outside*.

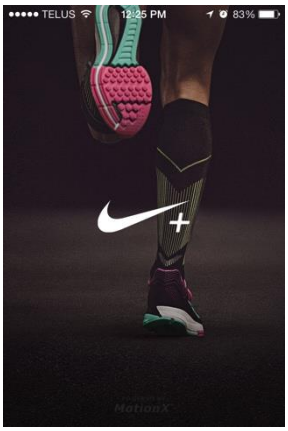
For the testing purposes of this study, we will ask that you DO NOT post your activity to any social media sites (like Facebook or Twitter) after using the Charity Miles app. This is to make sure that the study is as equal as possible across participants (for example, to make sure that participants don’t get different numbers of ‘likes’ or ‘shares’).

Please read through the Terms and Conditions, and the Privacy Policy of Charity Miles. If you wish to continue with the study after reading these documents, the research assistant will show you how to download and use the app.

APPENDIX I: Nike + Running Information Sheet

The Canadian Guidelines for physical activity state that we should get 150 minutes of moderate-vigorous activity each week, in 10 minute bouts or greater. In order to encourage people to get meet the recommended amount of exercise, we are conducting a study to see if certain exercise apps are effective in supporting physical activity.

For the next two weeks, we'd like you to try to attain 150 minutes of moderate-vigorous activity each week, in 10 minute bouts or greater, by using the Nike+ Running app.



The Nike+ Running is an exercise app that uses GPS technology to track the users' physical activity for walking, running, or biking. For the testing purposes of this study, we will ask that you only use the app to run or walk (at a moderate-intensity pace, so that you are beginning to sweat and breathe a little harder) *outside*.

For the testing purposes of this study, we will ask that you DO NOT post your activity to any social media sites (like Facebook or Twitter) after using the Nike+ Running app. This is to make sure that the study is as equal as possible across participants (for example, to make sure that participants don't get different numbers of 'likes' or 'shares').

Please read through the Terms and Conditions, and the Privacy Policy of The Nike+ Running app. If you wish to continue with the study after reading these documents, the research assistant will show you how to download and use the app.

APPENDIX J: Study Review Worksheet

TO BE COMPLETED BY STUDY RESEARCH ASSISTANT
Study Name:_____
Date of Participation: _____
Principal Investigator (Core Faculty): _____
Research Assistant:_____
RA Signature: _____

THE UNIVERSITY OF BRITISH COLUMBIA

STUDY REVIEW WORKSHEET

Thank you for participating in this study. The research portion of the session is now over, and the research assistant will next spend some time telling you more about this study to help clarify the larger goals of the research. The following review worksheet is designed by the Psychology Department Subject Pool to help you follow along as you learn more about this study and the nature of scientific inquiry in psychology. Although completing this worksheet is voluntary, your responses will help maximize what you learn from your experience as a participant in the Department Subject Pool. Responses can also help researchers refine their procedures and allow the Psychology Department to recognize study review sessions that participants find most educational. Your responses are completely anonymous, will not be used for research purposes or have any bearing on receiving credit for your participation.

1. What was the main purpose and/or broader implication of the current study?

2. This study relies primarily on an experimental or correlational design (circle one)?

3. The primary independent or predictor variable in this study is: _____

4. The primary dependent or outcome variable in this study is: _____

5. The primary hypothesis being tested is:

6. If you were going to do a study like this, what would you change/add/modify?

7. If this study was published in an Introductory Psychology textbook, it would be in a chapter on (circle at least one):

   Biological Psychology Development Sensation/Perception Learning/Memory Cognition/Language
   Motivation/Emotion Stress/Health Psychological Disorders Personality Social Psychology

8. How clear and informative was the debriefing for this study? not at all 1 2 3 4 5 extremely

9. How interesting and engaging was the debriefing for this study? not at all 1 2 3 4 5 extremely

Please return this completed form to the RA who conducted your