Financial Incentives for Physical Activity and Heart Health (FIPAHH): Exploring the Usability and Feasibility of an Eight-Week Financial Incentive and Physical Activity mHealth Intervention

by

Amanda Willms
Bachelor of Arts, Western University, 2019

A Thesis Submitted in Partial Fulfillment
of the Requirements for the Degree of

MASTER OF SCIENCE

in the School of Exercise Science, Physical and Health Education

Supervisory Committee

Financial Incentives for Physical Activity and Heart Health (FIPAHH): Exploring the Usability and Feasibility of an Eight-Week Financial Incentive and Physical Activity mHealth Intervention

by

Amanda Willms
Bachelor of Arts, Western University, 2019

Supervisory Committee

Dr. Sam Liu, School of Exercise Science, Physical and Health Education
Supervisor

Dr. Ryan Rhodes, School of Exercise Science, Physical and Health Education
Departmental Member

Abstract

Background: Hypertension is the leading modifiable risk factor for cardiovascular disease and mortality. Physical activity (PA) is critical for hypertension prevention, however scalable PA solutions are warranted. Previous studies have shown the potential of mHealth lifestyle interventions to be an effective and scalable strategy to improve PA outcomes, however, engagement and PA adherence remain a challenge. Financial incentives have the potential to overcome these challenges, by providing immediate behaviour reinforcement, but the effectiveness of a pay-per-minute (PPM) versus a modified social impact bond (SIB) financial incentive framework is unknown.

Objective: The objective of Study 1 was to co-create and determine the usability of Healthy Hearts, an eight-week mHealth financial incentive hypertension education program. The objectives of Study 2 were to determine the feasibility (recruitment, engagement, and acceptability) and evaluate the preliminary efficacy of eight-week financial incentive PA interventions of PPM and SIB relative to control.

Methods: In Studies 1 and 2, adults aged 40-65 who were not meeting the Canadian PA Guidelines were recruited online.

Study 1: The IDEAS framework was used to guide the development of Healthy Hearts. The development process consisted of intervention planning, development, and usability testing. For usability testing, participants completed online questionnaires and I conducted semi-structured interviews to assess Healthy Hearts and gather feedback to further enhance the user experience. Descriptive analyses were used to evaluate the online questionnaire data and thematic analysis was conducted for semi-structured interviews analysis.

Study 2: An eight-week feasibility study was conducted to explore the feasibility of a financial incentive PA intervention using the Healthy Hearts program. Study recruitment, retention and acceptability were evaluated following the intervention. Changes in PA outcomes (MVPA, daily steps), BP, and PA motivation were evaluated between PPM, SIB, and control groups using linear regressions.

Results:

Study 1: Six participants were recruited to gather feedback to enhance the content, layout, and design of the Healthy Hearts program to prepare the program to be employed in Study 2.

Study 2: 55 participants were recruited and randomized to the PPM (n=19), SIB (n=18), or control (n=18) groups. Recruitment, engagement, and acceptability were successful, with a recruitment rate of 77%, a 65% engagement rate, and overall positive feedback on the acceptability of the program. Relative to control at four weeks, the PPM and SIB arms increased their MVPA with medium effect (η^2_p= 0.06 and η^2_p=0.08, respectively). At eight weeks, relative to the control arm, the SIB arm increased their MVPA with medium effect (η^2_p=0.07) and no effect was noted between the PPM and control arm. There were small effects in PA outcomes, BP, and PA motivation.

Conclusion:

Study 1: The necessity for co-creating physical activity interventions was emphasized in the process of creating Healthy Hearts. Through the creation and usability testing of this program, valuable feedback was collected and integrated from the participants, thus preparing the program for Study 2.

Study 2: Per the high recruitment, engagement, and acceptability results, after minor changes are made, this study recommends a full-scale randomized control trial after appropriate power calculations.

Table of Contents

List of Tables

List of Figures

List of Abbreviations and Glossary Terms

BCT	Behaviour change technique
BP	Blood pressure
DBP	Diastolic blood pressure
M-PAC	Multi-Process Action Control Framework
MVPA	Moderate-to-vigorous physical activity
PA	Physical activity
PPM	Pay-per-minute
SIB	Social impact bond
SBP	Systolic blood pressure
SDT	Self-determination theory

Acknowledgments

There are so many people I would like to acknowledge and thank throughout my journey in completing my Master's degree. First, I would like to acknowledge my supervisor, Dr. Sam Liu, for your ongoing guidance, encouragement, and understanding that diamonds are made under pressure. I would also like to extend my gratitude to my committee members, Dr. Ryan Rhodes and Dr. Marc Mitchell, for your support throughout this process. You each have helped me grow as a researcher and as a person and I can't wait to further apply the numerous skills I have accumulated throughout this degree in my future endeavours.

I would also like to thank my family, specifically my Mom, Dad, Jason, Evan, Oma, Opa, and Uncle Brad. You have always tried to keep up with the next idea as my research unfolded over the past two years and I couldn't be more thankful for your support and inquiries. To the Digital Health Lab members, specifically Alyssa Roehrich, Brenda Adams, Dimas Adiputranto, Henry La, Sam Lapusniak, and Nick Smith along with other fellow EPHE grad students, I cannot thank you enough for your endless support and encouragement. Whether it be listening to me vent for five minutes, to grabbing a coffee, a beer, or going for a walk for a break; all these moments accumulated to successfully completing this thesis. And of course, all my friends from Grand River and Western University, while we may be thousands of kilometres apart, thank you for your support and checking in over the past couple years. To the staff and residents of Sandringham Care Centre, thank you for listening to endless physical activity and heart health information tidbits, for constantly asking me how my thesis is progressing, and giving me the opportunity to share my research with this unique population.

The financial support from the BC Support Unit Patient-Oriented Research Fellowship and Mitacs Research Training Award was pivotal in the pursuit of my academic goals. I greatly appreciate their interest in supporting my research. Lastly, this research would not have been possible without the lovely participants who dedicated their time and energy to completing this study. I hope in some way this research has improved your outlook on physical activity as much as it has mine.

Dedication

I would like to dedicate this research to my parents. Mom and Dad, your unconditional support, encouragement, and love from thousands of kilometres away has helped me through every step of this journey and I am eternally grateful for you both. No matter where we are in the world, this process has shown that we are only ever a FaceTime call away.

Chapter 1— Review of Literature

1.1 Prevalence of Hypertension

Hypertension (HT) is the leading risk factor worldwide for cardiovascular disease (CVD) and mortality (Forouzanfar et al., 2017). In 2020, CVD continues to be the leading cause of death among Canadians, with HT being the leading risk factor (Rabi et al., 2020). Left untreated, HT can lead to stroke, congestive heart failure, chronic kidney disease, diabetes mellitus, metabolic syndrome, and dyslipidemia (Kjeldsen, 2018; Ventura & Lavie, 2016).

HT Canada recognizes optimal blood pressure (BP) to be below 120/80 mmHg (Rabi et al., 2020). For the population in absence of diabetes mellitus, HT is diagnosed when systolic BP (SBP) is ≥ 135 mmHg and diastolic BP (DBP) is ≥ 85 mmHg after three-to-five visits to a medical doctor using automated office BP measurements (Rabi et al., 2020). The term 'above optimal BP' is used to address SBP measurements between 120-135mmHg and DBP measurements between 80-85mmHg. Previously, HT Canada and the American Heart Association referred to this 'above optimal BP' as pre-HT, and as such many studies have reported above optimal BP patients as pre-hypertensive patients (Cornelissen & Smart, 2013).

Data from 2012-2015 shows that nearly one quarter of all males (24%) and females (23%) aged 20-79 had a HT diagnosis with a BP reading of at least 140/90 mmHg (DeGuire et al., 2019). The risk of developing HT increases with age, with nearly 40% of those aged 40-59 having been diagnosed with HT with a BP measurement of 140/90mmHg or higher. In 2018, The American College of Cardiology and American Heart Association lowered the threshold for HT diagnosis to 130/80 mmHg (Whelton et

al., 2018) and consequently, this significantly increases the prevalence of HT (DeGuire et al., 2019). Beyond age, Canadians with lower socioeconomic status, or are Aboriginal, South Asian, or Black are at greater risk for developing HT (Campbell et al., 2012). Thus, it is critical that we explore scalable interventions to prevent HT.

1.2 Physical Activity and Hypertension

Physical activity (PA) is one of the most critical modifiable risk factors for lowering the risk of developing hypertension. A meta-analysis with 59 different dynamic endurance activity interventions (>four weeks in length) showed that 30 minutes of aerobic moderate PA on most (5-7) days reduced SBP by 3.5 mmHg [95% confidence limits −4.6 to −2.3] and DBP by 2.5 mmHg [95%CI: −3.2 to −1.7] in hypertensives (Pescatello et al., 2004). (Cornelissen & Smart, 2013). Although the effects of endurance exercise are greater among those with HT, individuals with above optimal BP still saw benefits in SBP and DBP with a mean reduction of −2.1 [−3.3 to −0.83] SBP/−1.7 [−2.7 to −0.68] DBP (Cornelissen & Smart, 2013).

There is a dose-response relationship between an individual's PA level and mortality in normal, elevated, and high BP populations (Joseph et al., 2019). The Canadian HT Education Program (CHEP) recommends moderate intensity aerobic PA on at least four days of the week for 30-60 minutes (Dasgupta et al., 2014). Moderate PA is any activity that noticeably accelerates one's heart rate, such as brisk walking, jogging, swimming, or dancing (Dasgupta et al., 2014). Regardless of exercise intensity, aerobic exercise for 30-60 minutes can result in a reduction of five to seven mmHg in both SBP and DBP for nearly one day after activity (Pescatello et al., 2004; Rossi et al., 2013). Aerobic exercise can be complemented with dynamic, isometric, or handgrip resistance

training (Dasgupta et al., 2014). Exercise exceeding that of five days per week and longer than 60 minutes in duration per session is not necessary for further BP reduction benefit (Dasgupta et al., 2014). However, exceeding this exercise recommendation may have other additional health benefits, such as improved mood, blood sugar management, and improved sleep quality (Tremblay et al., 2011).

Changes in other lifestyle behaviours (i.e., diet, weight management, smoking cessation) have also shown benefits in BP reduction. Table 1 further highlights the application and recommendation of lifestyle behaviour changes, as well as the mean reduction in SBP and DBP when each behaviour change recommendation is followed. While there are other health behaviour change targets (i.e., diet, weight management, smoking cessation) that those with or at risk of HT can adopt (Rabi et al., 2020), this thesis will primarily focus on PA. The results from this thesis may be applied to other health behaviours. Some studies suggest that only focusing on one health behaviour change target may prevent the participants from becoming overwhelmed by focusing on one behaviour change at a time (King et al., 2013). This belief is supported by the social cognitive theory, which recognizes mastery as a key concept in successful behaviour change (Bandura, 2001). By breaking down complex behaviour changes (i.e., targeting multiple lifestyle changes at once) into smaller steps (i.e., PA promotion independently), this can lead to the promotion of mastery and improve self-efficacy for behaviour change (Bandura, 2001; King et al., 2013). Furthermore, research has shown that an increase in PA over a two-month span may improve other lifestyle behaviours (i.e., eating a healthier diet, smoking cessation, and decreased alcohol consumption) (Mullen & Hall, 2015; Oaten & Cheng, 2006). One study has shown that when an individual adopts changes to

meet public health guidelines for a single health behaviour target, such as PA, these individuals are two and a half to five times more likely (Johnson et al., 2008) to make improvements in another lifestyle behaviour (i.e., a decrease in smoking and alcohol consumption, and an increase in healthy eating) (Oaten & Cheng, 2006).

Table 1

Health Behaviour Recommendations

Behaviour Change	Recommendation	Application	Mean Change in BP (mmHg) (SBP/DBP)
Physical Activity	30-60 minutes of dynamic moderate intensity exercise 4-7 days of the week in addition to activities of daily living.	Recommended for those with and without HT.	-5.4/-3.0[a]
Weight and WC	Maintaining a weight within a "healthy" BMI (18.5-24.9 kg/m^2) and a WC <102 cm for men and <88 cm for women to prevent hypertension or to reduce BP for hypertensive individuals.	Weight loss encouraged to be achieved with dietary education, being more physically active, and behaviour modification.	-6.0/-4.8[b]
Alcohol Intake	Abstinence is recommended as there is no safe limit with respect to HT. Hypertensive individuals should limit alcoholic drinks to <2 per day to lower blood pressure.	Recommended for those with and without HT.	-3.4/-3.4[b]
Healthier Eating	DASH-like balanced diet with fruits, vegetables, fibre and non-animal protein; low in saturated fat and cholesterol. Increasing potassium can aid in the reduction of BP for those with HT.	Recommended for those with and without HT.	-11.4/-5.5[b]

Relaxation Therapies	Participate in individualized relaxation intervention.	For patients whose HT is a source of stress.	-3.7/-3.5[b]
Smoking Cessation	Advise smokers to quit (and provide supports necessary). A smoke-free environment is ideal.	Beneficial for all in a global strategy to reduce risk for further complications.	-3.6/-3.1[c]

Note. HT= hypertension; BP= blood pressure; WC= waist circumference; BMI= body mass index; DASH= Dietary Approaches to Stop Hypertension

Mean change is between control and exercise groups

a: (Saco-Ledo et al., 2020)

b: (National Clinical Guideline Centre (UK), 2011)

c: (Lee et al., 2001)

1.2.1 Challenges Facing In-Person PA Interventions

A systematic review and meta-analysis of nine studies has shown that in-person PA programs with at least 24 weeks of follow-up have the ability to lower BP (Semlitsch et al., 2013). However, there are four known challenges associated with this form of delivery: 1) accessibility, 2) scalability, 3) limited personalization and 4) cost. In-person PA programs may only be available in certain cities and locations, limiting the accessibility or reach of these programs, especially for those living in rural communities (Gavarkovs et al., 2017). The scalability of in-person programming typically relies on partnerships with health organizations (O'Regan et al., 2020) and is therefore not always feasible. Tailoring group sessions to an individual's personal needs remains a challenge with both cost and resources, therefore limiting the personalization of in-person group sessions (Bethancourt et al., 2014). And lastly, the cost of in-person programs, including

accessing a facility and hiring qualified exercise professionals to run these programs, is a limitation of in-person PA programming.

The COVID-19 pandemic has only heightened the necessity for virtual programming in order to align with public health guidelines based on the region. Data from Google Trends suggest that many people have been turning to the Internet for instructions for at-home PA and exercise (Ding et al., 2020). With this increased query of individual's seeking virtual PA and exercise programming, this presents an incredible opportunity for health researchers and clinicians to offer virtual PA interventions. Virtual interventions delivered through a mobile app referred to as mobile health (mHealth) interventions, can be as effective as in-person therapies (Lu et al., 2019) and have the potential to expand intervention reach (Omboni, 2019).

1.2.2 Extending the Reach of PA Interventions with mHealth

mHealth is defined as the use of mobile technology to achieve positive health outcomes (Rehman et al., 2017). These technologies can be used as self-monitoring tools, avenues for educational content, and for collecting data back from the user or patient. Current mHealth programs can be implemented in one of two main ways. The first is human-supported, where user engagement and data utilization are used to enhance care (Jonathan et al., 2017). Human-supported mHealth interventions, however, require human resources throughout the duration of the program for extended support. The second implementation method of mHealth programs is more independent, or self-guided. Self-guided refers to interventions that are delivered with minimal or no facilitation from the healthcare provider and can be effective to improve PA levels (Kiss et al., 2019).

The reach of mHealth interventions can be vast, with 84.4% of Canadians over the age of 15 owning a Smartphone for personal use (Statistics Canada, 2021b). Furthermore, mHealth solutions may be a more cost-effective way to access health information (Anderson-Lewis et al., 2018).

1.2.3 Effectiveness of mHealth Interventions

Specific to cardiovascular risk, a recent meta-analysis explored pre-post changes for a variety of clinical parameters when the individuals were involved in an mHealth intervention to promote PA and a healthy lifestyle (Sequi-Dominguez et al., 2020). This meta-analysis categorized the nine studies as either including data monitoring, whether they enforced meeting PA guidelines, and whether goal setting was an included strategy. Sequi-Dominguez and colleagues (2020) concluded that PA and healthy lifestyle mHealth interventions have shown a significant reduction in BMI, with a pre-post mean reduction of 1.70 kg/m^2 (95% CI −3.20 to −0.20; effect size, Cohen's d: −0.46 (medium); *P*=.03), systolic BP (−7.33 mmHg, 95% CI −13.25 to −1.42; effect size: −0.43 (small); *P*=.02), and diastolic BP (−3.90 mmHg, 95% CI −7.70 to −0.11; effect size: −0.44 (small); *P*=.04). The success in improving these clinical outcomes, despite the heterogeneity of study designs, indicated that mHealth interventions can yield beneficial outcomes with different elements. Beyond clinical outcomes in mHealth, it is also important to consider PA levels. In a randomized control trial, Turner-McGrievy and colleagues (2013) showed that after six months there were significant differences in self-monitoring exercise with an mHealth app intervention group relative to a control group (Turner-McGrievy et al., 2013). Over the six-month intervention, those with access to a mobile phone app reported statistically significant greater intentional PA (196.4±45.9

kcal/day) than non-app users (1.2±0.5 days/week PA self-monitoring, $p<0.01$; 100.9±45.1 kcal/day intentional PA, $p=0.02$) (Turner-McGrievy et al., 2013).

1.2.4 Potential Barriers with mHealth Interventions

Despite this success in clinical and behavioural outcomes, mHealth interventions can suffer from poor engagement, with retention rates (completion rates of mHealth programs) as low as 40% after one months' use (Druce et al., 2019), and poor adherence (the degree of which one's behaviour corresponds with the recommendation) with approximately a 20% adherence rate by the end of the intervention (Guertler et al., 2015; Kohl et al., 2013). Despite the potential reach of these mobile interventions, the effectiveness of the intervention also varies due to the intervention design. Of the thousands of health and wellness apps that are available to the public through the app stores, many apps have not used behavioural theories and have limited use of behaviour change techniques (BCTs) (Payne et al., 2015). mHealth program designers may not be familiar with health behaviour change theories and techniques, leading to this disparity (Cowan et al., 2013). Along with developing an mHealth program grounded in behaviour change theories and techniques, providing contingent rewards such as ***material incentives***, a specific BCT, may have the potential to improve engagement and adherence to mHealth interventions (Michie et al., 2013). Financial incentives in this context are recognized as external rewards to encourage mHealth engagement and PA adherence. This thesis is focused on exploring the use of financial incentive-based strategies to prevent HT delivered using mHealth technology.

In the next two sections, I will 1) discuss the integration of behaviour theories and techniques with mHealth interventions to improve intervention efficacy, and 2) discuss the use of financial incentives to promote intervention engagement and PA levels.

1.3 The Use of Behavioural Change Theories and BCTs in mHealth Interventions

The use of behaviour change theories and BCTs can help guide mHealth intervention development. For this thesis, a behaviour change theory is defined as the accumulated knowledge of the mechanisms of action (mediators) and moderators of PA change (Davis et al., 2015). Behaviour change theories have been established to guide the development of PA programs for health behaviour researchers. BCTs, on the other hand, are the smallest "active component" of a behaviour change intervention (Michie et al., 2013) and were employed throughout the design of this thesis.

In a systematic review of 85 Internet-based health behaviour change interventions, those that used an 'extensive amount' of BCTs and targeted multiple constructs of behaviour change theories were associated with a significantly greater intervention effect size (Webb et al., 2010). A more recent scoping review found that the most commonly used theories in digital health behaviour change interventions are 1) social cognitive theory, 2) transtheoretical model, and 3) self-determination theory (Taj et al., 2019). A similarity among these social cognitive models is that they target key constructs of intention formation (i.e., attitudes, self-efficacy). These models assume that once an individual has an intention, it will result in a behaviour. However, PA research examining the relationship between one's intentions and acting on a behaviour shows dissonance. This dissonance between intention and behaviour has been labelled the "intention-behaviour gap" (Rhodes & Yao, 2015; Sheeran & Webb, 2016).

The intention-behaviour gap can be modelled through the action control framework (Rhodes & de Bruijn, 2013). Within this framework, Rhodes and de Bruijn (2013) separated intention and behaviour into distinct quadrants according to PA criteria and public health guidelines. The quadrants of the intention-behaviour relationship are 1) non-intenders, or people who do not participate in PA, 2) successful intenders, people who initiate PA, 3) non-intenders who begin initiating activity, and 4) unsuccessful intenders, those who do not follow through with initiating PA, despite previous intentions. It is established that intention plays a role in initiating behaviour change, however, a meta-analysis exploring the action control framework with PA showed that 36% of individuals who intended to participate in PA did not follow through with the execution of the behaviour (Rhodes & de Bruijn, 2013). This finding can be translated to mHealth apps, as a survey showed that of the 'intenders' who downloaded health-related apps, almost half (45.7%) of these intenders stopped using the apps (Krebs & Duncan, 2015).

Rhodes, de Brujin, and Yao further explored constructs (i.e., instrumental attitude, affective judgement) that could explain the translation from PA intention to behaviour (Rhodes & de Bruijn, 2013; Rhodes & Yao, 2015). Further, intention formation leading to action control adoption and maintenance was found to be explained by behaviour regulation and reflexive processes (Rhodes & de Bruijn, 2013; Rhodes & Yao, 2015). Rhode and colleagues (2013, 2015) recognized components of behavioural regulation to include monitoring behaviour and goal setting and components of reflexive processes to include identity and habit formation. After developing a greater understanding of these constructs and how an individual transitions from intention formation to action control

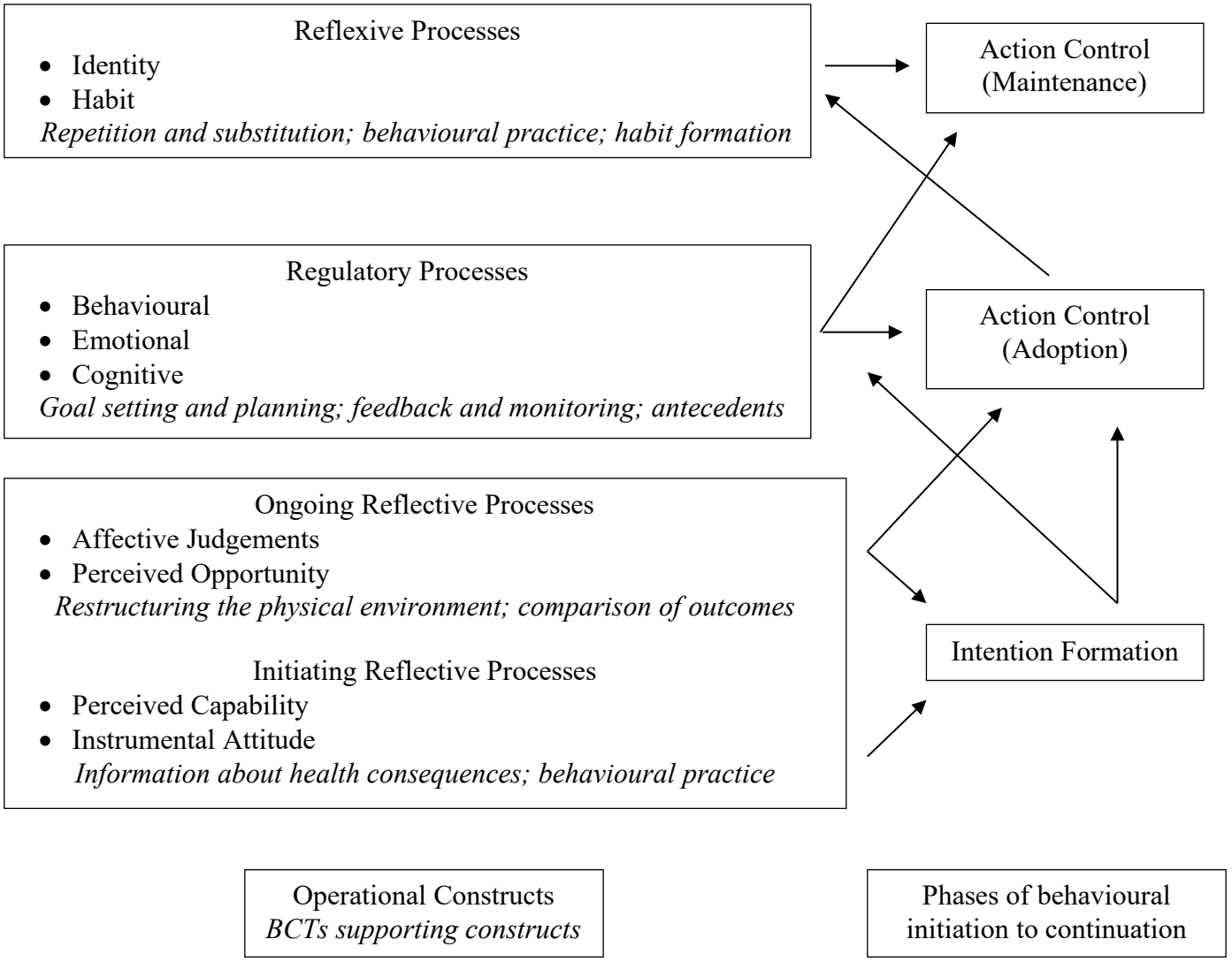
adoption and maintenance, Rhodes introduced the Multi-Process Action Control (M-PAC) framework to explain the intention-behaviour gap in PA behaviour change (Rhodes, 2017).

1.3.1 Multi-Process Action Control Framework

The M-PAC framework looks not only at the constructs in traditional social cognitive theories that lead to intention but also at how to translate positive intentions into behaviour (Rhodes, 2017; Rhodes & Yao, 2015). The M-PAC framework has been shown to promote PA in several different in-person PA studies (Kaushal et al., 2017; Vallerand et al., 2016, 2017) and has also developed into a web-based PA program (Liu et al., 2019). For this thesis, in Study 1 I will discuss the development and usability testing of a financial incentivized PA mHealth program grounded in M-PAC and Study 2 used this iteratively made mHealth app to encourage PA. A visual of this framework, its constructs, and supporting BCTs, is provided in Figure 1.

Figure 1

The Multi-Process Action Control Framework, adapted from (Rhodes, 2017)



The progression through the M-PAC framework describes the process of behaviour change from intention formation to action control adoption, and lastly to action control maintenance. The model suggests that when reflective processes are initiated, this influences the development of intention (Fishbein et al., 2001). Instrumental attitude (i.e., believing that initiating PA has more positive value than negative) and perceived capability (i.e., perceiving that one is capable to perform PA, despite motivation levels)

are crucial constructs in initiating the reflective process. Progressing beyond this initial intention stage involves ongoing reflective (i.e., perceived opportunity, affective judgements) and regulation processes (behavioural, emotional, and cognitive tactics to maintain focus). When an individual adopts these ongoing reflective processes and performs a certain behaviour, they enter the action control adoption stage. This translation from intention to behaviour is then strengthened with the regulation processes. These regulatory processes do not explain any motivation behind completing a behaviour but assist the individual in choosing the behaviour over not executing the behaviour. Examples of regulatory behaviours include planning, self-monitoring, seeking support, and regulating emotions to stick to an initial intention despite other temptations to not perform the behaviour. Furthermore, M-PAC suggests that as a result of regularly performing a behaviour, reflexive processes concur. These reflexive processes include habit formation and developing a sense of identity around a behaviour (i.e., exercise identity). These two constructs suggest that the individual has developed a drive toward the behaviour, independent of the prior reflective processes, and thus the individual has entered the action-control maintenance phase (Rhodes, 2017). The exact timeline in which an individual progresses through the layers of behavioural initiation through to maintenance is unclear, however, research suggests that if the individual reaches a self-standard, identity may form within two months (Rhodes et al., 2016).

In addition to M-PAC highlighting the process of behaviour change from intention formation to action control adoption and maintenance (i.e., translating intention to behaviour), the operational constructs align with different BCTs (Abraham & Michie, 2008; Michie et al., 2013) to help close the intention-behaviour gap (Rhodes, 2017). In

the next section, I will discuss how BCTs can be used in M-PAC for an mHealth intervention aimed to prevent HT.

1.3.2 BCTs and M-PAC

Michie and colleagues (2013) built on previous classification systems developed in 2008 (Abraham & Michie, 2008) to create the first cross-behaviour, hierarchically organized taxonomy. This taxonomy is composed of 93 well-defined BCTs and has received international expert consensus on their reliability (Michie et al., 2013; Michie, Ashford, et al., 2011). Each BCT is an observable and replicable component designed to manipulate causal processes that regulate behaviour (Michie, Abraham, et al., 2011; Michie, Ashford, et al., 2011). Consensus on the amount or combination of BCTs used in these interventions has not been established. However, it was established that information about health consequences, behaviour goal setting, self-monitoring of behavior and practical social support are the most commonly used BCTs amongst PA interventions and have the potential to be effective in significantly increasing PA when used (Duff et al., 2017). As mentioned above, BCTs can be used to strengthen the reflective, regulatory, and reflexive processes of M-PAC.

Initial constructs of M-PAC (i.e., instrumental attitude, affective judgement) tend to be based upon BCTs categorized as social support, natural consequences, and antecedents to behaviour. By employing techniques that shift an individual's thinking about completing a behaviour, i.e., providing information about health consequences and effective action planning, this can aid in the shift of one's thoughts to see a greater benefit than punishment in completing PA (Rhodes, 2017; Rhodes & Yao, 2015). While not addressed by M-PAC, another BCT that can be employed is a material incentive for

behaviour. A material incentive, i.e., a financial reward, has been shown to effectively lead to increases in PA (M. S. Mitchell et al., 2019). When one is initiating the reflective processes, a material reward has the potential to influence one's instrumental attitude, i.e., strengthening one's belief that there are more rewards than punishment in initiating a behaviour and how one views the benefits of PA. Further, financial incentives may help close the intention-behaviour gap, by helping promote more regulatory processes for PA intenders. The behavioural economics and theory guiding the effectiveness of material incentives is explained in section 1.4.

As one progresses through an intervention grounded in M-PAC, regulatory processes are strengthened with BCTs such as goal setting and self-monitoring. Reflexive processes in the action control maintenance phase are supported by BCTs surrounding the ideas of associations, repetition and substitution, and finding value in self-identity (Rhodes, 2017). Another BCT used to manage action control, as described by M-PAC, is self-monitoring, which will be highlighted in the next section. Other BCTs employed in this thesis are described in more detail in Study 1, where the development of an eight-week self-guided PA and HT education program was explained.

Self-Monitoring

Self-monitoring, defined as keeping a record of a specified behavior as a method for changing behaviour (Compernolle et al., 2019), is one of the many techniques used to help patients feel empowered in the prevention and management of chronic diseases. The World Health Organization recognizes patient empowerment as a process through which people gain greater control over decisions and actions affecting their health (World Health Organization, 2009).

Self-monitoring is also a key tactic to manage action control, as described by the M-PAC framework (Rhodes, 2017; Rhodes & Yao, 2015). In order to help regulate behaviours, self-monitoring is one strategy to assist an individual in choosing to be an 'intender', rather than to avoid the intended activity.

It has been well-established that web-based interventions have positive effects on patient empowerment (Samoocha et al., 2010), and we are seeing these effects mirrored in mobile health interventions (Mahmood et al., 2019). Patient participation through self-monitoring behaviours has led to an increase in satisfaction and adherence to programs (Schnall et al., 2015). Further, self-monitoring skills have the potential to lead to long term adherence to positive health behaviour changes (Tudor-Locke et al., 2004). Thus, it is important to enable patients to feel empowered by performing self-monitoring behaviours in an mHealth PA intervention to prevent HT.

Wearable technology devices are an incredible self-monitoring tool that are used in digital behaviour change interventions. Wearable technology devices, specifically PA monitors, refer to electronic technologies or computers incorporated into accessories that can be worn on the body (Mehdi & Alharby, 2018). Intelligence in wearable technologies can often outperform that of other digital health devices, such as mobile phones and laptops, as it can provide accurate heart rate data and other physiological function information (Mehdi & Alharby, 2018). Apple HealthKit and Google Fit are leading health programs in Smartphones. However, these apps are susceptible to inaccuracy as people may forget to carry their phones with them at all times (Wulfovich et al., 2019). Using a bracelet model or clip-on wearables addresses this potential inaccuracy. In North American studies, different models of Fitbit are a popular device used for PA tracking

(Coughlin & Stewart, 2016; Feehan et al., 2018). For the researcher, the Fitbit is a valid device in measuring moderate-to-vigorous physical activity (MVPA) over a seven day period with its heart rate monitor (Brewer et al., 2017). Fitbit and other wearable devices provide a "tangible" form of feedback, in that an individual can visualize their activity in a day and relate it to the number of steps or activity minutes registered on their wrist, hip, or ankle (Carter et al., 2018). This increased awareness of daily activities prompts reflection, which has the potential to initiate further goal-directed behaviours (Morrison et al., 2014) and further behavioural regulation (Rhodes, 2017; Rhodes & Yao, 2015). The success of interventions that promote and enable self-monitoring can be optimized when the information is specifically targeted at the individual.

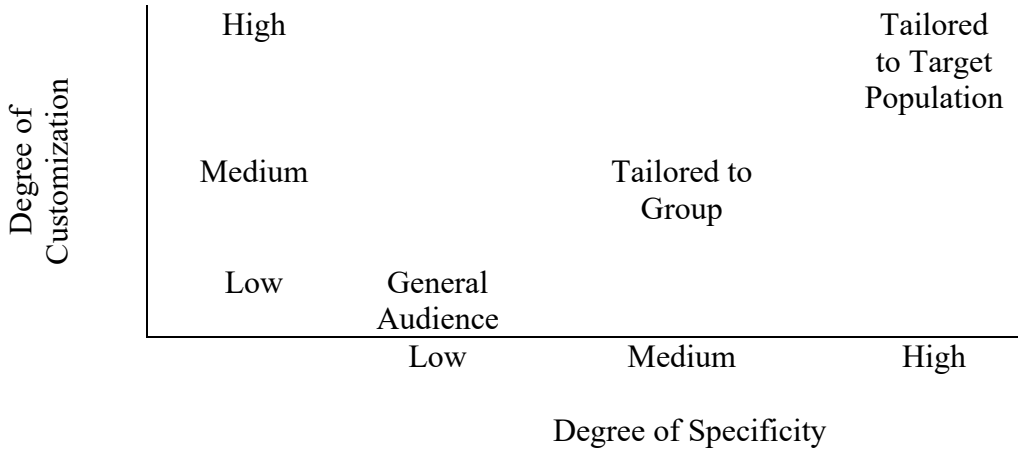
Tailored Information

For the purpose of this thesis, tailored information refers to the necessity of the intervention to align with the participant's needs and preferences. The information tailored to the participants was structured around the concepts of M-PAC and employed various BCTs each week. By tailoring information, the aim is to enhance the relevancy of the information delivered (Kreuter & Wray, 2003) through the mHealth platform and consequentially lead to greater uptake and adherence to the program. An example from Study 1 of this tailored design is in the early weeks of the program; the content is based on information about health consequences and behavioural practices to initiate reflective processes. Based on the nature of the study, the information is tailored to 'intenders' of PA, as it is assumed all participants in this study have intentions to exercise in the near future.

Public health communication strategies to tailoring information are typically threefold, with the least customized target being the general audience, to targeting a specific group, to individually-targeted messages being the most customizable (Hawkins et al., 2008). The Canadian HT Education Program (CHEP) is an example of low customization educational content (Rabi et al., 2020). HT educational content geared to adults can be found through HealthLinkBC and would be considered medium individuality and customization, as this content is targeted at adult PA intenders resident in British Columbia. Lastly, HT education information targeted at adults in British Columbia who are motivated to increase their PA is categorized as the highest degree of specificity and customization. Figure 2 displays this continuum.

Figure 2

Continuum of Tailored Content



Note. This figure was derived from (Hawkins et al., 2008).

With copious amounts of research documenting the importance of developing behaviour change interventions grounded in behaviour change theories and techniques,

there is still a gap in the uptake of these interventions by the target individuals. This has prompted health behaviour researchers to turn to extrinsic rewards.

1.4 Financial Incentives

It is well established that long-term engagement with mHealth behaviour change strategies remains a challenge with an average retention rate of 40% after one month of use (Druce et al., 2019). An avenue that health behaviour researchers have been exploring is implementing forms of extrinsic motivators to increase adherence in mHealth interventions (Gong et al., 2018). Extrinsic motivators are a tool that can be used to promote adherence to a health behaviour, such as PA. Financial incentives, a form of extrinsic reward, have been gaining popularity since the 1960s for health behaviour change interventions (Elliott & Tighe, 1968). Since 1980, we have seen numerous PA interventions that have shown a significant increase in the PA metric with financial incentives (M. S. Mitchell et al., 2019; Strohacker et al., 2014). The use of financial incentives as a BCT can be integrated with the M-PAC framework.

When initiating reflective processes to begin a PA behaviour, financial incentives may have the power to close the gap between exercise intention and PA behaviour. This ‘nudge’ that financial incentives provide is further explained in section 1.4.1. The regulatory processes of M-PAC, i.e., behavioural, emotional, and cognitive tactics, are responsible for managing action control (Rhodes, 2017; Rhodes & Yao, 2015). The M-PAC framework recognizes that action control management may be influenced by outside intervention, such as financial incentives, to further close the intention-behaviour gap.

With the use of PA wearable devices, researchers are able to reward real-time activity, opposed to less accurate behaviours, such as gym visits which don't gauge the amount or intensity of the activity completed (M. S. Mitchell et al., 2013). These devices further allow us to reward specific PA metrics, such as steps or PA minutes. Out of 20 studies that objectively tracked steps, financial incentives averaging USD $5.60/MET-hour/ person had a small effect (0.25 [0.13-0.36], $P < .01$; $I^2 = 55\%$) on increasing PA (Luong et al., 2021).

With an increase in the popularity of using financial incentives to promote a positive health behaviour change, there is a debate in the literature as to whether or not the benefits of financial incentives (i.e., increased PA) outweigh the drawbacks (i.e., diminishing intrinsic motivation) (Deci & Ryan, 2002). An individual is intrinsically motivated to do PA when they complete the activity for the benefit of activity alone, or otherwise worded as "for their own sake" (Deci, 1971). An early meta-analysis showed that behaviours that were extrinsically rewarded, such as with a financial reward, praise, or a sticker, diminished an individual's intrinsic motivation with small effect (Deci et al., 1999). For example, paying someone to increase their PA levels might make that person less motivated to complete PA once the financial incentive is removed. The cognitive evaluation theory (CET), a subset of the self-determination theory (SDT) (Deci & Ryan, 1985b), provides a counterargument to the claim that financial rewards extinguish intrinsic motivation. Deci and Ryan (1985) claim that rewards only reduce intrinsic motivation when they are perceived as controlling the behaviour. They also state that rewards have the potential to increase intrinsic motivation if the individual gains feelings of competence while completing a task, such as PA (Deci & Ryan, 1985b).

1.4.1 Behaviour Economics

A financial incentive can be considered a 'nudge' to perform a behaviour. In 2008, Richard Thaler and Cass Sunstein brought light to behaviour economics in the field of psychology in their book entitled, *Nudge: Improving decisions about health, wealth, and happiness*. Behaviour economics, or nudge theory, explains how humans are rational decision makers (Oliver, 2012), and that human judgements are biased in systematic ways for people to make self-beneficial choices (Camerer & Loewenstein, 2004), and thus, why financial incentives can be a driver to perform a behaviour. The term 'present bias' is often used when discussing behaviour economics and it refers to the tendency to act in favour of an individual's immediate self-interest, opposed to the long-term well-being. For PA or exercise specifically, the immediate 'costs' of participating in activity (i.e., time spent, muscle soreness) often outweigh the long-term gains (i.e., controlled blood pressure, weight loss, etc.). Since there is this delay in the outcome reward for completing PA, individuals are apt to quit, a phenomenon called 'extinction behaviour'. Some examples of other decision biases that are recognized by behaviour economics principles include loss aversion (i.e., favour avoiding losing money rather than acquiring equal gain), commitment (i.e., pledging to reach a goal in advance), and over-optimism (i.e., over-estimating the likelihood of earning money) (McGill et al., 2019b). Mitchell and colleagues (2019) recognize other decision biases that have arose in more recent literature, including the fresh start effect (i.e., positive behaviour change around certain dates and times) and the numerosity effect (i.e., associating larger numbers, e.g., loyalty points, with greater financial gain, despite having equal value).

Financial incentives are the 'nudge' to extinguish one's thoughts of not completing the desired behaviour. By immediately rewarding aspects of PA, even with a

modest incentive, this has the power to tip the scale of "decisional balance" and increase the likeliness that an individual continues to participate in the desired PA behaviour. The nudge theory helps to explain the predictable psychological tendencies of human behaviour decision making. While it cannot fully explain all underlying motivation, it has the potential to be an effective way of promoting positive behaviours (Dolan et al., 2012).

1.4.2 Self-Determination Theory

While behaviour economics can explain how financial incentives can immediately tip the scale of "decisional balance" (Camerer & Loewenstein, 2004), SDT looks to explain the degree to which one is intrinsically or extrinsically motivated to perform a behaviour (Deci et al., 1991; Deci & Ryan, 2002). SDT was introduced in the previous section and is often discussed in behavioural financial incentive interventions as the incentive is an external motivator.

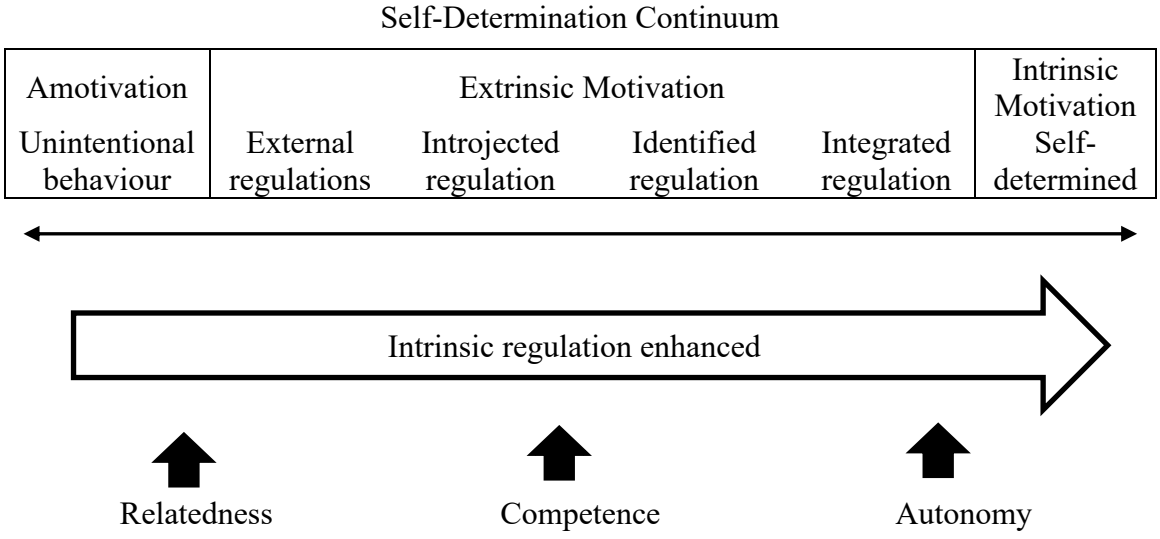
Deci and Ryan's research with self-determination is mainly focussed on intrinsic motivations and the conditions needed to improve this motivation. A sub-theory of the SDT is the CET (Deci & Ryan, 1985a). The CET recognizes that in order to foster self-motivation, an individual needs to feel competent, autonomous, and related to the activity (Deci & Ryan, 1985a; Ryan & Deci, 2000). While the CET does not discourage the use of financial rewards as extrinsic motivators, it does suggest that if the reward is informational or supports an individual's feelings of competence, then financial incentive may maintain or even enhance intrinsic motivation (Ryan & Deci, 2000).

The desire to do a task, i.e., PA, for its own sake and without any extrinsic factors is how intrinsic motivation is defined (Deci & Ryan, 2002). It has been well established that as a population, adults are not intrinsically motivated to do PA. In Figure 3 below,

the continuum of motivation, from amotivation to intrinsic motivation is displayed. External regulations (i.e., I am exercising for a financial incentive) is on the one end of the extrinsic motivation continuum, and integrated regulation (i.e., Exercise is part of who I am) is on the other end. Movement along this continuum is based on the individual's degree of relatedness, competence, and autonomy to which they feel towards the behaviour (Deci & Ryan, 1985b).

Figure 3

The Self-Determination Continuum adapted from (Ryan & Deci, 2000)



Autonomy refers to a human's desire to make behaviour choices according to one's sense of self. By allowing an individual to have the choice and an opportunity for self-direction is one way a researcher can empower a participant to feel autonomous in completing a health behaviour (Deci et al., 1991). An example of autonomous choice in this thesis is that the participants are able to choose their preferred PA, so long as their heart rate is in the "moderate-to-vigorous" range for that participant's age. Activities suggested to the participants were walking, biking, hiking, swimming, and yardwork.

Many PA studies have reported positive associations with exercise adherence when feelings of autonomy are enhanced (Teixeira et al., 2012). Competence can be defined as an individual's ability to successfully finish a task. A sense of competence pairs with the ability to take on an optimal challenge. Third, the sense of relatedness involves a sense of belonging and social support. In this thesis, competence and relatedness were aimed to be enhanced through an mHealth education program, highlighting the benefits of PA for heart health (see Study 1 for more details). According to Ryan and Deci (2000), when an individual shows increased regulation of the basic psychosocial needs of self-determination (relatedness, competence, and autonomy), this will foster more intrinsic motivation for the behaviour.

A recent example of an effective mHealth app is Carrot Rewards, an app that employs constructs of SDT along with behavioural economics. Mitchell et al. (2018) combined the underpinnings of SDT which includes whether or not an individual's behaviour is done willingly or if it's determined by external sources (Deci & Ryan, 2002). These concepts, along with employing behaviour change techniques, lead to a statistically significant increase in steps (115.70 more steps (95% CI 74.59 to 156.81; P<.001)) with modest effect (Cohen f^2: 0.0059 (P<.001)) over a 12-week period (M. Mitchell et al., 2018).

1.4.3 Structuring Financial Incentive Interventions

Researchers have explored different financial incentive interventions, manipulating (1) the framework, (2) the type, (3) the delivery form, and (4) the timing of the incentive. There are two popular financial incentive frameworks, gain-framed and loss-framed incentives. The type of financial incentive refers to the structure of the

incentive (i.e., receiving monetary compensation per step versus when a set goal is reached). The delivery form looks at two different avenues: whether the incentive is given individually or team-based, as well as whether the pay-out is done virtually through mobile devices or in person. Lastly, the timing of the incentive can either be immediate or delayed, i.e., after the intervention. As there are multiple components to consider when designing a financial incentive intervention, consensus has not yet been determined for the most effective and the most feasible intervention.

Financial Incentive Framework

Financial incentives can be given in two different frameworks: gain-framed and loss-framed. Gain-framed incentives start at a zero-point, and money is given when the individual's goal is achieved. With loss-framed incentives, individuals are given all possible earnings at the beginning of the intervention and money is taken away as a punishment when goals are not met. There is mixed reviews in PA research as to which is most effective (Chokshi et al., 2018; McGill et al., 2019a). In particular, among a population of 209 patients living with ischemic heart disease, implementing a loss-framed incentive was effective in increasing steps to an adaptive, personalized step goal during the intervention and follow-up period (Chokshi et al., 2018). Participants that received the incentive in this intervention started each week with $14 and lost $2 every day they did not reach their personalized step goal. This methodology was established to address the nature of individuals to be more motivated by losses than gains (Kahneman & Tversky, 1979; Patel, Asch, Rosin, Small, Bellamy, Heuer, et al., 2016) and for one to avoid the feeling of regret (Chapman & Coups, 2006; Connolly & Butler, 2006; Krähmer & Stone, 2013; Zeelenberg & Pieters, 2004). Chokshi and colleagues (2018) were

successfully able to evoke a step difference of 1864 steps in favour of the financial incentive group, relative to the control arm during the eight-week maintenance phase of the program. Furthermore, when the financial incentive was removed, the incentive arm continued this increase in steps, relative to control (Chokshi et al., 2018).

Financial Incentive Type

Many studies have explored manipulating the type of incentive given. The form of financial incentive delivery could be cash, with an added certainty (i.e., lottery) component or without, voucher, given a good or service, expense reimbursement, or a donation to a charity (M. S. Mitchell et al., 2015).

Cash pay-outs, such as a 'pay-per-minute financial incentive model, where individuals earned a small amount of money (~$0.02) for every minute completed per week, has been shown to be effective (M. Mitchell et al., 2018; M. S. Mitchell et al., 2019). Cash payments can also be manipulated by implementing set payouts, or lottery style interventions. Lottery-based framework is manipulated to only give participants a chance to receive financial compensation when their goal is achieved. The likelihood of significantly increasing PA levels was higher when there was a better chance of winning the lottery upon reaching their goal (Patel et al., 2018).

Vouchers as a financial incentive are another recurring method. By tailoring the type of voucher generally to the participants, there is potential to motivate individuals to achieve their daily goals. Effective vouchers have included supermarket vouchers among older adults (Farooqui et al., 2014) and gift vouchers for local stores for inactive adults (Ball et al., 2017).

Providing a good or service or reimbursement when PA goals are another method of PA financial incentive (M. S. Mitchell et al., 2013). An example of a good or service can be a new pair of running shoes or a new water bottle. A reimbursement financial incentive can partner with local gyms, where people are able to get a portion of their membership fee back when proving they are active. This reimbursement incentive provides similar framework to a loss-framed financial incentive.

Some researchers have explored the idea of "social" financial incentives where the participants have the opportunity to donate their rewards to a charity. When participants are given the option to keep the reward for themselves or to donate the reward to a charity, individual's chose to keep the reward for themselves (Harkins et al., 2017). Therefore, charitable donations, or social incentives, tend to be the least effective financial incentive intervention delivery form.

While higher pay-outs are limited due to funding, one study has shown that offering participants as low as $0.04 a day in the form of loyalty points for their chosen company (i.e., SCENE points, drop, etc.) has been shown to modestly motivate individual's to achieve their daily PA goals (M. Mitchell et al., 2018).

Self-Funded Incentive: Social Impact Bond

A criticism of financial incentive-based PA interventions is the sustainability of these programs. A social impact bond (SIB) may be a solution to overcome sustainability related issues facing traditional financial incentive models by introducing a self-funded structure. A SIB is a unique strategy to improve health outcomes, where governments enter into agreements with social service providers, and is funded by investors based on pre-determined social outcomes (OECD, 2016). A SIB is a contract with a governing

authority, whereby it pays for better social outcomes (e.g., improvement in PA) and passes on the part of the savings achieved to investors. (See Figure 4).

In this thesis, I proposed a modified version of a SIB that can be used for mobile-based HT prevention interventions (Figure 5). The main difference between the modified version used and a traditional SIB is that the participants (e.g., the individuals participating in the HT prevention program) will be acting as both investors and the ones receiving the service (e.g., the HT prevention program).

Figure 4

Social Impact Bond Structure

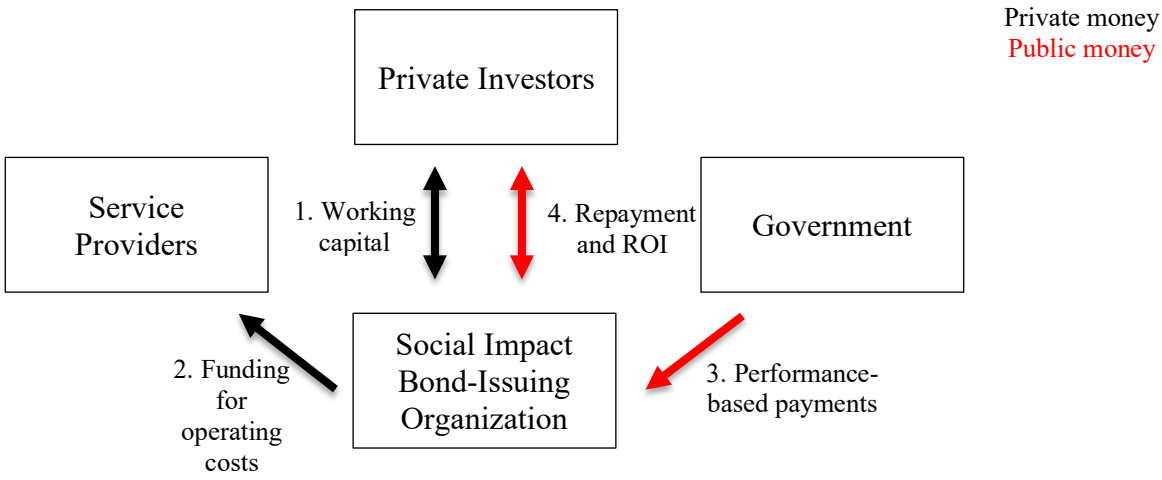
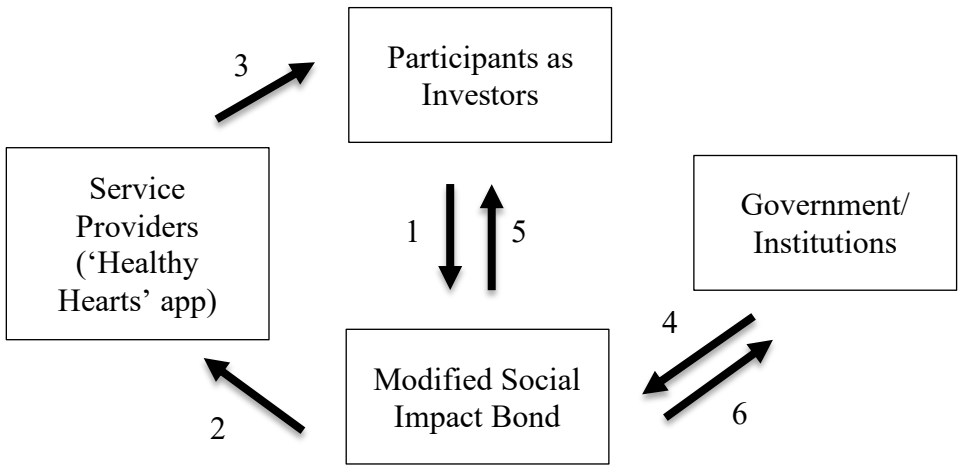


Figure 5

Modified Social Impact Bond Structure in Thesis



Modified SIB Mechanics. The modified SIB for this thesis follows a six-step structure, broken down into the following: In step one, it was recognized that participants receiving the intervention were the investors. Similar to the traditional SIB model, participants will invest money into the modified SIB. In steps two and three, the SIB funds will be used as reward in the intervention. Steps four and five recognize that if the participant reaches the desired PA outcome, then the government or private institution will pay the participants for reaching their goal. In this thesis, the Digital Health Lab provided this funding as it was a mock modified SIB. A unique feature of the modified SIB is highlighted in step six. That is that money invested into the SIB may be re-invested by the government or private institutions. The interest gained from the investment by the government can then be used to pay for the desired outcome in steps four and five. Based on the S&P 500 stock index funds over the last 30 years have shown an average investment return between 5-8% per year (J.B. Maverick, 2021). Thus, in the modified SIB proposed in this thesis, I will use 5% as the rate of return on investment for participants if they achieve their desired behaviour outcome. Advantages of the modified SIB model is that it is sustainable, and participant can gain both health and financial benefits. To my knowledge, the success of this modified version of SIBs in PA outcomes has not been explored. However, traditional SIBs have been effective in improving the efficiency and provision of criminal justice systems in the United States and has the potential to expand to other domains (Nazari Chamaki et al., 2019).

Financial Incentive Delivery

Comparing individual incentives to team incentives is another method of manipulating financial incentives. One randomized control trial found that when in an

arm where both the individual and the whole team benefits from reaching their goals, individuals were able to significantly reach their goals relative to other arms (Patel, Asch, Rosin, Small, Bellamy, Eberbach, et al., 2016). It can be concluded that it is crucial to provide each individual with an incentive in order to promote achieving daily step goals. Despite the social supportive structure of teams, individuals still require individual tangible rewards in order to provide motivation to reach their goal. In other team-based interventions, individuals can benefit off of knowing how they rank amongst their peers, plus receiving financial incentives for achieving their step goals (Patel, Volpp, et al., 2016).

Delivery of financial incentives can either be done through mobile devices or in-person. In the digital age, mobile financial incentive delivery offers a remote opportunity to deliver incentives. With mobile delivery, the facilitator can also choose to display the participant's progress and earnings. Limited research has been done exploring the difference between these two delivery methods.

Financial Incentive Timing

The researcher or facilitator can control the timing of when the financial incentive is delivered. Effective studies in the past have delivered the financial incentive to the participant monthly (Courneya et al., 1997; Patel et al., 2018) and at the end of the intervention (i.e., after 24 weeks) (Charness & Gneezy, 2009). Adams et al., (2017) manipulated the timing of the incentive and goal setting. They found that the best framework during the intervention is combining immediate rewards (daily) with adaptive step goals (developed by an algorithm based on individual's performance). This range in

success in varying financial incentive delivery times suggests that there is no best practice of financial incentive delivery timing.

Table 2 visually displays the features of financial incentive behaviour change interventions. Consensus has not yet been determined for the most effective financial incentive intervention. Additionally, financial rewards can provide immediate reinforcement of behaviour, but the scalability of this strategy is often limited due to cost.

Table 2

Financial Incentive Design in Behaviour Change Interventions

Features	Elements
Framework	
	Gain-framed
	Loss-framed
Financial Incentive Type	
	Cash – direct (i.e., pay-per minute) or lottery-style
	Social impact bond
	Charitable donation
	Voucher
	Loyalty points
Delivery Form	
	Mobile vs in person
	Individual vs team
Timing	
	Immediately
	Delayed

With the vast choices presented to the researcher to design effective financial incentive interventions, an important component the researcher cannot control is the participant's motivation to engage in a new health behaviour.

1.4.4 Study Rationale

Based on my literature review, a current challenge is how can we use a sustainable financial incentive model with a scalable mHealth intervention to prevent hypertension. Previous studies have already shown that financial incentives and mobile health interventions can be an effective strategy for PA related outcomes with small-to-moderate effect (Luong et al., 2021). Unfortunately, on a population-level, even modest incentives for physical activity may are not feasible or sustainable long-term due to cost (Wu et al., 2011). Therefore, a modified version of the SIB proposed may be a sustainable solution. However, such modified SIB mHealth intervention aimed to prevent hypertension does not currently exist. Further, the feasibility of such intervention compared with traditional PPM remains unclear. Thus, in this thesis, I will develop a mHealth financial incentive-based intervention and evaluate the feasibility of the intervention.

1.5 Research Objectives

This thesis consists of two related studies. The objective of Study 1 was to describe the process of developing an eight-week mHealth financial incentive HT education program (Healthy Hearts) and to evaluate the usability of the Healthy Hearts program. The objectives of Study 2 were to 1) determine the feasibility (recruitment, engagement, acceptability) of an eight-week mobile-based PPM and SIB HT prevention PA program, and 2) to explore the effects of PPM and SIB interventions relative to control on PA levels, BP, and PA motivation following the intervention.

Chapter 2— A Usability Study to Evaluate an Eight-Week Self-Guided Hypertension Education Mobile App

2.1 Abstract

Background: Adherence and poor engagement in physical activity (PA) programs are recurring problems with mHealth interventions. A strategy to overcome these problems is by grounding the app in behaviour theory, such as the Multi-Process Action Control (M-PAC) framework. Unlike other behavioural theories, the M-PAC framework looks to close the intention-behaviour gap, as exercise intentions alone are not strong enough to elicit positive behaviour change. Further, adding an incentive to a PA program can improve adherence and engagement. These elements along with co-designing an mHealth app with the target users ensure that apps meet the needs of both groups.

Purpose: The purpose of this study was to describe the process of developing an eight-week mHealth financial incentive hypertension education program (Healthy Hearts) and to evaluate the usability of the Healthy Hearts program.

Methods: The IDEAS framework was used to guide the development of the Healthy Hearts program. The development process consisted of 1) intervention planning: what and how to shift a web-based program to a mobile app and to determine further needs and requirements of the program; 2) intervention development: iteratively designing the mHealth program grounded in M-PAC and further strengthened with financial incentives; 3) usability testing: assessing the mHealth program and gathering feedback from six participants to further enhance the user experience through online questionnaires and semi-structured interviews.

Results: A need for this program was suggested during the intervention planning phase, as there has not been a financial incentive-driven M-PAC mHealth program tested for physical activity. Intervention development successfully created an eight-week financial incentive hypertension education program for adults aged 40-65 not currently meeting the Canadian Physical Activity Guidelines (<150 minutes of moderate-to-vigorous physical activity per week). Usability testing was successful, with six participants recruited, feedback was gathered to enhance the content, layout, and design of the Healthy Hearts program to prepare the mHealth program for Study 2.

Conclusion: The development of an mHealth PA intervention grounded in the M-PAC theory and delivered with financial incentives could further enhance the effectiveness of mHealth interventions and have a significant impact on extending the reach of existing PA programs. This study has reinforced the importance of an iterative co-design process between the users and the research team to design an mHealth physical activity intervention. Through this process, the users were able to provide valuable feedback on the content, design, and layout of the program. A study is now needed to evaluate the feasibility of the Healthy Hearts mHealth program.

2.2 Introduction

2.2.1 Literature Review

Hypertension (HT) is the leading risk factor for cardiovascular disease (Kjeldsen, 2018) and death in the world (DeGuire et al., 2019). The prevalence of HT in Canada is on the rise, with 25% of Canadians over 20 years of age currently diagnosed with HT and a lifetime incidence of developing HT at 90% among adults (Padwal et al., 2016). It is therefore critical to develop effective and scalable HT interventions for cardiovascular disease prevention.

Recent studies suggested mHealth lifestyle interventions can be an effective and scalable strategy to improve lifestyle behaviours (i.e., physical activity (PA)) and reduce blood pressure (BP) (Sequi-Dominguez et al., 2020). However, app engagement remains to be a challenge for mHealth interventions. (Ernsting et al., 2017).

This poor engagement can be due to a combination of factors. The first factor encompasses the age-, socioeconomic-, literacy-, and health-related disparities amid current mHealth apps (Ernsting et al., 2017). The second factor is that many of the mHealth apps have been created without research expertise or appropriate testing (Cook et al., 2016), or in other words, from a top-down approach where the user is not incorporated in the design process. To combat this issue, this study incorporated a co-design process with the target end user and research team to ensure the program met their needs, and therefore the extent to which the app could be used to improve adult PA levels and contribute to their motivation to continue using the app (Ayala & Elder, 2011).

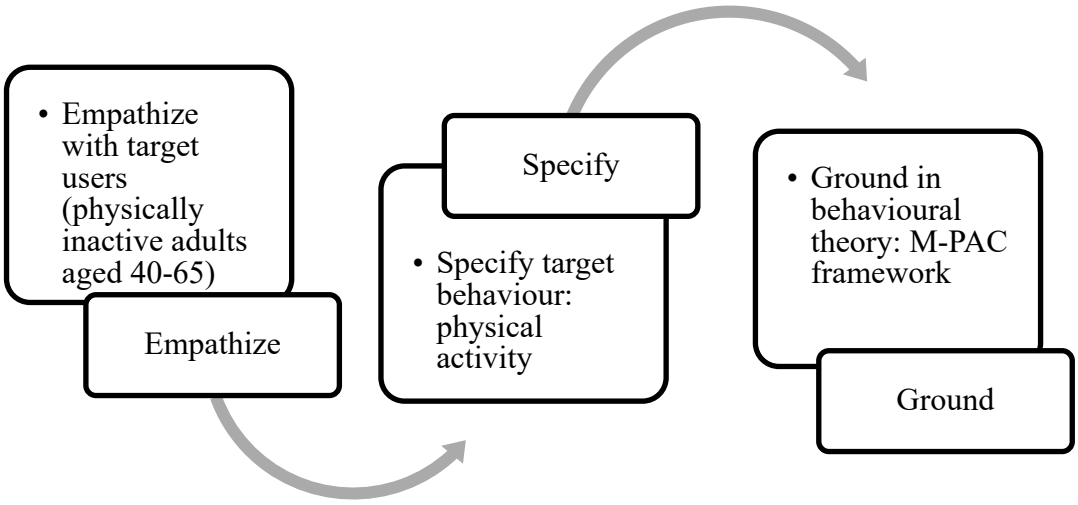
To effectively and efficiently co-design and disseminate mHealth behaviour change interventions, Mummah and colleagues (2016) developed the IDEAS framework. This framework proposed four overarching stages to developing effective behaviour change interventions: integrate, design, assess, and share (Mummah et al., 2016). The implementation of these four stages into digital behaviour interventions is envisioned to accelerate the process of knowledge translation of evidence-based content from the research team to the participant (Mummah et al., 2016).

The first stage of the framework, Integrate, involves addressing: 1) the needs of the target user, 2) the behaviour that the intended user is expected to improve, and 3) grounding this behaviour change intervention for the target user in theory. The mHealth

HT education program being used in this thesis is built on a previous web-based intervention (S. Liu et al., 2015). This provided a foundation for the content in the program and expected outcomes related to improving PA in an adult population have been previously assessed in an iterative process between the research team and the users. When this platform moved from web-based to mobile, it was crucial that an integrated KT process was followed so all users could assist with feedback to ensure that this mHealth program was relevant and useful to all stakeholders. Figure 6 represents the flow of the integrate stage of the IDEAS framework.

Figure 6

Stage 1 of IDEAS Framework: Integrate, adapted from (Mummah et al., 2016)

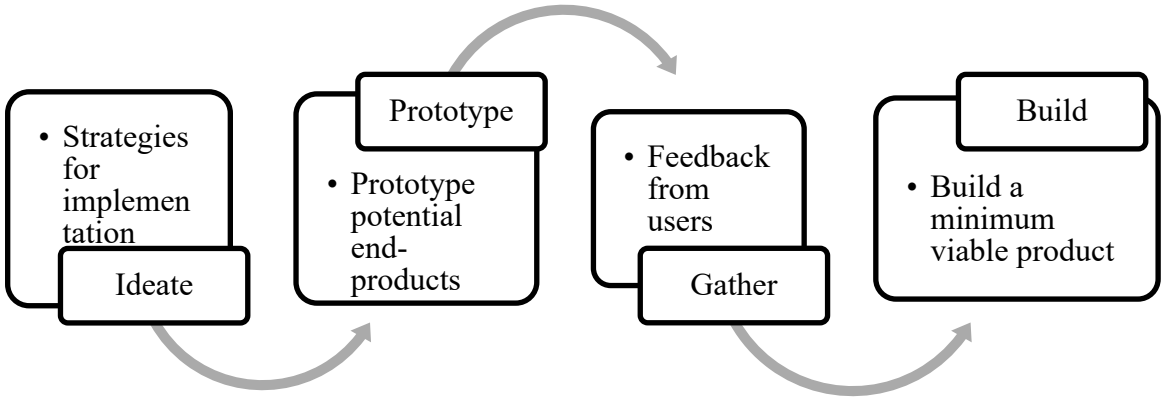


The second stage of the IDEAS framework, the design phase, is an iterative and cyclical approach, where a prototype is designed and repetitively tested to meet the needs of the target population. In this stage, the research team harnessed the insights from the target user and behavioural theory and 1) envisioned strategies for implementing the information into a deliverable, 2) developed prototypes of potential products, 3) collected user feedback and recommendations, and 4) iteratively build a product to use in an

intervention based on feedback and overall design. Figure 7 displays the process of the design stage of the IDEAS framework.

Figure 7

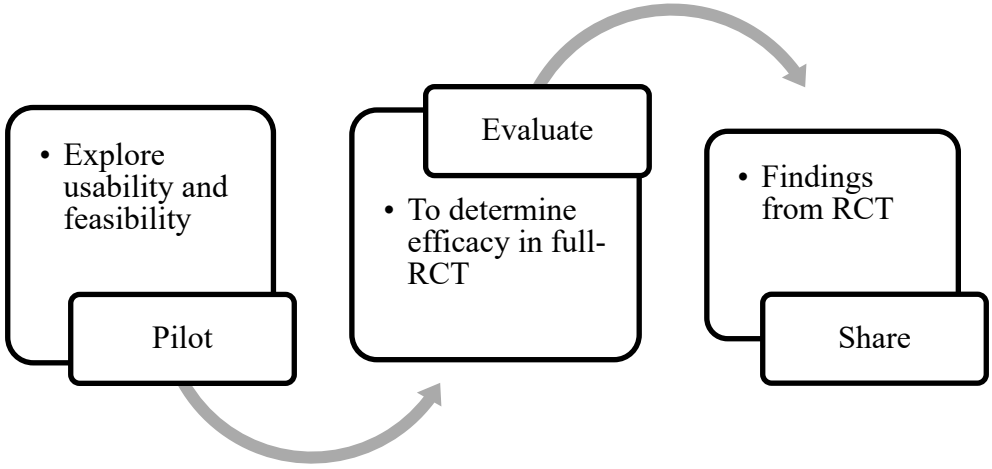
Stage 2 of IDEAS Framework: Design, adapted from (Mummah et al., 2016)



Mummah and colleagues (2016) also recommend rigorously assessing the usable product in either a pilot trial or RCT in the third stage. The final stage, Share, of the IDEAS framework is crucial to keep all stakeholders involved. However, these last two stages were not conducted in Study 1. Figure 8 displays the processes of the Assess and Share stages of the IDEAS Framework.

Figure 8

Stages 3 and 4 of IDEAS Framework: Assess and Share, adapted from ((Mummah et al., 2016)



2.2.2 Objectives

The objectives of this study were to 1) describe the process of developing an eight-week self-guided financial incentive hypertension education program, and 2) evaluate the usability of the intervention.

2.3 Methods

The Integrate, Design, Assess, and Share (IDEAS) framework was followed to help the development of this mHealth intervention (Mummah et al., 2016). Based on this framework, Study 1 involved the integration and design phases of this framework. Table 3 illustrates the timeline of these two stages.

Table 3

Timeline of Mobile Program Development

Phase	Activities	Dates
1) Intervention development	Transform program to mobile app	December 2020-January 2021
2) Usability testing	Qualitative and quantitative feedback	February-March 2021
	Revise program based on results	March 2021

2.3.1 Intervention Planning

The current Healthy Hearts program was modified from an effective user and expert-driven HT management lifestyle web-based program (S. Liu et al., 2015) to meet the established preferences for an mHealth program (Vo et al., 2019). Some of these preferences include increased personalization of a tailored health program, improving participant engagement by including surveys and quizzes embedded into the lessons, and increasing patient empowerment by encouraging individual goal setting through the app (Vo et al., 2019).

The Healthy Hearts program was adapted from an eight-week web-based HT management program. The adapted program consisted of 25 lessons, developed based on the Multi-Process Action Control (M-PAC) framework (Rhodes, 2017; Rhodes & Yao, 2015). The M-PAC framework addresses the intention-behaviour gap through the understanding that ongoing reflective processes (i.e., affective attitude and perceived opportunity) and regulation processes (behavioural and cognitive tactics to maintain intention focus) are necessary for the intention to become an action. With this strong foundation of both reflective and regulatory processes, the maintenance of behaviour is supported with habit and identity, which can be categorized as reflexive processes (Kaushal et al., 2017; Rhodes, 2017; Rhodes & Yao, 2015; Vallerand et al., 2017). Further, an extensive literature search was conducted to determine how to embed financial incentives into this mHealth program to promote PA.

2.3.2 Intervention Development

Following the M-PAC framework, the lessons started with intention formation (lessons 1–10), then moved into action control adoption (lessons 11-19)

and concluded with action control maintenance (lessons 20–25). Three lessons were designed to be delivered each week and encompassed the following topics: PA and heart health, goal setting and planning, PA and mental health, building PA opportunities by restructuring the physical and social environment, and exercise habit and identity formation. Numerous BCTs (Michie et al., 2013) were used throughout the lessons and are listed in Table 4 below. Many BCTs are successful in helping an individual advance through the M-PAC constructs and develop positive exercise habits and exercise identity. Financial incentives are also an effective BCT that can improve engagement in PA interventions (Kramer et al., 2019; Strohacker et al., 2014). An mHealth intervention grounded in the M-PAC theory and further strengthened with financial incentives has not yet been tested. An outline of the topics covered, M-PAC constructs employed, and BCTs used is provided in Table 4.

Table 4

Outline of Intervention Content and Features

Week	Topics Covered	M-PAC Construct	Behaviour Change Technique Used
1. Getting started in a PA program	• Canadian PA Guidelines • Introducing relationship between PA and BP	Initiating reflective processes (perceived capability, instrumental attitude)	Action planning (1.4)*, Information about health consequences (5.1)*, Material incentive (behaviour (10.1)*
2. Reaching your PA goals	• SMART goals • FITT principle • Enjoyment with PA	Initiating reflective processes (perceived capability, instrumental attitude) and ongoing	Goal setting (1.1)*, Action planning (1.4)*, Review behaviour goals (1.5)*, Behavioural practice/ rehearsal (8.1)*

		reflective processes	
3. Progressing your PA goals	• Progressing FITT principles • HT and CVD prevention with PA	Initiating reflective processes (perceived capability)	Goal setting (1.1.)*, Self-monitoring of behaviour (2.3)*, Information about health consequences (5.1)*, Graded tasks (8.7)*
4. Your emotions and PA	• Mental benefits of PA • Loneliness and heart health (COVID-19) • Responding to PA-avoiding triggers • Developing trigger management strategies	Ongoing reflective processes (affective attitude)	Goal setting (1.1)*, Self-monitoring (2.3)*, Monitoring of emotional consequences (5.4)*, Behavioural practice/ rehearsal (8.1)*, Distraction (12.4)*
5. Your support system and PA	• 4 pillars of social support • Identifying social support network	Ongoing reflective processes (perceived opportunity)	Goal setting (1.1)*, Self-monitoring (2.3)*, Social support (practical) (3.2)*, Social support (emotional) (3.3)*, Behavioural practice/rehearsal (8.1)*
6. Your environment and PA	• Creating a positive internal environment to promote PA motivation • Outdoor environment and effect on PA • Changing environment to promote PA	Ongoing reflective processes (perceived opportunity)	Goal setting (1.1)*, Self-monitoring (2.3)*, Prompts/cues (7.1)*, Behavioural practice/rehearsal (8.1)*, Restructuring the physical environment (12.1)*, Adding objects to the

			environment (12.5)*
7. Slippery slope and lifestyle change	• Exercise identity introduction • Balancing responsibilities to maintain PA	Regulation processes, reflexive processes (identity, habit)	Goal setting (1.1)*, Self-monitoring (2.3)*, Behavioural practice/rehearsal (8.1)*, Habit formation (8.3)*
8. Staying motivated after this program	• Getting unstuck during times of relapse • Making informed choices to promote quantum change • Self-monitoring strategies to continue	Regulation processes, reflexive processes (identity)	Goal setting (1.1)*, Self-monitoring (2.3)*, Behavioural practice/rehearsal (8.1)*, Incompatible beliefs (13.3)*, Valued self-identity (13.4)*

Note. PA= physical activity; BP= blood pressure; HT= hypertension; CVD= cardiovascular disease

* the numbers in the brackets indicate the BCT for reporting in behaviour change interventions (Michie et al., 2013).

The goal of the self-guided program was to inform adults aged 40-65 of the benefits of PA to prevent HT. Similar to the web-based program that this intervention was adapted from (Nolan et al., 2013), this program was eight weeks in length. At the start of each lesson, an objective was stated and was met in the lesson through informational content, surveys, and quizzes.

The Healthy Hearts program was delivered through Pathverse (*Pathverse*, 2021). The Pathverse platform features a web portal for health researchers and clinicians to create engaging mobile app interventions with “drag and drop” features instead of coding. The content is then instantly displayed on the Pathverse mobile

app. The platform is organized to deliver multiple lessons in programs. Each lesson is composed of three different types of cards: information cards, survey cards, and quiz cards. Each lesson followed the same structure for clarity throughout the program. Figure 9 shows the structure of each lesson. Survey data and lesson completion data can be downloaded by the program creator. Program creators are able to enrol participants through the web portal and enrolled participants are able to instantly see the programs they are enrolled in. Figure 10 displays the first prototype made for usability testing. The process of uploading content into lessons on the Pathverse web portal was iterative to ensure that the text and images used throughout were readable and visually appealing. Throughout this process, feedback was given to the development team in order to improve Pathverse. After all the content was uploaded, it was ready to be tested by the ideal users.

Figure 9

Flow of Lesson Structure

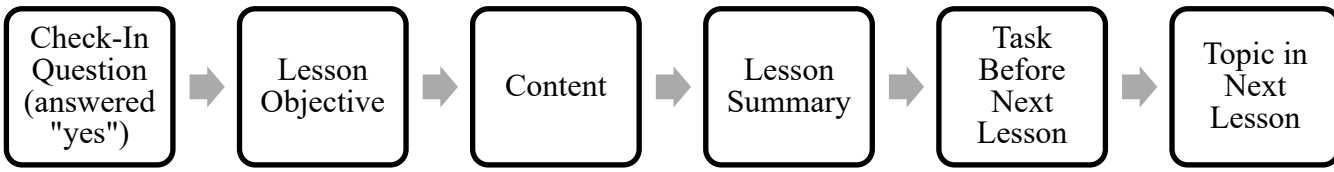
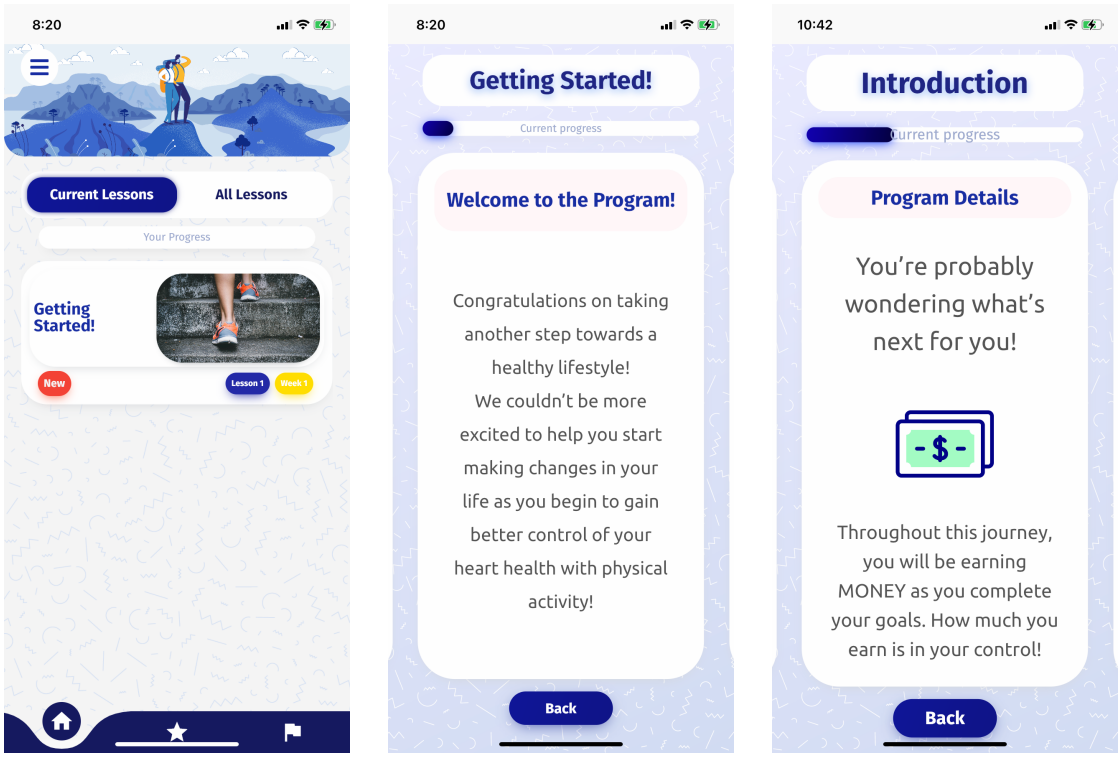


Figure 10

First Prototype for Usability Testing



2.3.3 Usability Testing

This usability testing was intended to determine how the target user interacts with a mobile-based program and whether the program meets its intended purpose. A convergent parallel design was conducted to gain an in-depth analysis of the acceptability, ease of use and satisfaction, and system information arrangement of an mHealth program. This methodology supported the ability to compare, verify, or narrate quantitative data (Likert-scale questionnaires) and qualitative data (think-aloud transcripts and semi-structured interviews) (Creswell, 2015). Quantitative and qualitative data were analyzed separately, and the semi-structured interviews were designed to bring life to the questionnaires, to hear real feedback and emotion from the app testers. These

interviews gave participants the opportunity to share information that the questionnaires could not capture and bring emotion to their feelings.

Semi-structured interviews and a modified acceptability questionnaire used by the research team in previous studies were used to determine if the content was acceptable for the target audience (adults aged 40-65). Ease of use and satisfaction and system information arrangement were assessed primarily through the mHealth App Usability Questionnaire (MAUQ) (Zhou et al., 2019) and by analyzing commentary throughout the usability testing. Ease of use looked to determine how easily the user could interact with Pathverse and to ensure optimal functionality of the platform. Similar to ease of use, satisfaction was defined as the extent to which the platform was pleasing to use. Lastly, assessing the system information arrangement determined whether the functions and navigation through the app were optimal for the user.

The findings from this study were used to determine the usability of an eight-week self-guided HT education program, called Healthy Hearts, on a mobile app. After participants had a chance to think-aloud through a lesson in the Healthy Hearts program, semi-structured interviews (Table 6) were conducted and quantitative questionnaires were completed to assess acceptability (Table 9), ease of use and satisfaction (Table 10), and system information arrangement (Table 11) of the mobile app, Pathverse. The quantitative instruments used were a modified version of the mHealth App Usability Questionnaire (Zhou et al., 2019) to match the needs of the app for the purpose of this study.

Participants

Participants in this mixed-methods study were recruited through boosted Facebook posts from February 13-March 5, 2021. Inclusion criteria included: adults aged 40-65, with access to a Smartphone (Apple or Android) with Internet, residing in Canada, and not meeting the Canadian PA Guidelines of 150 minutes of MVPA per week (Tremblay et al., 2011). Thus, the boosted Facebook post was targeted at adults aged 40-65 within a ten-kilometre radius of the city centres of the following British Columbia cities: Victoria, Vancouver, Kamloops, and Kelowna. Of the 169 people that engaged with the ad, 11 people expressed interest in participating by filling out the linked Google Form with their contact information. Of these 11 people, five people were recruited for usability testing. Participants were informed that they would earn $20 for their time for participating in this study.

Procedure

This study was approved by the Human Research Ethics Board at the University of Victoria (protocol number 17-361) and took place virtually through Zoom.

To participate in usability testing, participants were emailed after providing their contact information in a Google Form. After brief email correspondence, an eligibility meeting was arranged with the individual through the University of Victoria's Zoom service. Individuals were informed that they were allowed to use a nickname or a substitute name and having their camera on was optional. This initial meeting was set to ensure that the individual was between the ages of 40 and 65, located in Canada, owned a Smartphone (Apple or Android), and was not currently meeting the Canadian PA Guidelines of 150 minutes of MVPA per week (Tremblay et al., 2011). If the individual was still interested in participating after this eligibility meeting, a consent form was

emailed to the individual and a formal usability meeting was scheduled after the consent form was signed and returned.

These eligible and consented participants were asked to meet individually again through the University of Victoria's Zoom Service. The individual was informed that this meeting would take approximately 45 minutes, that they must take this meeting from their Smartphone, and were asked to download the mobile app, Pathverse, in advance. The meeting was recorded through Zoom local recording along with adamant notetaking throughout the meeting. Audio files were saved to the Digital Health Lab's secure drive once downloaded following the meeting. Once the meeting started, participants were asked to share their phone screen, so it was possible to follow along with the experience in real-time. Unique login credentials were given to each participant and logging into the Pathverse app was the first goal-oriented task of the meeting. During and after each task, individuals were asked about the aesthetic, features, and relevancy of the content they were viewing. The second task was to complete the first lesson of the Healthy Hearts program. This lesson addressed the content that would be covered in the eight-week PA program, including earning a financial incentive, and introduced the benefits of PA for overall heart health. This lesson also incorporated both survey and quiz cards so the user could see the full potential of a lesson on Pathverse. After completing this lesson, individuals were invited to scroll through all lessons offered in the Healthy Hearts program and were invited to share feedback on lesson photos and names. The next task was to access the fitness page of the program and connect the individual's phone to display selected fitness data. At the time of testing, only Apple iOS devices were able to display their fitness data. The final task was to go to the "Goal Setting" page and set a

goal. A list of the goal-oriented tasks throughout the usability testing process is outlined in Table 5.

Table 5

Goal-Oriented Tasks in Usability Testing

Task	Activity
Log into app	• Input login information
Complete a lesson	• Start lesson • Navigate through cards of lessons • Interact with survey and quiz cards
Connect to fitness page	• Navigate to new page in app • Tap to connect fitness information to be displayed on app
Set a goal	• Navigate to new page in app • Locate 'set a goal' button • Add a goal

Throughout this process, participants were asked to "think-aloud" as they completed the tasks to further capture their ongoing thought processes while they are using the program, as well as any difficulties they may experience (Fonteyn et al., 1993). The participants were informed that they were allowed to ask questions, but that they may not immediately receive answers to their questions for goal-oriented tasks in order to follow their full thought processes during troubleshooting unless they explicitly requested. This was done to help minimize any disruptions to the spontaneous thoughts generated during task execution. Any problems encountered throughout the tasks were documented.

After the participant completed the goal-oriented tasks, semi-structured interviews were conducted. The purpose of the semi-structured interviews was to direct open-ended feedback and to further understand the thoughts and emotions of the participants. Further,

these questions served to capture the participant's perception of the design and content on the app with questions relating to the acceptability, usability, satisfaction, and system arrangement. Table 6 displays an overview of potential questions asked in the semi-structured interview and emerging themes from both the interview responses and goal-oriented task feedback.

Table 6

Interview Questions and Responses

Interview Questions	Theme/ Summary
Q1. Can you tell me what you liked best about the app?	Personalization: All participants who tested the personalized program (n=4) appreciated an introduction of the program creator.
Q2. Can you tell me what you liked least about the app?	Display: Pathverse was not yet optimized to as many phones, including those with larger font sizes, so words were often cut out.
Q3. Can you tell me about how easy it was to navigate or our find your way around the app?	Lesson progression: Many participants (n=4) were not under the assumption to swipe left to progress through the lesson. Page access: While accessing three pages on the app was well responded to, the symbols representing different pages (i.e., fitness page) on the menu bar were not clear.
Q4. Can you tell me about what you thought about the overall look of the app?	Design: Participants all liked the simple visual of the app, including layout and fonts.
Q5. Can you tell me what you thought about the information provided on the app?	Heart health: One participant stated that the content was "very clear" and "didn't use jargon". Financial incentive: All participants were intrigued by a chance to earn money while simultaneously using the app.

After the semi-structured interview, the participant was given a link to access an online questionnaire that asked for demographic information and an adapted version of the mHealth App Usability Questionnaire (MAUQ) (Zhou et al., 2019). Components of

the MAUQ that related to Pathverse, and the Healthy Hearts program were included, including seven items from the ease of use and satisfaction (MAUQ_E) component, five items from system information arrangement (MAUQ_S), and one item (Item 15) from the usefulness questionnaire (MAUQ_U) was added to a previously used acceptability questionnaire. Item five from the MAUQ_E was adapted from "I feel comfortable using this app in social settings" to "I feel comfortable using this app on my own". For consistency among usability questionnaires used, a five-point Likert-scale was used: '1', strongly agree, '2' agree, '3' neutral, '4' disagree, and '5' strongly disagree.

Two rounds of usability testing were conducted. Two participants participated in the first round of usability testing. Identical comments involving the length of the lesson were made by both participants. Changes were made to reflect these comments before the remaining four individuals completed the usability testing. Data saturation was met and exceeded after all participants (n=6) completed testing. After feedback was transcribed and analyzed, a feedback document was prepared for the development team in the Digital Health Lab to present suggestions in terms of high, medium, and low priority. These high priority feedback items were changed prior to Study 2.

2.3.4 Statistical Analysis

After the Zoom meeting concluded, interview mp4 files were downloaded. The audio was transcribed using transcription software. The transcript produced aligned with the screen recording obtained from Zoom to follow along visually and auditorily. Upon relistening to the audio, notes taken throughout the usability testing were cross-referenced with the recorded audio and thematic analysis began to "identify, analyze, organize, describe, and report themes found within a data set" (Braun & Clarke, 2006).

Quantitative data were entered and analyzed using the International Business Machine Corporation Statistical Package for the Social Sciences (IBM SPSS) version 26 to describe group demographic characteristics and determine group means on outcome measures.

The six-step process of thematic analysis outlined by Braun and Clarke (2006) was followed to conduct a meaningful evaluation of the qualitative data. Thematic analysis allows freedom for the researcher to have autonomy over the themes and concepts that can be derived from the data (Braun & Clarke, 2006). After familiarizing myself with the data through transcription and cross-referencing my notes, I began coding the data. I initially coded the data into categories such as colours, features, accessibility, usage, and feelings. Each code also indicated whether the comment was positive or negative and if it related to the content in the program or the user interface of Pathverse. I then grouped this data into the themes of usability, acceptability, or engagement. Table 7 outlines the six-steps of thematic analysis along with the general tasks for each.

Table 7

Six Steps of Thematic Analysis as Outlined by Braun & Clarke (2006)

Phase	Tasks Completed
1. Familiarize self with data	Transcribe data; write down initial codes
2. Assign preliminary codes to data	Code features, organize data relevant to each code
3. Search for patterns	Collate codes into potential themes
4. Review themes	Compare themes in dataset; generate thematic map
5. Define and name themes	Ongoing thematic analysis; generate clear names for each theme

6. Produce report	Relate themes back to purpose of study; generate report of themes along with quantitative data

2.4 Results

2.4.1 Participants

Of the 11 potential participants contacted, six individuals were recruited to complete this study. Four potential participants did not respond to the initial recruitment email, and one did not meet eligibility criteria. The participant sample was 66% female, with half of the participants (n=3) being within the age range of 50-59 years of age, and 100% Caucasian. All participants had at least five years' experience using a Smartphone and were all experienced in using their Smartphone for Internet browsing. Please refer to Table 8 for full participant characteristics.

Table 8

Participant Characteristics

Variable	N = 6
Gender, n [%]	
Male	2 [33]
Female	4 [66]
Age in years, n [%]	
40-49	2 [33]
50-59	3 [50]
60-65	1 [17]
Ethnicity, n [%]	
White	6 [100]
Education level, n [%]	
Some college or university	3 [50]
College or university degree completed	2 [33]
Graduate degree or higher	1 [17]

Two rounds of usability testing were conducted. Comments made from participants 001 and 002 were from the first round of usability testing, and comments

from participant 003 through to 006 were from round two of usability testing. The usability results from both rounds of testing were cumulated and summarized below.

2.4.2 Acceptability of Content and Design

Acceptability questions and feedback looked to determine how the target population would use the app and the content they read in their daily life. Findings for the acceptability of the Healthy Hearts program on the Pathverse app were relatively consistent among participants. It was immediately clear after two participants completed usability testing (n=2) that the introductory lesson was too long. The lesson initially consisted of 28 cards (i.e., pages of information) and participants 001 and 002 both commented on "losing interest near the end". This resulted in dividing up the introductory lessons into two separate lessons for round two of usability testing. From both rounds of testing, 67% (n=4) of the participants 'agreed' (2) with the following statements: "This app will be useful for my health and well-being", "I enjoyed reading the content in the lessons", "I enjoyed using the interactive tools in each lesson", and "I found the content in each lesson useful". These statements, along with other acceptability statements that were used in the quantitative analysis can be found in Table 9.

Table 9

Acceptability Feedback

Statement from Questionnaire	Mean (SD)
The app would be useful for my health and well-being.	2.00 (0.63)
I enjoyed reading the content in the lesson.	2.33 (0.52)
I enjoyed using the interactive tools (i.e., survey and quiz features) in the lesson.	2.33 (0.52)
I found the content in the lesson useful.	2.33 (0.52)
I thought the content in the lesson was applicable to me.	2.17 (0.75)

I would imagine that most people who are seeking better health habits would find the content applicable.	2.00 (0.63)

Note. Data from acceptability questionnaire and Item 15 from MAUQ_A; ‘1’, strongly agree, ‘2’ agree, ‘3’ neutral, ‘4’ disagree, and ‘5’ strongly disagree.

Similar comments were made from participants (n=2) after the first round of usability testing. Participant 001 stated, “I’m losing my drive to read come the end of it” and participant 002 stated, “There’s a lot of words [in the lesson], but maybe because it’s the first lesson”. Upon making changes to the amount of content delivered in the first lesson, comments of this nature subsided and were replaced with “the small images are important to break up the text” and “this is a good [number] of words [on the screen]” from participant 003 and 005, respectively.

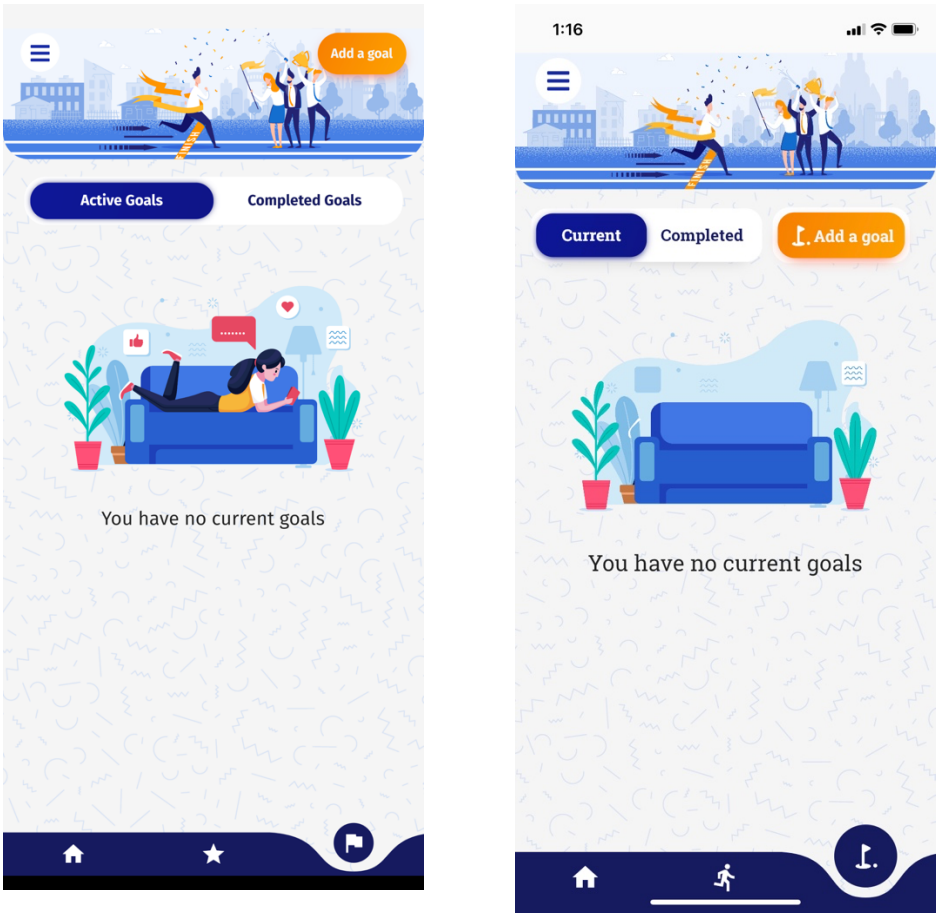
There were mixed feelings about the self-monitoring Fitness page on Pathverse. 50% of participants (n=3) commented that the star icon to indicate the Fitness page “doesn’t mean Fitness to me”, as participant 006 stated. On the Fitness page, steps were displayed in an accumulation of the past three days, the past week, and the past month, a display that participant 002 said, “is simple” and “a good illustration for all abilities”. Participant 004 shared this sentiment, stating “steps is really common and good”. The simplicity of this page was not as positively received, with participant 006 stating “the visual doesn’t mean anything to me”. When probed into what they would like to see displayed on the Fitness page, participant 006 stated they “value the distance” and would like to see “steps converted into kilometres”. Participant 004 would “like to see stairs”.

Similar to the Fitness page, the icon that depicted the Goal Setting Page (a flag) “did not mean goals” to participant 006. 100% (n=6) of participants commented on the location of the “Add a Goal” button on the page. Participant 005 mentioned that the

button “is a little bit hidden away” and “kind of got lost” in the header image. Further, “more pathway to setting a goal” was a suggestion from participant 004, and participant 003 suggested addressing “when goal setting will be taught in the program” so the user is aware. Figure 11 shows the original Goal Setting Page in comparison to the updated page.

Figure 11

Goal Setting Page- Then and Now



2.4.3 Ease of Use and Satisfaction

Ease of use and satisfaction was the first sub-category analyzed with a mixed-methods approach. This sub-category looked at the extent to which Pathverse was an effective, efficient, and satisfactory platform to deliver a heart health education program

to those at risk for developing hypertension. All data under the theme “usability” as well as positive coded qualitative data was analyzed to supplement the quantitative scores from the MAUQ_E. Quantitative data analysis supplemented the qualitative data, with most ‘agreeing’ (2) or ‘strongly agreeing’ (1) with the items in this category. The statement “The amount of time involved in using this app has been fitting for me” was the most agreeable statement, with all participants (n=6) at least ‘agreeing’ with the statement. The same results were mimicked for the statement “I feel comfortable using this app on my own” with all participants (n=6) at least ‘agreeing’ with the statement. One participant, participant 003 exclaimed, “Wow, I am impressed with how user friendly this is!” A list of means and standard deviations for all statements in the MAUQ_E is reported in Table 10.

Table 10

Ease of Use and Satisfaction from the mHealth App Usability Questionnaire

Statement from Questionnaire	Mean (SD)
The app was easy to use.	2.17 (0.75)
It was easy for me to learn to use the app.	1.83 (0.75)
I like the interface of the app.	1.50 (0.55)
The information in the app was well-organized, so I could easily find the information I needed.	2.00 (0.89)
I feel comfortable using this app on my own.	1.67 (0.52)
The amount of time involved in using this app has been fitting for me.	1.83 (0.41)
I would use this app again.	1.83 (0.75)
Overall, I am satisfied with this app.	1.67 (0.52)

Note. Data from MAUQ_E; ‘1’, strongly agree, ‘2’ agree, ‘3’ neutral, ‘4’ disagree, and ‘5’ strongly disagree.

2.4.4 System Information Arrangement

The system information arrangement referred to the user interface of the mobile app. Questions and comments relating to the navigation, content and feature arrangement, and general interaction with the Pathverse platform were analyzed under this category. The statement “The navigation was consistent when moving between screens” from the MAUQ_S was the most agreed upon statement with 83% (n=5) participants ‘agreeing” (2) with the statement. A suggestion from participant 005 was to “include a card or a tutorial to explain what each piece of the app does”.

One participant ‘disagreed’ (4) with the statement “Whenever I made a mistake using the app, I could recover quickly”. This participant brought forward that their fitness data was not displayed, and they were left with “no direction on how to fix it”. The issue has since been resolved. Means and standard deviations from the statements of MAUQ_S are displayed in Table 11.

Table 11

System Information Arrangement from the mHealth App Usability Questionnaire

Statement from Questionnaire	Mean (SD)
Whenever I made a mistake using the app, I could recover quickly and easily.	2.50 (0.84)
This app adequately acknowledged and provided information to let me know the progress of my action.	2.67 (0.52)
The navigation was consistent when moving between screens.	2.17 (0.41)
The interface of the app allowed me to use all the functions (such as entering information, responding to reminders, viewing information) offered by the app.	2.33 (1.21)

This app has all the functions and capabilities I expect it to have.	2.00 (0.63)

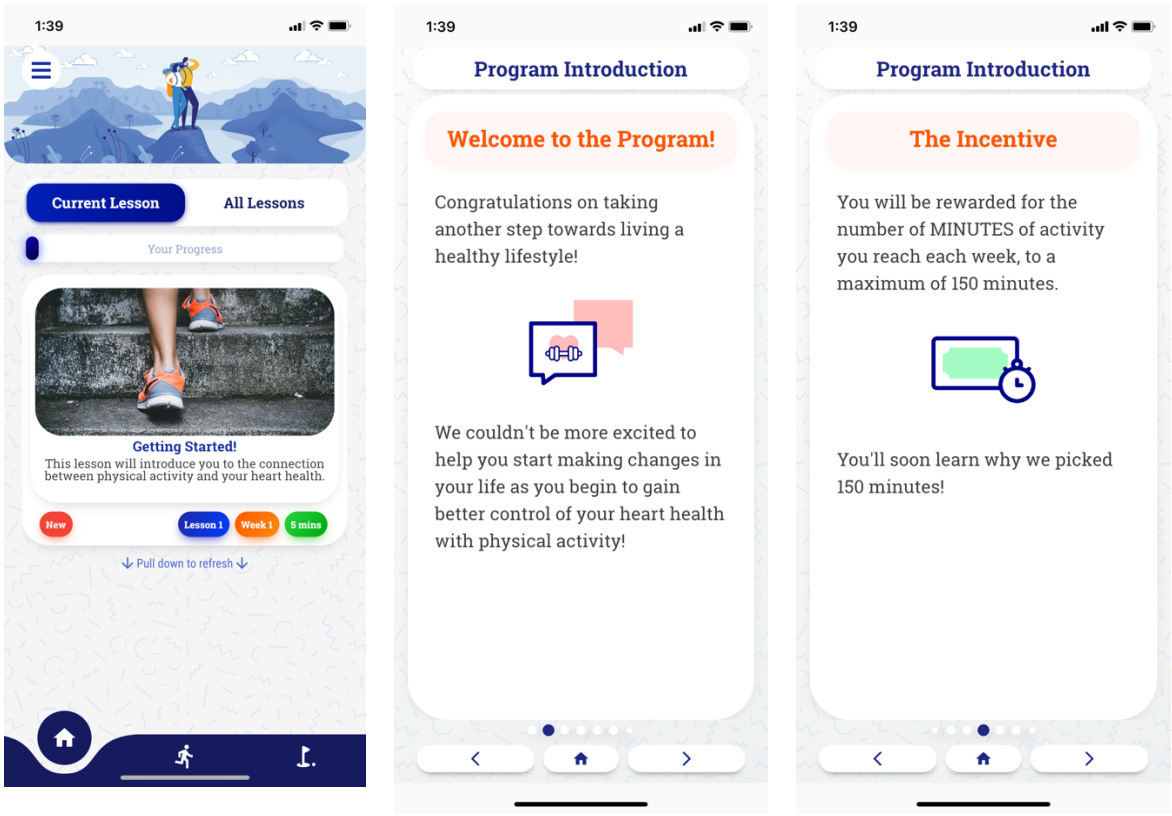
Note. Data from MAUQ_E; '1', strongly agree, '2' agree, '3' neutral, '4' disagree, and '5' strongly disagree.

When participants were asked about the layout of the home page and the lesson details, comments were overall positive. All participants (n=6) were able to switch tabs from "Current Lessons" to "All Lessons" without difficulty. Comments relating to the lessons, including the lesson name, photo, and tags included in the lesson, participant 001 commented, "I like the pictures that have nature in them, it makes me want to go outside." Participant 003 had the same sentiment and added that nature photos and those exercising "showed fitness" and "[they] liked that to feel inspired". Half of the participants (n=3) commented on the colours of the tags associated with the lesson. The tags at the time were blue, yellow, and red. The yellow tag with white text was "hard to read" according to participant 001. This statement was matched by two other participants and participant 003 suggested "using orange instead of yellow to compliment the blue and make it easier to read".

Based on these results, along with the following breakdown of ease of use and satisfaction, system information arrangement and acceptability, the content and the user interface underwent adjustments to improve 1) accessibility and readability of content and colours 2) the accessibility of the goal setting page and 3) guidance for the goal setting page within the lessons. Other key changes included the layout and aesthetic design of the platform, such as adjusting paragraph spacing, adding images, and hyperlinks to access other health-related information. Figure 12 shows the updated design of the Pathverse app relative to the photos from Figure 10.

Figure 12

Current Design of Pathverse



As a result of all feedback, modifications were made to prepare Healthy Hearts for Study 2. Table 12 displays an overview of themes, quotations, and program modifications made to address the feedback received.

Table 12

Themes, Quotations, and Program Modifications

Theme with Sample Quotation (Participant ID, Round #)	Modifications to Program (Program Features Affected)
Content *"There's a lot of words and [cards], I definitely lost interest at the end and would have swiped through if you weren't watching" (Participant 001, Round 1)*	• Divided first lesson into two shorter lessons (Lessons 1-2) • Ensured length of all lessons were of similar length (Lessons 3-25)

Personalization *"I love the personalization, saying that you're here with me in the program is very motivating" (Participant 004, Round 2)*	• Added more reminders throughout that I am cheering participants on
UI Layout *"I don't mind the [number] of words, but the layout [font differences, words cut off] wasn't always appealing" (Participant 003, Round 2)*	• Consulted with development team to ensure Pathverse was optimized for various Smartphones
Navigation *"Do I have to keep swiping left to progress?" (Swiped left) "Oh that's how I keep going" (Participant 006, Round 2)*	• Consulted with development team to change lesson layout delivery • Included forward and backward arrows on each page as alternative options to swiping left and right
Goal Setting *"The add a goal button doesn't stand out to me" (Participant 002, Round 1)*	• Consulted with development team to move location of "add a goal button" • Moved the button from top right to a more central location
Duration *"I would like to know how much time to budget for each lesson" (Participant 005, Round 2)*	• Added a tag that recommends the length of time each lesson will take (i.e., 6 mins)
Mixed Media *"Small icons are nice to break up the words" (Participant 004, Round 2)*	• Included various icons in the middle of each card to break up the amount of text
Colour *"I love the colour yellow [on the tag] but it is very hard to tell what it says with the white text" (Participant 003, Round 2)*	• Consulted with development team to change the tag colours • Changed yellow tag to orange and white text was much more eligible per the Digital Health Lab team

2.5 Discussion

The purpose of this study was to describe the process of developing an eight-week mHealth financial incentive HT education program (Healthy Hearts) and to evaluate the usability of the Healthy Hearts program to prepare the app to be used for Study 2. The

evaluation of the Healthy Hearts program used a mixed-method approach with quantitative data through an adapted mHealth App Usability Questionnaire being described through qualitative semi-structured interviews. The iterative design process involved in the program development promoted the ability to find and make changes quickly when any issues arose. Although the usability testing highlighted some usability issues (i.e., too much content, layout and appearance of certain texts and icons), many positive comments were also received about the content and design of the mobile-based program. The target users were exposed to the type of content to be delivered in the eight-week program and were introduced to the addition of a financial incentive to promote PA and adherence to the program. By identifying and improving various issues throughout the process of Study 1, this will ensure that this will not impact the results of using the mobile app program in Study 2. Further, it was decided that each participant in Study 2 would be given a user manual to walk them through a full step-by-step guide to using the Pathverse app.

This study was additionally aligned with Canada's Strategy for Patient-Oriented Research Patient Engagement Framework (Rouleau & Moody-Corbett, 2012). As such, this study met two of the three phases: 1) identifying goals and outcomes of an effective HT education program and 2) conducting usability assessment of the app to further enhance the usability experience. The third phase identified for this Patient Engagement Framework was assessing the feasibility of the intervention and was conducted in Study 2.

Following the IDEAS framework (Mummah et al., 2016) for developing effective digital behaviour change interventions resulted in a quick and timely development

process. Four key factors contributed to the success of the development of the Healthy Hearts program through Pathverse. First, an iterative design strategy allowed for previous knowledge from the original web-based program (S. Liu et al., 2015) to be translated and effectively tested in this study. Second, the Pathverse platform was a simple and efficient method to create the first prototype and subsequent changes to the platform. The "drag and drop" features employed in the Pathverse web platform assisted with the efficiency and simplicity to customize the Healthy Hearts program. This framework also allowed feedback between the user and the multidisciplinary Digital Health Lab team in order to improve the user interface and experience. The Digital Health Lab team consists of researchers and software developers who cyclically created the Pathverse Admin web platform and mobile app. Third, the usability assessment enabled the ability to further improve the Healthy Hearts program into an acceptable mobile app program for Study 2.

The Healthy Hearts program is the first of its kind to be delivered through Pathverse. This new platform was an efficient tool to adopt a web-based program into a mobile-friendly deliverable and enhance the program with features including surveys and quizzes. The Healthy Hearts program was also grounded in the M-PAC theory to address intention formation and action control (Rhodes & Yao, 2015). Adding a financial incentive component in Study 2 has the potential to further strengthen the adherence to the Healthy Hearts program. Further, the Pathverse platform allowed for efficiency in adding and adapting content with its "drag and drop" editing features for the content creators. To the best of our abilities in the timeline for executing Study 2, the Digital Health Lab team attempted to take as many user interface suggestions as possible into consideration. Unfortunately, not all suggestions were feasible prior to Study 2,

including: additional self-monitoring features beyond steps, advanced features with goal setting (e.g., delete a goal, date goal set and achieved, goal priority), and a tutorial on how to use the app. At the time this thesis was written, more self-monitoring features and a Pathverse app tutorial have been implemented on the app. By further assessing the Healthy Hearts program with usability testing, the content and user interface was enhanced for Study 2.

2.5.1 Next Steps

Future studies are now warranted in order to determine intervention feasibility, efficacy, engagement, and impact. This can be done by receiving feedback on the entirety of the eight-week program and making content and user interface changes to improve the overall user experience of the Healthy Hearts program. Study 2 is designed to test the feasibility, acceptability and preliminary efficacy of an eight-week study supplemented with the Healthy Hearts program, aligning with the Assess stage of the IDEAS framework and sharing the cumulative results of both Study 1 and Study 2 will encompass the Share stage of the framework (Mummah et al., 2016).

2.5.2 Limitations

Despite the overall positive feedback received from the study, this study did not come without its limitations. Due to the restrictions imposed by the COVID-19 pandemic, usability testing of this program had to be done virtually through Zoom. Although it was possible to record the participant's screen and their audio, the participant's video was shut off when the screen share was enabled, so capturing the individual's facial expressions or body language while testing the program was not an option. Further, it was harder to control the environment in the participant's setting,

which lead to some distractions and interruptions (i.e., pets, doorbells). Secondly, the demographic of this usability testing was not fully encompassing the population. All participants were Caucasian and had at least some post-secondary education, and thus is limiting to the generalizability of the findings. Their current PA levels were not assessed at the time of usability testing; however, it was self-reported that the participants were not meeting the Canadian PA Guidelines. Additionally, only one introductory lesson was completed during usability testing. Despite this lesson covering an overview of what to expect in the rest of the lessons in the program, it did not allow users to see the content in the remainder of the lessons. Although the Healthy Hearts program is grounded in theory, the IDEAS framework (Mummah et al., 2016) was not rigorously followed and therefore it is not conclusive if this program will improve PA outcomes.

2.6 Conclusion

The purpose of this study was to co-design and explore the usability of an eight-week self-guided hypertension education program delivered through a mobile app for users aged 40-65 not meeting the Canadian PA Guidelines. The data from this research supported previous findings of an Internet-based PA program using the M-PAC theory by Liu et al. (2019) in that the content and user interface was satisfactory. Through qualitative and quantitative measures, it was determined that ease of use and satisfaction, system information arrangement, and acceptability were all agreeable amongst all participants. The process of this usability study, in collaboration with the multidisciplinary work of the Digital Health Lab, has reinforced the importance of an iterative and collaborative process in acceptable behaviour change interventions. Collecting input through this mixed-methods study was a crucial step in ensuring the

intervention designed for Study 2 is acceptable for its target users by providing valuable feedback on the design and content in the Healthy Hearts program. The development process used in this study has allowed me to enhance the quality of this program to be delivered through Pathverse.

Chapter 3— Financial Incentives for Physical Activity and Heart Health (FIPAHH): A Randomized Feasibility Study Comparing the Effects of Mobile-Based Financial Incentive Interventions for Adults at Risk of Developing Hypertension

3.1 Abstract

Background: Hypertension (HT) is the leading modifiable risk factor for cardiovascular disease and mortality. Adopting lifestyle modifications, like an increase in physical activity (PA), can be an effective strategy in controlling one's blood pressure (BP). Despite the well-known benefits of increasing PA, many adults are not meeting the Canadian PA guidelines. Financial incentive PA interventions have the power to increase PA levels but are often limited due to cost. Further, these programs can be made scalable through mHealth technologies. There is a gap in the literature about the most feasible and effective financial incentive PA framework, and thus a pay-per-minute (PPM) and social impact bond (SIB) financial incentive framework were explored.

Objectives: 1) To determine the feasibility (recruitment, engagement, acceptability) of an eight-week mobile-based PPM and SIB HT prevention PA program, and 2) to explore the effects of PPM and SIB interventions relative to control on PA levels, BP, and PA motivation following the intervention.

Methods: Adults aged 40-65 who were not currently meeting the Canadian PA Guidelines were recruited and randomized into one of the following groups: financial incentive groups, PPM or SIB, or a control group. Feasibility outcome measures were assessed, including recruitment, engagement, and acceptability. At baseline and follow up, blood pressure and physical activity motivation were measured. Changes in PA outcomes (MVPA, daily steps) relative to baseline were compared among PPM, SIB, and

control groups at four, and eight weeks using linear regressions. Changes in BP and PA motivation relative to baseline were compared among the groups at follow-up.

Results: 55 participants were recruited and randomized to the PPM (n=19), SIB (n=18), or control (n=18) groups. The recruitment, retention rate, and engagement were 77%, 75% and 65%, respectively. The intervention received overall positive feedback, with 90% of comments praising the intervention structure, financial incentive, and educational materials. Relative to control at four weeks, the PPM and SIB arms increased their MVPA with medium effect (PPM vs. control: η^2_p= 0.06, 117.80 (SD= 514) minutes; SIB vs control: η^2_p=0.08, 145.25 (SD=616) minutes). At eight weeks, PPM maintained a small effect is MVPA relative to control (η^2_p= 0.003, 22.82 (SD= 249) minutes) and SIB displayed a medium effect size (η^2_p= 0.07, 113.78 (SD= 256) minutes). Small effects were observed for PPM and SIB relative to control for SBP and DBP (PPM: η^2_p= 0.12, Δ SBP 7.12 (SD= 23.61) mmHg; η^2_p= 0.04, Δ DBP 3.55 (SD= 6.25) mmHg; SIB: η^2_p= 0.00, Δ SBP -0.41 (SD= 1.36) mmHg; η^2_p= 0.02, Δ DBP -2.31 (SD= 7.66) mmHg) and RAI (PPM: η^2_p= 0.00, SIB: η^2_p= 0.03).

Conclusion: The recruitment, engagement, and acceptability results suggest that future full-scale RCT examining the efficacy of SIB, PPM relative to control is feasible. Further, the SIB arm may have a larger effect than PPM in increasing MVPA per week relative control at eight weeks. Studies with longer duration are warranted.

3.2. Introduction

3.2.1 Literature Review

Cardiovascular disease (CVD) is one of the leading causes of death among Canadians each year (Canada, 2020). Hypertension (HT) is the most common but

modifiable risk factor for CVD. Physical activity (PA) is a key lifestyle factor for lowering blood pressure (BP) (Diaz & Shimbo, 2013), and thus reducing one's risk for developing HT. Despite this knowledge, PA levels for adults remains low, with 84% of Canadian adults not meeting the Canadian PA Guidelines (Clarke, Janine; Colley, Rachel; Janssen, Ian; Tremblay, 2019). Behaviour scientists have explored many possible solutions to increase adherence to PA in these populations (Tuso, 2015), as chronic disease prevention and management is possible with increased PA (Pedersen & Saltin, 2015). Financial incentives, a form of extrinsic reward, have been gaining popularity in these interventions over the past decade as they have been shown to effectively increase adherence to a behaviour (Gong et al., 2018) as well as engagement in the program (i.e., completing lessons in an education program) (Druce et al., 2019). Financial incentives represent a component of behavioural economics, where individuals are rewarded immediately for their actions, called a present bias. Researchers have explored different incentive interventions, manipulating goal setting, financial incentive amount, delivery, and timing. Consensus has not yet been determined for the most effective financial incentive intervention for people with chronic disease as there has been limited research surrounding this population (Pedersen & Saltin, 2015). It is evident that further research is needed to determine the feasibility and efficacy of financial incentive interventions.

A recent systematic review reported that both gain and loss-framed financial incentives can promote PA outcomes (leisure-time PA, walking behaviour, PA guidelines, kilocalories expended, and total PA) with small-to-moderate effect (Luong et al., 2021). The gap in this literature is determining the most sustainable and effective financial incentive to deliver to a population. Carrot Rewards, an mHealth app that

rewarded individuals very small daily rewards ($0.04/ day) in the form of loyalty rewards for reaching their step goals received attention for its success in Canada (M. Mitchell et al., 2018). The success of modest incentives, with daily incentives as low as $0.10 USD per day, with increasing PA levels have been mimicked in other financial incentive interventions (M. S. Mitchell et al., 2019). Unfortunately, on a population-level, even modest incentives for physical activity may are not feasible or sustainable long-term due to cost (Wu et al., 2011). Financial incentives for health promotion are currently implemented in government agencies, corporate wellness programs (Qantas, 2016), and private insurers (Greaves, 2019), and have the potential to continue to expand into a public health strategy (Luong et al., 2021). A strategy gaining popularity for positive health outcomes is a social impact bond (SIB). A SIB is a contract between a governing authority and the public sector to produce better social outcomes, i.e., better health (Albertson et al., 2018). By nature of the SIB, they have the potential to deliver better health outcomes while minimizing financial risk. SIBs reward the participating public in a 'pay for success' model, where when the goals agreed upon are met, financial and social (i.e., health) benefits are made.

In this study, a modified investment-based SIB model was tested to encourage adherence to a PA program. Opposed to having the participants invest their own money into the program, a mock investment and contract were made to mimic that of a SIB. The success of the SIB was compared to that of a previously established successful 'pay-per-minute' (PPM) financial incentive model. The PPM model is similar to that of rewarding individuals immediately for their daily step counts, which has been successful in past research (Adams et al., 2017; M. Mitchell et al., 2018). Currently, the effectiveness of the

modified SIB and PPM has not been previously evaluated. Thus, a feasibility study is needed to explore the preliminary efficacy of these financial incentive interventions.

To accelerate the development of behavioural interventions, Czajkowski and colleagues (2015) developed the ORBIT model to progressively support developing more evidence-based behavioural treatments available to prevent and treat chronic diseases. This feasibility pilot study aligns with the goals of Phase IIb of the ORBIT model to determine the feasibility of conducting a trial of a full intervention (Czajkowski et al., 2015). Czajkowski and colleagues (2015) recommend quantitative and qualitative data collection to collect information about feasibility and acceptability and for researchers to examine the screening to enrolment ratio, attrition, and response rates from condition and control groups. The intent is that this information will suggest if this feasibility study empirically supports a future efficacy trial.

3.2.2 Objectives

The primary objective of this study was to determine the feasibility (recruitment, engagement, acceptability) of an eight-week mobile-based PPM and SIB hypertension prevention program. The secondary objectives of this study were to explore the effects of PPM and SIB interventions relative to control on PA levels, BP, and PA motivation following the intervention.

3.2.3 Hypotheses

Based on previous studies (Burkow et al., 2018; Compernolle et al., 2020), I hypothesized that >70% of interested individuals would be recruited, engagement rates would be >60%, and >80% of participants would find the study acceptable. For the secondary objective, I hypothesized that those in the PPM or SIB arms, relative to

control, would show a small-to-moderate effect size in improving MVPA and daily steps at four and eight weeks. Furthermore, those who were receiving a financial incentive would display a relative increase in autonomy and have small-to-moderate effects in improvements of resting BP at follow-up, relative to the control group.

3.3 Methods

3.3.1 Study Design

A CONSORT checklist was followed for reporting this feasibility pilot trial (Thabane et al., 2016). By nature of this feasibility study (i.e., participants were required to know what financial incentive they were receiving), it was unblinded. Participants were randomly assigned to one of the three groups (PPM, SIB, control). Simple randomization method was used. This 8-week feasibility pilot trial was conducted between April 26th, 2021, and August 1st, 2021. All participants provided consent before the start of the study.

3.3.2 Ethics

Ethics approval for this study was obtained through the Human Research Ethics Board at the University of Victoria (protocol number 20-0016) in January 2021. The data was securely stored in locked cabinets when not in use and the electronic version of them was stored on a secure network drive through the University of Victoria. The data will be disposed of after 5 years following the publication of the study; hard copies will be shredded, and the electronic version will be deleted.

3.3.3 Eligibility Criteria

Inclusion criteria included adults aged 40-65 that were not meeting the Canadian Physical Activity Guidelines of 150 minutes of MVPA per week (assessed by GAQ

(CSEP, 2017)), residing in British Columbia, Canada, have normal to corrected-normal vision, and be English-literate. Exclusion criteria included a diagnosis of diabetes, other heart conditions, and other mobility restrictions.

3.3.4 Procedure

The entire study was conducted online due to the COVID-19 pandemic. Interested individuals responded to a Facebook ad. I contacted the individual to arrange an initial online eligibility meeting using a video conference. This first eligibility meeting was no longer than 30 minutes. I confirmed the individual met all eligibility criteria and reviewed study details. Once the consent form was signed and returned, a baseline meeting was scheduled, and a Fitbit Inspire 2 (*Fitbit Inspire 2*, n.d.) was mailed to the participant's address.

At the virtual baseline meeting, participants completed the baseline questionnaire (i.e., demographics and BREQ-3) and reported their most recent resting BP measurement. Afterwards, I created anonymous login credentials for each participant to log in to a Fitbit account and was available for questions and troubleshooting throughout the program. Prior to starting the intervention, participants were asked to complete one week of baseline testing to collect MVPA and steps using their Fitbit. MVPA and steps were also recorded at four and eight weeks. Participants were encouraged to use their own personal Smartphone but were provided with an Android smartphone, if necessary. Participants in the SIB and PPM groups accessed the intervention by downloading the Pathverse App. Following the eight-week intervention, participants were asked to complete the same study questionnaire (i.e., BREQ-3) as in baseline and report the most recent resting BP readings. Participants also completed a semi-structured interview to record program

acceptability and feedback. Participants were asked to mail the Fitbit back to the researcher following the study. Appendix A contains email and voice scripts for eligibility screening, baseline assessment, and follow-up meetings.

3.3.5 Study Groups

Pay-Per-Minute (PPM) Incentive Group

The HT education program was developed using the M-PAC framework (see Study 2 for more details). Participants were introduced to a 25-lesson Healthy Hearts program, with one lesson during baseline week and three lessons per week throughout the intervention. Healthy Hearts aimed to build exercise intention by highlighting the benefits of PA and encouraging goal setting and self-monitoring. Additionally, similar to previous "pay-per-minute" studies (Ball et al., 2017), participants in this intervention arm were rewarded $0.02 for each minute of MVPA tracked through the Fitbit. The maximum amount of money to earn per week was $2.50, and $20 for all eight weeks, which would be rewarded if the individual meets and/or exceeds 150 minutes of MVPA, the Canadian PA Guidelines for adults (Tremblay et al., 2011). Participants were emailed each week informing them which lessons to complete and were told they can ask for their current earnings in the study. Participants were compensated after they completed the intervention. If the participant dropped out of the intervention, they were compensated for the number of weeks they completed. The full contents of the Healthy Hearts program can be seen in Appendix B.

Social Impact Bond (SIB) Incentive Group

Participants were presented the same HT PA intervention as the PPM. However, the financial incentive differed. Participants in this intervention arm signed a mock

contract committing to invest $400 into their health for the duration of the eight-week program. This contract can be found in Appendix C. No money was taken from the participants; however, they were encouraged to put this money aside for the duration of the study. Participants received a percentage of return on this initial investment based on the number of weeks they successfully met the Canadian Physical Activity Guidelines, as recorded by their Fitbit. If a participant in this group met the goal for 0-2 weeks of the intervention, they received a 0% return. If a participant met the goals for 3-4 weeks of the intervention, they received a 1.5% return on this investment, equivalent to $6. If a participant met their goal for 5-7 weeks of the intervention, they received a 3% return on investment, or $12. Lastly, the maximum return on investment is 5%, or $20, and this was rewarded if the participant met the goal for all 8 weeks of the intervention. A 5% investment return was chosen based on the annualized S&P500 stock based on the last 50 years (J.B. Maverick, 2021). Similar to the PPM group, participants were emailed each week informing them which lessons to complete and were told they can ask for their current earnings in the study. Participants were compensated after they completed the intervention. If the participant dropped out of the intervention, they were compensated for the number of weeks they completed.

Control Group

An ethical imperative for any health promotion program is to ensure that the control group also receives essential information about HT prevention. To match the weekly intervention delivery frequency, participants received one email per week with contents from HealthLinkBC (*HealthLinkBC*, n.d.), Canadian Hypertension Education Program (*Hypertension Canada*, 2020), and Health Seekers through the Heart and Stroke

Foundation (*Health Seekers*, 2020). Information delivered to participants in the control arm included PA and heart health benefits and general PA tools and logs. The full control program email correspondence is in Appendix D.

3.3.6 Outcome Measures

Feasibility Outcome Measures

Recruitment Rate. This was calculated by dividing the number of individuals who enrolled in the study by the number of individuals who were eligible to enrol. This value was then divided by the number of months of recruitment (Walters et al., 2017).

Screening to Enrolment Ratio. This was calculated by dividing the number of individuals who attended the eligibility meeting by the number of participants enrolled in the study (Cavallo et al., 2018).

Retention. This was calculated by dividing the number of participants who completed the study by the number of participants enrolled in the study (Czajkowski et al., 2015).

Engagement. Lesson completion data was downloaded from the Pathverse Admin portal. Engagement was defined by the number of lessons that the intervention groups completed through the Pathverse app. There are a total of 25 lessons in the program.

Acceptability. Acceptability was measured post-intervention through virtual semi-structured interviews between the participant and the researcher. Follow-up acceptability questions can be found in Appendix E. Thematic analysis was conducted to analyze and report themes from the semi-structured interviews (Braun & Clarke, 2006)

and responses were divided into positive feedback and recommendations for improvement.

Secondary Outcome Measures

Weekly MVPA. Fitbit devices (*Fitbit Inspire 2*, n.d.) has been shown to be a valid and reliable tool to measure MVPA (Feehan et al., 2018). Activity data from the Fitbit website was downloaded and activity categorized as "minutes fairly active" and "minutes very active" were summed to accumulate the moderate and vigorous activity minutes, respectively. Moderate activity data was considered "minutes fairly active" and vigorous activity data was considered "minutes very active" (Hartung et al., 2020). These minutes were summed together each week to comprise weekly MVPA.

Average Daily Steps. Step data was downloaded throughout the intervention from the individual's Fitbit account. The validity and reliability of using Fitbit to measure daily steps have been previously been established (Hartung et al., 2020). An extremely high or low step count (i.e., 2 standard deviations from the population mean) were identified throughout the week to ensure that the participants in fact wore the Fitbit for the entire day. Average daily step count was calculated using three randomly selected days during the week, and one day from the weekend, which is in keeping with conventional procedures for estimating daily step count (Liu et al., 2020).

BP. Self-report BP was collected. Participants were emailed instructions on how to measure their BP, per Hypertension Canada to self-report an average of their three most recent BP measurements (*Hypertension Canada*, 2020). These instructions included no coffee or smoking 30 minutes prior, rest quietly prior to measuring, keep feet flat on the floor, and to place BP cuff on bare left arm.

PA Motivation. The Behavioural Regulation in Exercise Questionnaire (BREQ-3) (Markland, D. & Tobin, 2004; Wilson, P.M., Rodgers, W.M., Loitz, C.C., & Scime, 2006) was used to measure PA motivation. The Relative Autonomy Index (RAI) was calculated using the BREQ-3 questionnaire with the following formula: RAI= (amotivation × (−3)) + (external regulation × (−2)) + (introjected regulation × (−1)) + (identified regulation) + (integrated regulation × 2) + (intrinsic regulation × 3). Scores on the RAI range from +20 to -24, with higher scores indicating more autonomous motivation and lower scores indicating more extrinsic motivation (Ryan & Connell, 1989).

3.3.7 Statistical Analysis

Quantitative data was analyzed using the International Business Machine Corporation Statistical Package for the Social Sciences (IBM SPSS) version 26. Differences in baseline characteristics were evaluated by Pearson's chi-squared test for categorical variables and one-way analysis of variance (ANOVA) for continuous variables. Measures of normality were used to determine if the dataset was normally distributed and appropriate for further analysis. To test the normality of baseline and follow-up measures, a Shapiro-Wilk test was applied using a significance of .05. Results of this test showed that there were no significant differences in outcomes measures between the three groups at baseline; as well, outcome measures were normally distributed at baseline.

I used descriptive statistics to determine the feasibility (recruitment, engagement, acceptability) of an eight-week mobile-based PPM and SIB hypertension prevention program. Changes in MVPA, daily steps, SBP, DBP and PA motivation were analyzed

using an intention-to-treat approach (McCoy, 2017). Baseline measures were carried forward to deal with missing follow-up data (Newgard & Lewis, 2015). Delta values for MVPA and steps were calculated with data from baseline, four weeks, and eight weeks. I used multiple linear regression to evaluate whether change from baseline to four weeks and from baseline to eight weeks for PA were significantly different between PPM, SIB, and control. Each linear regression model was adjusted for the baseline value of each dependent variable.

Analysis of SBP, DBP and RAI were analyzed at baseline compared to follow-up (eight weeks). I used a multiple linear regression to evaluate whether change from baseline to eight weeks for SBP, DBP and RAI were significantly different between PPM, SIB, and control. Each linear regression model was adjusted for baseline value of each dependent variable. Due to the small sample size, I focussed on calculating effect sizes, specifically partial eta squared (η^2_p) values. An η^2_p= 0.01 indicated a small effect, η^2_p= 0.06 indicated a medium effect and η^2_p= 0.14 indicated a large effect (Lakens, 2013). Finally, the follow-up semi-structured interviews were analyzed using thematic analysis (i.e., overall positive and negative comments and future program changes) (Braun & Clarke, 2006).

3.4 Results

3.4.1 Participants

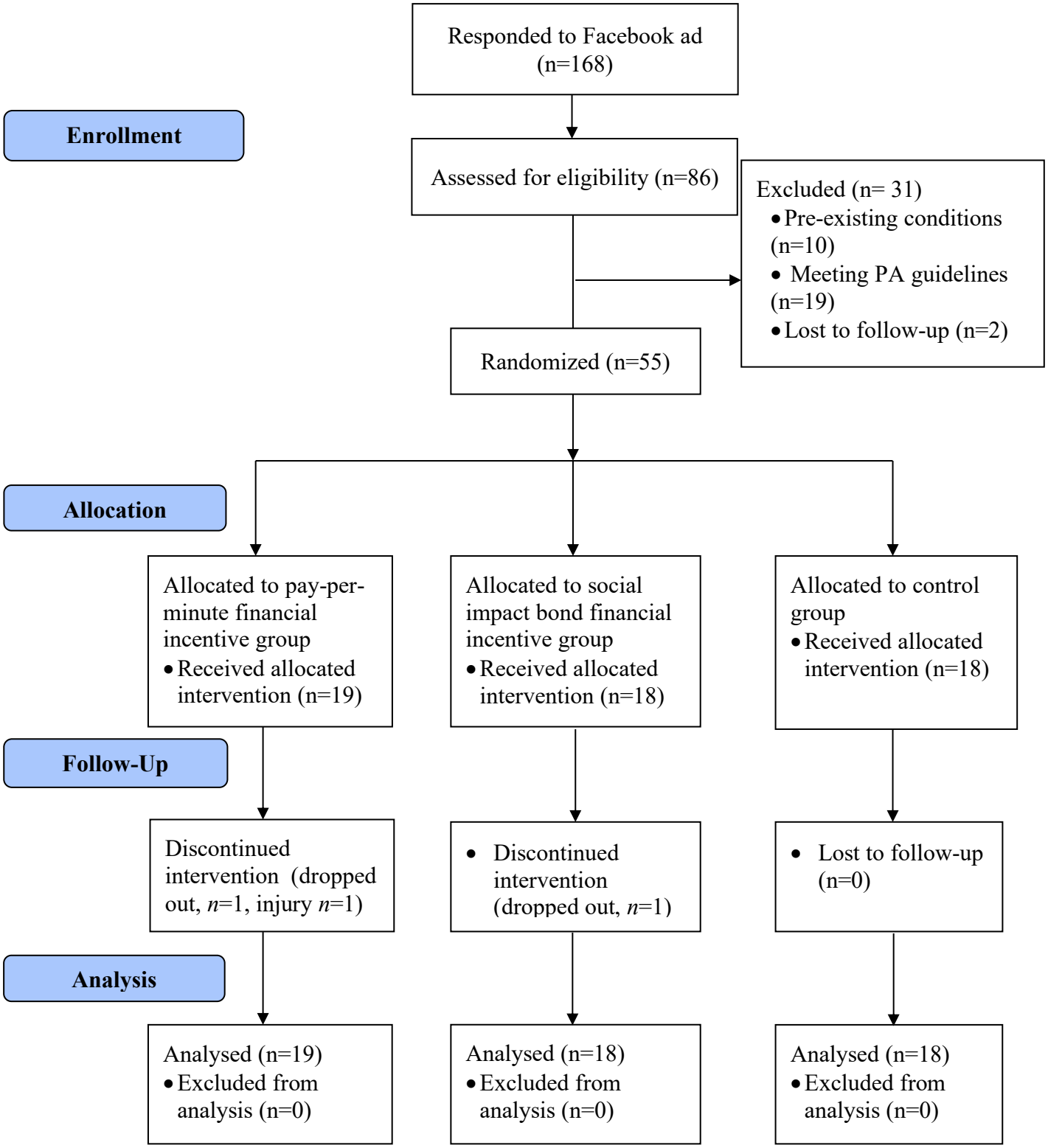
A CONSORT flow diagram outlining participant recruitment is shown in Figure 13. A total of 86 individuals replied to an initial screening email after expressing interest to participate in the study through Facebook during the five-week recruitment period. 31 participants were excluded because they did not meet the inclusion criteria (n=29) and did not continue to respond to emails (n=2). These participants were then allocated to

either the PPM financial incentive group (n=18), the SIB financial incentive group (n=18), or the control group (n=18).

Two participants in the PPM financial incentive group discontinued the intervention, one of which dropped out and stopped syncing their Fitbit, and one who dropped out due to injury not related to the study. One participant in the SIB group dropped out and stopped syncing their Fitbit. All participants (n=18, 100%) allocated to the control arm successfully completed the intervention and follow-up meetings.

Figure 13

CONSORT Flow Diagram of Enrolment, Allocation, Follow-Up, and Analysis



3.4.2 Baseline Characteristics

Baseline demographics and physical activity levels are presented in Table 13. There was no significant group difference at baseline for age, sex, ethnicity, education, income, or living situation ($p>0.05$). The mean age for participants was 55.4 (SD=5.99, age range 40-65) years and most of the participants were Caucasian (91.1%). Females made up the majority (91.1%) of the sample. 81.8% of the sample had at least some college or university education and nearly half (49.1%) reported earning a gross family income of $100,000 or greater. Most (69.1%) participants were currently married or living with a partner. Despite all participants self-reporting accumulating less than 150 minutes of MVPA per week, the average amount of weekly MVPA accumulated was 202.67 (SD= 175.38) at baseline, exceeding the Canadian PA Guidelines (Tremblay et al., 2011). Participants on average walked 7420 (SD=3050) steps per day. Across all groups, SBP and DBP were 123.35 (SD= 11.89) and 78.77 (SD= 9.18) mmHg, respectively. PPM, SIB, and the control arm all reported greater relative autonomy with RAI scores of 15.68 (SD= 2.43), 14.64 (SD= 2.40), and 15.75 (SD= 2.25), respectively.

Table 13

Baseline Characteristics

	PPM (*n*=19)	SIB (*n*=18)	CON (*n*=18)	p-value	All (*n*=55)
Age (years)	55.4 (5.70)	55.8 (6.17)	55.1 (6.43)	.95	55.4 (5.99)
Sex				.47	
Male	3 [15.8]	1 [5.6]	1 [5.6]		5 [8.9]
Female	16 [84.2]	12 [94.4]	17 [94.4]		51 [91.1]
Ethnicity				.15	
Caucasian	19 [100]	18 [100]	17 [94]		54 [98]
South Asian			1 [5.6]		1 [2]
Education				.60	
Some high school	-	1 [5.6]	-		1 [1.8]
High school graduate	2 [10.6]	3 [16.7]	4 [22.2]		9 [16.4]

Some college/ university	3 [15.8]	-	-		3 [5.5]
College/ university degree	10 [52.5]	7 [38.9]	9 [50]		26 [47.3]
Graduate degree or higher	4 [21.1]	7 [38.9]	5 [27.8]		16 [29.0]
Yearly household income				.38	
$15,000-$29,999	1 [5.3]	1 [5.6]	-		2 [3.6]
$30,000-$49,999	1 [5.3]	2 [11.1]	1 [5.6]		4 [7.3]
$50,000-$74,999	3 [15.8]	4 [22.2]	2 [11.1]		9 [6.4]
$75,000-$99,999	2 [10.5]	5 [27.8]	4 [22.2]		11 [20.0]
$100,000-$150,000	7 [36.8]	2 [11.1]	6 [33.3]		15 [27.3]
$150,000+	4 [21.1]	4 [22.2]	4 [22.2]		12 [2.8]
Living situation				.33	
Married or living with partner	12 [63.2]	11 [61.1]	15 [83.3]		38 [69.1]
Single or living alone	4 [21.1]	2 [11.1]	1 5.6]		7 [12.7]
Single or living with others	3 [15.8]	5 [27.8]	2 [11.1]		10 [18.2]
MVPA	216.95 (199.27)	131.78 (157.06)	258.50 (148.79)	.09	202.67 (175.38)
Daily steps	7367 (3095)	7106 (3358)	7789 (2806)	.80	7420 (3050)
SBP (mmHg)	125.18 (12.03)	123.00 (10.92)	121.70 (12.48)	.80	123.35 (11.89)
DBP (mmHg)	80.82 (8.28)	77.5 (9.89)	77.80 (9.94)	.67	78.77 (9.18)
RAI Score	15.68 (2.43)	14.64 (2.40)	15.75 (2.25)	.32	15.38 (2.37)

Note. MVPA: moderate-to-vigorous physical activity; SBP= systolic blood pressure; DBP= diastolic blood pressure; RAI= relative autonomy index.

Descriptive statistics are presented as mean (SD) and number of participants [percentage].

RAI: positive scores indicate greater relative autonomy; negative scores indicate more controlled regulation.

3.4.3 Feasibility Outcomes

Recruitment

With recruitment taking place over a five-week period, the recruitment rate was 77%. Thus, the screening to enrolment ratio dictated that 95% of those eligible did enrol in the study, with a total of 55 participants that provided consent. Throughout the eight-week intervention, there was a 95% retention rate, with 52 of 55 randomized participants completing the study. An 80-100% retention rate is indicative of a strong trial (Jackson & Waters, 2005).

App Engagement

Engagement was analyzed for the PPM and SIB arms, as the control group did not have access to the Healthy Hearts program through Pathverse. Usage metrics are presented in Table 14. Lessons were presented on a completion-basis, meaning you had to complete the previous lesson in order to unlock the next. A chi-square analysis indicated there was no significant difference between the financial incentive groups in terms of the number of lessons completed ($p>.05$). Overall, 65% of all Healthy Hearts lessons were completed. Of those who dropped out of the study, one completed 28% of the program and two completed 32% of the program.

Table 14

Usage Data at Eight-Week Follow-Up

Number of lessons completed	All incentive groups (n=37)	PPM (n=19)	SIB (n=18)
25, 100%	24 (65%)	12 (63%)	12 (67%)
20-24, 80-96%	1 (2%)	1 (5%)	-
15-19, 60-76%	1 (2%)	-	1 (6%)
10-14, 40-56%	5 (13%)	3 (16%)	2 (10%)
5-9, 20-36%	5 (13%)	2 (11%)	3 (17%)

<5, <20%	1 (2%)	1 (5%)	-

Note. PPM= pay-per-minute; SIB= social impact bond.

Descriptive statistics are presented as number of participants (percentage).

Intervention Acceptability: Qualitative Evaluation

A total of 52 participants completed the semi-structured interview at the follow-up meeting. Overall, 90% of the comments were positive towards the intervention, with the other 10% of comments suggesting recommendations for improving the program. Interview comments were summarized into the following themes:

Intervention Content. Those in the PPM and SIB groups were asked what they thought of the layout and content of the Pathverse app. The user-friendliness of Pathverse was mentioned by most that used it (PPM n=13; SIB n=15), with positive comments relating to the usability and system interface, with participant 001 in the SIB arm stating, "it was super easy to navigate". When asked about which Pathverse lessons positive stood out to them, two participants (n=2, 5%), both in the SIB arm, mentioned a lesson titled "The Internal Environment" and referenced a Qi Gong for Heart Health video. Lessons relating to goal setting and exercise identity also got praise from two different participants, participant 014 in the SIB arm and participant 045 in the PPM arm. Ten participants (n=10, 27%) mentioned that three lessons in Pathverse per week were "just enough", as participant 016 stated. Generally, the content was well accepted, with participant 027 in the SIB arm stating, "all the content was great" and participant 053 in the SIB arm stated, "I've read so much repetitive health information in the past, it was refreshing to read new information". The control group, who received weekly emails,

also gave positive feedback (n=16, 89%) on the variety of content received. In particular, participant 024 mentioned that it was “digestible content each week”.

Program Impact. When asked about the impact of the program on their physical activity, 30 participants (n= 30, 55%) commented on the Fitbit, citing how it was a useful tool to see their daily activity. One participant in the PPM arm, participant 010, stated that they “loved considering minutes [of MVPA] over steps” as it was “something more meaningful that [they] weren’t used to doing”. Participant 020 in the PPM arm stated that this program made them “much more aware of doing activity”. This feeling was matched by participant 027 of the SIB arm who stated that “this program kept exercise in the front of [their] mind”. Other positive comments from those in the SIB arm included participant 014 stating that “this program motivated [them] to do something every week” and participant 016 mentioning that the program “made [them] competitive with myself”.

Financial Contribution. Participants in the SIB group (n=18) were asked if they would have been willing to give their own money towards their contract. Of those who said yes to investing $400 into their health with a guarantee to be given the money back after eight weeks, 86% of participants reported a gross income of greater than $75,000 per year. Of those that said no to investing their own money for the duration of the program, 75% reported earning less than $75,000 gross annual income.

Sample quotations of positive comments and areas of improvement were presented in Table 15 and 16, respectively.

Table 15

Sample Quotations of Positive Comments

PPM Group	SIB Group	Control Group

"I thought Pathverse was a quick and great way to check-in throughout the program and take time to reflect on yourself… I don't usually take time for that."	"I love the idea of investing in myself, there are so many benefits to investing in your health."	"I started walking to and from work every day, something I haven't done before. The Fitbit was super motivating!"
"I know that I should be doing more activity, like going for walks, but I usually don't bother. This program was the kick I needed."	"I have always struggled with achieving goals I set for myself, but with proper instruction on setting SMART goals throughout the program, I finally feel confident in reaching healthy goals."	"The weekly emails you sent were just enough."
"This program changed my automatic thought process of, 'I have no time' […] I liked the program.'	"The content was great, especially with maintaining motivation near the end of the program. I took screenshots so I can refer back!"	"I've never considered tracking my minutes compared to steps, and I found that so much more valuable."
"I thought the content was good, 3 lessons per week was a great amount and it definitely got me doing [more exercise]."	"The program motivated me to do something every week. I felt lazy on days where I didn't at least move for a little bit."	"I'm surprised at how much I was motivated by a Fitbit, to always see that on my wrist was very motivating."

Recommendations for Program Improvements. The sample quotations of recommended feedback are presented in Table 16. While the user interface of Pathverse was appreciated, some participants (n=3) did not find all the lessons necessary for them. A different three participants mentioned they wanted more guidance with how much they were earning each week in the program, either through email or Pathverse. Those in the social impact bond (n=19) group were asked if they were to have been required to put aside their own $400 if they would have been comfortable with that amount of money over the eight-week program. Six participants (n=6, 32%) mentioned that they would not have been comfortable investing their own money into a PA program.

Table 16

Sample Quotations of Recommendations for Program Improvements

Pay-Per-Minute Financial Incentive Group Sample Quotations	Social Impact Bond Financial Incentive Group Sample Quotations
"While the content overall was very good, I found some of the surveys hard to answer as they weren't clear as to how much depth you wanted."	"I didn't feel connected to some of the lessons, as I don't usually turn to my social circle for motivation."
"While I appreciated the incentive, it was not enough to be the main driver of physical activity for me."	"I would be comfortable with the [$400], but I would need more guidance"
"I found the lessons started off very interesting and engaging, but near the end they got a little wordy."	

Secondary Objectives

MVPA. At four weeks, both PPM and SIB showed similar medium intervention effect, relative to control (PPM vs. control: η^2_p= 0.06, 117.80 (SD= 514) minutes; SIB vs control: η^2_p=0.08, 145.25 (SD=616) minutes). However, at eight weeks SIB showed a medium effect relative to control (η^2_p= 0.07), while the small effects were observed for PPM relative to control (η^2_p= 0.003). This translates to an increase of MVPA by 22.82 (SD=249) minutes per week for PPM relative to control. Meanwhile, SIB intervention showed an increase of 113.78 (SD= 256) minutes relative to control (See Table 17).

Daily Steps. Relative to control, both PPM and SIB showed a small effect with changes in daily steps at both four (PPM: η^2_p= 0.02, Δ daily steps 937 (2039); SIB: η^2_p= <0.001, Δ daily steps 274 (2043)) and eight weeks (PPM: η^2_p= 0.02 Δ daily steps -27 (2362); SIB: η^2_p= <0.001, Δ daily steps -144 (2367)) (See Table 17).

Table 17

Changes in Physical Activity Outcomes at Four Weeks, and Eight Weeks Relative to Baseline

	PPM (n=19)		SIB (n=18)		CON (n=18)			4 weeks				8 weeks		
							Overall p-value	PPM vs CON	SIB vs CON	PPM vs SIB	Overall p-value	PPM vs CON	SIB vs CON	PPM vs SIB
	Δ 4w	Δ 8w	Δ 4w	Δ 8w	Δ 4w	Δ 8w		η^2_p	η^2_p	η^2_p		η^2_p	η^2_p	η^2_p
MVPA (minutes)	117.89 (315.99)	20.58 (201.68)	144.78 (236.68)	149.17 (214.32)	-31.56 (122.39)	-20.67 (134.15)	.08	**.06**	**.08**	<.001	.15	<.001	**.07**	.05
Daily steps	950 (2329)	-7 (2887)	352 (1839)	-23 (1962)	221 (2274)	183 (2906)	.54	.02	<.001	.02	.83	<.001	**.07**	<.001

Note. PPM= pay-per-minute; SIB= social impact bond; CON= control MVPA= moderate-to-vigorous physical activity.

Descriptive statistics are presented as mean (SD).

Boldface indicates at least a medium effect in partial eta squared values.

BP. Relative to control, SBP decreased in the SIB intervention group (η^2_p< 0.001, Δ SBP -0.41 (SD= 1.36) mmHg), but increased in the PPM intervention (η^2_p= 0.12, Δ SBP 7.12 (SD= 23.61) mmHg). Similarly, relative to control DBP decreased in the SIB intervention group (η^2_p= 0.02, Δ DBP -2.31 (SD= 7.66) mmHg), but increased in the PPM intervention (η^2_p= 0.04, Δ DBP 3.55 (SD= 6.25) mmHg).

RAI. At 8-week follow-up, the PPM arm decreased their score by 0.34 (SD= 1.44, η^2_p= 0.00) relative to control and the SIB arm decreased their store by 1.34 (SD= 4.26, η^2_p= 0.03) relative to control. The reduction translates to a small effect size.

Table 18 below displays BP and PA motivation changes at the eight-week follow-up.

Table 18

Changes in Secondary Outcomes at Eight Weeks Relative to Baseline

	PPM (*n*=19)	SIB (*n*=18)	CON (*n*=18)	Overall p-value	PPM vs CON	SIB vs CON	PPM vs SIB
	Δ 8w	Δ 8w	Δ 8w		η^2_p	η^2_p	η^2_p
SBP (mmHg)	+1.36 (5.54)	-5.45 (8.48)	-4.80 (12.34)	.08	**.12**	<.001	**.13**
DBP (mmHg)	+0.18 (4.92)	-4.00 (6.94)	-1.90 (11.81)	.17	.04	.02	**.12**
RAI	-2.78 (3.63)	-3.93 (2.54)	-3.31 (3.25)	.27	<.001	.03	.05

Note. PPM= pay-per-minute; SIB= social impact bond; CON= control MVPA: moderate-to-vigorous physical activity; BL= baseline.

Descriptive statistics are presented as mean (SD).

Boldface indicates at least a medium effect in partial eta squared values.

3.5 Discussion

The primary objective of this study was to determine the feasibility (recruitment, engagement, acceptability) of an eight-week mobile-based PPM and SIB hypertension prevention program. The secondary objectives of this study were to explore the effects of PPM and SIB interventions relative to control on improving PA levels, BP, and PA motivation following the intervention. To my knowledge, this is the first mobile app intervention to compare the PPM and SIB financial incentive arms, relative to a control group. Overall, the findings from this study support a future efficacy trial. The modified SIB intervention evaluated in this study may be a sustainable financial incentive to promote PA. Future studies with larger sample size and longer study period are warranted.

Primary Outcome Measures

Based on previous research (Compernolle et al., 2020; Ryde et al., 2013), I hypothesized that recruitment for this study would be feasible at >70%. In this study, the recruitment was 77% over five weeks. Ryde and colleagues (2013) analyzed the characteristics for success in 30 workplace PA interventions and categorized a recruitment rate ≥70% as high. While the settings and durations of these interventions varied, it was assumed the employee population included adults, and thus is comparable to this sample. Compernolle and colleagues (2020) had a recruitment rate of 83% for the mHealth study and recruited 28 older adults for a three-week intervention. While these comparator studies did not target adults specifically aged 40-65 at risk for hypertension, they did employ PA improving strategies or were offered through mHealth technologies. Further, it was challenging to find studies lasting eight-weeks in length, therefore I have compared my recruitment rates to similar PA studies.

Throughout the eight-week intervention, there was a 95% retention rate, with 52 of 55 randomized participants completing the study. The retention is much higher compared to previous web-based and mHealth interventions (50-80%) that have reported high dropout rates (Sam Liu et al., 2013; Meyerowitz-Katz et al., 2020). However, the current retention rate is comparable to some of the digital behaviour change interventions (90-95%) (Compernolle et al., 2020). Retention rates among financial incentive studies typically increase with the value of the monetary incentive offered (Booker et al., 2011).

Previous research has shown that maintaining engagement over time is a challenge in many mHealth interventions (Zhao et al., 2016). Low user engagement typically leads to poor intervention effectiveness and adherence (Kelders et al., 2012). Of those in the incentive arms that received the Healthy Hearts program, user engagement was acceptable with 65% completing the program, and 75**%** were using the app four weeks in. Engagement usage metrics vary amongst studies, and thus finding a similar study was a challenge. However, in a randomized control trial of 125 parent-child dyads, it was reported that 53.5% (SD= 37.6%) of mHealth content relating to family weight loss that delivered in the 16-week intervention was accessed (Wilson et al., 2019). Future studies need to explore other engagement methods explored in digital PA studies include the number of app logins and duration of use (Foster et al., 2010; Simons et al., 2018), days and minutes of use (Al Ayubi et al., 2014), and monitoring use of the app (i.e., logging in a PA diary) (Choi et al., 2016; Simons et al., 2018).

Overall, positive feedback was received on the program. Both objective usage metrics and subjective experiences with the Healthy Hearts program delivered with Pathverse showed that adults were highly engaged with this intervention. Many

commented that completing three lessons per week was an adequate amount that did not overwhelm them. These findings are all indicators of the acceptability of the intervention to this demographic. Although there were suggestions for program modifications moving forward, nothing deterred participation in the current study.

Secondary Outcome Measures

The study results supported my hypothesis that those in the PPM or SIB arms, relative to control, would show a small-to-moderate effect size in improving MVPA and daily steps at four and eight weeks. Small-to-moderate effect sizes have been documented for overall increases in physical activity in other financial incentive interventions (Luong et al., 2021; M. S. Mitchell et al., 2019). In a recent meta-analysis, Luong and colleagues (2021) determined the effect size for the following financial incentive PA interventions for adults over age eighteen: gym attendance (moderate, SMD [95% CI] = 0.46 [0.28-0.63], $P < .0001$; $I^2 = 84\%$), daily steps (small, 0.25 [0.13-0.36], $P < .01$; $I^2 = 55\%$), PA guidelines (insufficient evidence), kilocalories expended (insufficient evidence), and total PA (insufficient evidence). These small-to-moderate effect sizes found among these populations support the recommendation for a full RCT, along with the high feasibility ratings. Based on the changes in MVPA, an estimated 102 participants are needed per group for the full efficacy trial (power= 0.8).

Long-term sustainability for PPM programs has been questioned in previous studies (M. S. Mitchell et al., 2013) (M. Mitchell et al., 2018). Given the comparable effect sizes observed in SIB and PPM relative to the control for improving MVPA and steps, this suggests that SIB may be a more sustainable option for institutions and government agencies to implement financial incentive-based PA programs. Even though

we did not ask participants to commit in investing their own money in the SIB group, over 68% of the participants in the study said they are willing to invest their own money. Participants found the 5% return from SIB acceptable. This is important to the feasibility of the investment-based SIB model proposed in this thesis because several stock index funds over the last 30 years have shown an average return between 5-8% (J.B. Maverick, 2021). Thus, it maybe is possible for this investment-based SIB model to be employed by insurance, government or private firms, where employees may have the option to reinvest a portion of a person's paycheque if they are meeting a certain behaviour outcome.

Contrary to my hypothesis, participants in PPM and SIB groups did not show a small to moderate reduction in SBP and DBP relative to control. Previous studies of similar length have reported a significant reduction in SPB and DBP by -3.8 mm Hg (95% confidence interval [Cl], -5.63 to -2.06 mmHg; P <0.01) and -2.1 mmHg (95% CI, -3.51 to -0.65 mmHg; P <0.05), respectively (Liu et al., 2013). The small effect size observed in this study is study may be due to a floor effect as the mean baseline BP was 123/79 mmHg.

Lastly, I hypothesized that those in the PPM and SIB arm would increase their autonomous motivation due to receiving an eight-week hypertension education program and receiving a modest incentive. The design of this program encouraged self-efficacy development in promoting reaching attainable PA goals, a strategy that has the potential to increase intrinsic motivation through the self-determination theory (Crane et al., 2012). However, the results of this study did not align with my hypothesis. It may be possible that a longer intervention duration may be required to improve intrinsic motivation (Deci & Ryan, 1985b). Previous studies have cautioned against the use of external incentives as

they may inhibit intrinsic motivation (Charness & Gneezy, 2009). However, some studies have shown that extrinsic rewards may be used to fulfil these psychological needs in order to avoid harming intrinsic motivation by rewarding achievements of realistic self-regulatory goals (e.g., monitoring MVPA), and providing choice to the participants for the types of reward and the activities (M. S. Mitchell et al., 2013). It may be possible that additional behaviour change techniques (e.g. goal setting, action planning, and self-monitoring) may be required to increase motivation when used in conjunction with financial incentives.

3.5.1 Limitations

There are several study limitations. First, the participants were primarily Caucasian, with higher education, and earning above the median income for British Columbians (Statistics Canada, 2021a), and therefore does not represent the population as a whole. Recruiting through Facebook may have presented this recruitment bias (Benedict et al., 2019), thus limiting this studies generalizability. The use of self-report for physical activity levels at baseline also introduced a reporting bias. All participants reported accumulating less than 150 minutes of MVPA per week during eligibility screening, however, MVPA during baseline week was above the Canadian PA Guidelines for all three groups.

Second, BP was a secondary outcome of this study. Since this study was completed virtually, it lacked the consistency of having a trained research assistant measure participants' BP. Over half (56%) of participants had access to a personal BP cuff at baseline, but due to pharmacies removing BP cuffs due to COVID-19, blood pressure measurements were not accessible to all. It was assumed that participants who

were able to record their own BP followed the Hypertension Canada recommendations to properly measure BP, as provided through email from the research assistant.

Further, this study was conducted from April 26th-August 1st, 2021. Throughout this time, COVID-19 protocols changed, as British Columbia moved through their "Restart Program" (*BC's Restart: A plan to bring us back together*, 2021). Throughout the time of this study, restrictions were easing, allowing more individuals to resume going to the gym and meeting up with family and friends for activity. Further, British Columbia experienced a record-breaking heat dome, as mentioned by many participants in all three study groups when asked about barriers to completing physical activity. Among these participants, noticeable 'dips' were seen in the individual's physical activity.

Finally, this study did not have a follow-up period. Many financial incentive intervention studies have shown that after the financial incentive is removed, activity levels retreat to baseline (Barte & Wendel-Vos, 2017). While most participants were exceeding the Canadian Physical Activity Guidelines at baseline, this is still a factor to consider.

It is important to note that achieving optimal heart health is multidimensional, and this study primarily focussed on PA to maintain heart health and prevent hypertension. Among this sample, participating in more PA yielded non-significant mean reductions in SBP and DBP for the SIB and control arms after eight weeks of the intervention, but this is not particularly generalizable to the general population.

3.6 Conclusion

The current study examined the feasibility of an eight-week SIB and PPM financial incentive mHealth intervention to improve physical activity and collected both quantitative and qualitative data. Feasibility results indicated high recruitment and retention rates, engagement, and acceptability. Preliminary results in terms of increased physical activity showed a medium effect, as well as the potential to improve blood pressure outcomes. Further, sample size can be calculated using partial eta squared values for a randomized control trial. These results support recommendations for a full-scale randomized control trial in line with Phase III of the ORBIT model (Czajkowski et al., 2015).

Chapter 4— General Conclusions

The main objectives of this thesis were: 1) to co-create and determine the usability of Healthy Hearts, an eight-week self-guided mHealth hypertension education program; and 2) to determine the feasibility and preliminary efficacy of an eight-week feasibility pilot physical activity trial, incorporating financial incentives along with the Healthy Hearts program. This section is a summary of the main findings, as well as recommendations for future research.

4.1 Positioning the Thesis

The global burden of the increasing prevalence of non-communicable diseases increases year by year, with hypertension being at the forefront of diagnoses, cause of mortality, and healthcare spending (Mills et al., 2020). Lifestyle interventions, particularly physical activity promotion studies, have shown a small-to-moderate effect when they are delivered virtually through a mobile phone (Mönninghoff et al., 2021). Further, when financial incentives are added to these physical activity interventions, a meta-analysis has shown similar small-to-moderate effect sizes (Luong et al., 2021). However, there is room for improvement by exploring more feasible financial incentive delivery methods and expanding on social cognitive theories. This thesis explored different methods to implementing financial incentive interventions, and the feasibility of this type of intervention.

4.2 Study 1

Study 1 followed the IDEAS Framework to help co-design and test the Healthy Hearts program (Mummah et al., 2016). During the intervention planning phase, I found through a literature search that there was a gap to fill in creating a successful physical activity mHealth app grounded in M-PAC. Afterwards, I developed a financial incentive-

based HT education program for inactive adults using the M-PAC framework. Through usability testing with participants, I gathered valuable feedback and made the appropriate changes relating to the content on the app, layout, and design. Overall, this study helped prepare for Study 2.

4.3 Study 2

Results from this study suggest that it is feasible to deliver a mobile-based financial incentive intervention (e.g., PPM and modified SIB). Recruitment, through screening to enrolment ratio, was 95% with an equivalent retention rate. Engagement was acceptable with 65% of participants completing the 25 lessons of the program, and follow-up interviews yielded overall positive feedback, with minor suggestions for improvement. While there were no significant differences in MVPA and daily steps, small to medium effects were noted for both SIB and PPM relative to control following 8 weeks. Notable changes to the study design before recommendation for a full-scale randomized control trial include: implementing notifications for Pathverse lessons, including an in-app tutorial on how to use the Pathverse app, and integrating a financial incentive earning right into the app.

4.4 Positioning the Results in the Literature

Study 1 demonstrated the importance of including participants as part of the designing process. Co-designing the intervention with the participants is strongly supported with previous literature and aligns with the patient-orientated research framework (Rouleau & Moody-Corbett, 2012). Results from the usability testing enabled me to further feasibility testing. The use of usability testing has been shown to be a critical step to improve mHealth intervention uptake (Compernolle et al., 2020; Pfister et al., 2020).

Study 2 demonstrated that the modified SIB can be a feasible and potentially more sustainable financial incentive model than traditional PPM programs. This finding adds to the existing financial incentive because, because to my knowledge, this is the first study that exampled the feasibility of SIB, PPM versus control (Luong et al., 2021; Mitchell et al., 2019). With a fully powered study, further exploring the effectiveness of a financial intervention of this type is needed.

There are several important research and public health implications as a result of my thesis. Firstly, this thesis emphasized the necessity for following the IDEAS framework to rapidly co-design the Healthy Hearts mHealth program. This co-design process was further supported by using the Pathverse platform to efficiently create prototypes and deploy the Healthy Hearts program in Study 1 and to rapidly modify and make improvements before Study 2. Secondly, this study presented a modified SIB that, to my knowledge, has not been conducted in financial incentive PA research and was able to yield moderate effect sizes in weekly MVPA (Luong et al., 2021; M. S. Mitchell et al., 2019). The modified SIB or similar should be explored outside of the research setting, including in government agencies or insurance firms, where ‘participants’ are invited to invest their money to the SIB-creating agency to explore potential PA and other lifestyle modification outcomes. Third, this thesis highlighted the potential of maintaining intrinsic motivation by combining an mHealth HT education program grounded in the M-PAC framework with a financial incentive intervention. Financial incentive lifestyle interventions are often critiqued for diminishing intrinsic motivation, however, intrinsic motivation, measured through the RAI, did not significantly decrease after this eight-week financial incentive PA intervention.

4.5 Strengths and Limitations

One study strength is the mixed methodology used in both Study 1 and 2 was one of its strengths. By implementing both qualitative and quantitative methodologies to collect and analyze usability and feasibility data, a well-rounded approach was implemented to gain valuable feedback from participants (Lopez-Fernandez & Molina-Azorin, 2011). Results from Study 1 were used to effectively prepare the Healthy Hearts program for Study 2. Thus, the Healthy Hearts program was not only based on previous literature, but it was also shaped by its end users, 3 of 6 (50%) of which participated and utilized the program in Study 2. Therefore, the stance on the recommendation of a full-scale randomized control trial is built upon existing literature in this field, qualitative semi-structured interview data, quantitative survey collection data, and a feasibility trial.

One limitation is the recruitment for both Study 1 and 2 was done through Facebook, falling victim to a selection bias. Those who volunteer to participate in research may be systematically different from those who do not. Secondly, a follow-up period is often recommended in financial incentive behaviour change research, to determine whether an individual's behaviour reverts to baseline (Luong et al., 2021). Further, while the COVID-19 pandemic accelerated the virtual atmosphere in many different domains of people's day-to-day life, a human research study relying on consistency between participants suffers from these distanced interactions. As such, analyzing participants during usability testing for body language and emotions, in-person tutorials of using the Fitbit and study details, along with blood pressure measurements may suffer from inaccuracy. Nevertheless, implementing a physical activity intervention during a revolutionary time such as COVID-19 has presented an incredible opportunity where people are potentially shifting to value and take time for their physical health, as

documented in semi-structured interviews and a small-to-moderate increase in PA in Study 2. Despite these limitations, this thesis contributed to the current literature in financial incentives and physical activity and was the first study conducted through Pathverse.

4.6 Future Directions

After appropriate power calculations derived from Study 2, a full-scale randomized control trial is recommended to further explore the efficacy of employing a financial incentive arm such as the SIB arm into public health policy. The future randomized control trial must consider the changes recommended in Study 2.

There are three main future directions for this research. First, a full-scale efficacy trial should be considered to compare the PPM and SIB financial incentive frameworks in an adequately powered study. Second, this mHealth intervention was employed through Pathverse, a platform designed for researchers without coding experience to deliver health content and collect feedback from the participants (*Pathverse*, 2021). This platform tremendously eased the iterative co-design process of developing the Healthy Hearts program with feedback from the participants and the Digital Health Lab team. This process further highlighted the need to explore tools like Pathverse and other no or low code app development platforms to accelerate the prototypes of mHealth interventions (Caballar, 2020). Lastly, the promising effect sizes in this thesis showed there is a need to build strategic public and private partnerships with investment firms, insurance, and government agencies in order to implement a SIB framework for PA and other lifestyle factors.

Bibliography

Abraham, C., & Michie, S. (2008). A taxonomy of behavior change techniques used in interventions. *Health Psychology*, *27*(3), 379–387. https://doi.org/10.1037/0278-6133.27.3.379

Adams, M. A., Hurley, J. C., Todd, M., Bhuiyan, N., Jarrett, C. L., Tucker, W. J., Hollingshead, K. E., & Angadi, S. S. (2017). Adaptive goal setting and financial incentives: a 2 × 2 factorial randomized controlled trial to increase adults' physical activity. *BMC Public Health*, *17*(1), 1–16. https://doi.org/10.1186/s12889-017-4197-8

Al Ayubi, S. U., Parmanto, B., Branch, R., & Ding, D. (2014). A Persuasive and Social mHealth Application for Physical Activity: A Usability and Feasibility Study. *JMIR MHealth and UHealth*, *2*(2), e25. https://doi.org/10.2196/mhealth.2902

Albertson, K., Fox, C., O'Leary, C., & Painter, G. (2018). *Payment by Results and Social Impact Bonds: Outcome-Based Payment Systems in the UK and US*. Policy Press. https://doi.org/10.1332/policypress/9781447340706.001.0001

Anderson-Lewis, C., Darville, G., Mercado, R. E., Howell, S., & Di Maggio, S. (2018). mHealth Technology Use and Implications in Historically Underserved and Minority Populations in the United States: Systematic Literature Review. *JMIR MHealth and UHealth*, *6*(6), e128. https://doi.org/10.2196/mhealth.8383

Ayala, G. X., & Elder, J. P. (2011). Qualitative methods to ensure acceptability of behavioral and social interventions to the target population. *Journal of Public Health Dentistry*, *71*, S69–S79. https://doi.org/10.1111/j.1752-7325.2011.00241.x

Ball, K., Hunter, R. F., Maple, J. L., Moodie, M., Salmon, J., Ong, K. L., Stephens, L. D.,

Jackson, M., & Crawford, D. (2017). Can an incentive-based intervention increase physical activity and reduce sitting among adults? The ACHIEVE (Active Choices IncEntiVE) feasibility study. *International Journal of Behavioral Nutrition and Physical Activity*, *14*(1), 1–10. https://doi.org/10.1186/s12966-017-0490-2

Bandura, A. (2001). Social Cognitive Theory: An Agentic Perspective. *Annual Review of Psychology*, *52*(1), 1–26. https://doi.org/10.1146/annurev.psych.52.1.1

Barte, J. C. M., & Wendel-Vos, G. C. W. (2017). A Systematic Review of Financial Incentives for Physical Activity: The Effects on Physical Activity and Related Outcomes. *Behavioral Medicine*, *43*(2), 79–90. https://doi.org/10.1080/08964289.2015.1074880

BC's Restart: A plan to bring us back together. (2021). https://www2.gov.bc.ca/gov/content?id=2873D79FF0CE411A913142FB2BC345FC

Benedict, C., Hahn, A. L., Diefenbach, M. A., & Ford, J. S. (2019). Recruitment via social media: advantages and potential biases. *DIGITAL HEALTH*, *5*, 205520761986722. https://doi.org/10.1177/2055207619867223

Bethancourt, H. J., Rosenberg, D. E., Beatty, T., & Arterburn, D. E. (2014). Barriers to and facilitators of physical activity program use among older adults. *Clinical Medicine & Research*, *12*(1–2), 10–20. https://doi.org/10.3121/cmr.2013.1171

Booker, C. L., Harding, S., & Benzeval, M. (2011). A systematic review of the effect of retention methods in population-based cohort studies. *BMC Public Health*, *11*(1), 249. https://doi.org/10.1186/1471-2458-11-249

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Brewer, W., Swanson, B. T., & Ortiz, A. (2017). Validity of Fitbit's active minutes as compared with a research-grade accelerometer and self-reported measures. *BMJ Open Sport & Exercise Medicine*, *3*(1), e000254. https://doi.org/10.1136/bmjsem-2017-000254

Burkow, T. M., Vognild, L. K., Johnsen, E., Bratvold, A., & Risberg, M. J. (2018). Promoting exercise training and physical activity in daily life: a feasibility study of a virtual group intervention for behaviour change in COPD. *BMC Medical Informatics and Decision Making*, *18*(1), 136. https://doi.org/10.1186/s12911-018-0721-8

Caballar, R. D. (2020). *Programming Without Code: The Rise of No-Code Software Development*. https://spectrum.ieee.org/programming-without-code-no-code-software-development

Camerer, C. F., & Loewenstein, G. (2004). Behavioral Economics: Past, Present, Future. In *Advances in Behavioral Economics* (pp. 3–52). Princeton University Press. https://doi.org/10.1515/9781400829118-004

Campbell, N., Young, E. R., Drouin, D., Legowski, B., Adams, M. A., Farrell, J., Kaczorowski, J., Lewanczuk, R., Lum-Kwong, M. M., & Tobe, S. (2012). A Framework for Discussion on How to Improve Prevention, Management, and Control of Hypertension in Canada. *Canadian Journal of Cardiology*, *28*(3), 262–269. https://doi.org/10.1016/j.cjca.2011.11.008

Canada, S. (2020). *Table 13-10-0394-01 Leading causes of death, total population, by age group*. https://doi.org/https://doi.org/10.25318/1310039401-eng

Carter, D. D., Robinson, K., Forbes, J., & Hayes, S. (2018). Experiences of mobile health in promoting physical activity: A qualitative systematic review and meta-

ethnography. In *PLoS ONE* (Vol. 13, Issue 12). https://doi.org/10.1371/journal.pone.0208759

Cavallo, C., Labib, M. A., Honea, N., & Nakaji, P. (2018). Letter: Enrollment-To-Screening Ratio: An Undervalued Data in Randomized Clinical Trials. *Neurosurgery*, *82*(6), E184–E185. https://doi.org/10.1093/neuros/nyy079

Chapman, G. B., & Coups, E. J. (2006). Emotions and preventive health behavior: Worry, regret, and influenza vaccination. *Health Psychology*, *25*(1), 82–90. https://doi.org/10.1037/0278-6133.25.1.82

Charness, G., & Gneezy, U. (2009). Incentives to Exercise. *Econometrica*, *77*(3), 909–931. http://www.jstor.org/stable/40263846

Choi, J., Lee, J. hyeon, Vittinghoff, E., & Fukuoka, Y. (2016). mHealth Physical Activity Intervention: A Randomized Pilot Study in Physically Inactive Pregnant Women. *Maternal and Child Health Journal*, *20*(5), 1091–1101. https://doi.org/10.1007/s10995-015-1895-7

Chokshi, N. P., Adusumalli, S., Small, D. S., Morris, A., Feingold, J., Ha, Y. P., Lynch, M. D., Rareshide, C. A. L., Hilbert, V., & Patel, M. S. (2018). Loss-framed financial incentives and personalized goal-setting to increase physical activity among ischemic heart disease patients using wearable devices: The ACTIVE REWARD randomized trial. *Journal of the American Heart Association*, *7*(12). https://doi.org/10.1161/JAHA.118.009173

Clarke, Janine; Colley, Rachel; Janssen, Ian; Tremblay, M. S. (2019). *Accelerometer-measured moderate-to-vigorous physical activity of Canadian adults, 2007 to 2017*. Statistics Canada. https://doi.org/https://doi.org/10.25318/82-003-x201900800001-

eng

Compernolle, S., Cardon, G., van der Ploeg, H. P., van Nassau, F., de Bourdeaudhuij, I., Jelsma, J. J., Brondeel, R., & van Dyck, D. (2020). Engagement, acceptability, usability, and preliminary efficacy of a self-monitoring mobile health intervention to reduce sedentary behavior in Belgian older adults: Mixed methods study. *JMIR MHealth and UHealth*, *8*(10), 1–12. https://doi.org/10.2196/18653

Compernolle, S., DeSmet, A., Poppe, L., Crombez, G., De Bourdeaudhuij, I., Cardon, G., van der Ploeg, H. P., & Van Dyck, D. (2019). Effectiveness of interventions using self-monitoring to reduce sedentary behavior in adults: a systematic review and meta-analysis. *International Journal of Behavioral Nutrition and Physical Activity*, *16*(1), 63. https://doi.org/10.1186/s12966-019-0824-3

Connolly, T., & Butler, D. (2006). Regret in economic and psychological theories of choice. *Journal of Behavioral Decision Making*, *19*(2), 139–154. https://doi.org/10.1002/bdm.510

Cook, V. E., Ellis, A. K., & Hildebrand, K. J. (2016). Mobile health applications in clinical practice: pearls, pitfalls, and key considerations. *Annals of Allergy, Asthma & Immunology*, *117*(2), 143–149. https://doi.org/10.1016/j.anai.2016.01.012

Cornelissen, V. A., & Smart, N. A. (2013). Exercise Training for Blood Pressure: A Systematic Review and Meta-analysis. *Journal of the American Heart Association*, *2*(1). https://doi.org/10.1161/JAHA.112.004473

Coughlin, S. S., & Stewart, J. (2016). Use of Consumer Wearable Devices To Promote Physical Activity: a Review of Health Intervention Studies. *Journal of Environment and Health Science*, *2*(6), 1–6. https://doi.org/10.15436/2378-6841.16.1123

Courneya, K. S., Estabrooks, P. A., & Nigg, C. R. (1997). A Simple Reinforcement Strategy for Increasing Attendance at a Fitness Facility. *Health Education & Behavior*, *24*(6), 708–715. https://doi.org/10.1177/109019819702400606

Cowan, L. T., Van Wagenen, S. A., Brown, B. A., Hedin, R. J., Seino-Stephan, Y., Hall, P. C., & West, J. H. (2013). Apps of Steel: Are Exercise Apps Providing Consumers With Realistic Expectations? *Health Education & Behavior*, *40*(2), 133–139. https://doi.org/10.1177/1090198112452126

Crane, M. M., Tate, D. F., Finkelstein, E. A., & Linnan, L. A. (2012). Motivation for Participating in a Weight Loss Program and Financial Incentives: An Analysis from a Randomized Trial. *Journal of Obesity*, *2012*, 1–9. https://doi.org/10.1155/2012/290589

Creswell, J. W. (2015). *A concise introduction to mixed methods research*. Sage.

CSEP. (2017). *Get Active Questionnaire*. Canadian Society for Exercise Physiology. http://www.csep.ca/home

Czajkowski, S. M., Powell, L. H., Adler, N., Naar-King, S., Reynolds, K. D., Hunter, C. M., Laraia, B., Olster, D. H., Perna, F. M., Peterson, J. C., Epel, E., Boyington, J. E., & Charlson, M. E. (2015). From ideas to efficacy: The ORBIT model for developing behavioral treatments for chronic diseases. *Health Psychology*, *34*(10), 971–982. https://doi.org/10.1037/hea0000161

Dasgupta, K., Quinn, R. R., Zarnke, K. B., Rabi, D. M., Ravani, P., Daskalopoulou, S. S., Rabkin, S. W., Trudeau, L., Feldman, R. D., Cloutier, L., Prebtani, A., Herman, R. J., Bacon, S. L., Gilbert, R. E., Ruzicka, M., McKay, D. W., Campbell, T. S., Grover, S., Honos, G., … Poirier, L. (2014). The 2014 Canadian Hypertension

Education Program Recommendations for Blood Pressure Measurement, Diagnosis, Assessment of Risk, Prevention, and Treatment of Hypertension. *Canadian Journal of Cardiology*, *30*(5), 485–501. https://doi.org/10.1016/j.cjca.2014.02.002

Davis, R., Campbell, R., Hildon, Z., Hobbs, L., & Michie, S. (2015). Theories of behaviour and behaviour change across the social and behavioural sciences: a scoping review. *Health Psychology Review*, *9*(3), 323–344. https://doi.org/10.1080/17437199.2014.941722

Deci, E. L. (1971). Effects of externally mediated rewards on intrinsic motivation. *Journal of Personality and Social Psychology*, *18*(1), 105–115. https://doi.org/10.1037/h0030644

Deci, E. L., Koestner, R., & Ryan, R. M. (1999). A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation. *Psychological Bulletin*, *125*(6), 627–668. https://doi.org/10.1037/0033-2909.125.6.627

Deci, E. L., & Ryan, R. M. (1985a). Cognitive Evaluation Theory. In *Intrinsic Motivation and Self-Determination in Human Behavior* (pp. 43–85). Springer US. https://doi.org/10.1007/978-1-4899-2271-7_3

Deci, E. L., & Ryan, R. M. (1985b). *Intrinsic Motivation and Self-Determination in Human Behavior*. Springer US. https://doi.org/10.1007/978-1-4899-2271-7

Deci, E. L., & Ryan, R. M. (Eds.). (2002). Handbook of self-determination research. In *Handbook of self-determination research.* (pp. x, 470–x, 470). University of Rochester Press.

Deci, E. L., Vallerand, R. J., Pelletier, L. G., & Ryan, R. M. (1991). Motivation and Education: The Self-Determination Perspective. *Educational Psychologist*, *26*(3–4),

325–346. https://doi.org/10.1080/00461520.1991.9653137

DeGuire, J., Clarke, J., Rouleau, K., Roy, J., & Bushnik, T. (2019). Blood pressure and hypertension. *Health Reports*, *30*(2), 14–21. https://doi.org/10.25318/82-003-x201900200002

Diaz, K. M., & Shimbo, D. (2013). Physical activity and the prevention of hypertension. *Current Hypertension Reports*, *15*(6), 659–668. https://doi.org/10.1007/s11906-013-0386-8

Ding, D., del Pozo Cruz, B., Green, M. A., & Bauman, A. E. (2020). Is the COVID-19 lockdown nudging people to be more active: a big data analysis. *British Journal of Sports Medicine*, *54*(20), 1183–1184. https://doi.org/10.1136/bjsports-2020-102575

Dolan, P., Hallsworth, M., Halpern, D., King, D., Metcalfe, R., & Vlaev, I. (2012). Influencing behaviour: The mindspace way. *Journal of Economic Psychology*, *33*(1), 264–277. https://doi.org/10.1016/j.joep.2011.10.009

Druce, K. L., Dixon, W. G., & McBeth, J. (2019). Maximizing Engagement in Mobile Health Studies: Lessons Learned and Future Directions. *Rheumatic Disease Clinics of North America*, *45*(2), 159–172. https://doi.org/10.1016/j.rdc.2019.01.004

Duff, O. M., Walsh, D. M., Furlong, B. A., O'Connor, N. E., Moran, K. A., & Woods, C. B. (2017). Behavior Change Techniques in Physical Activity eHealth Interventions for People With Cardiovascular Disease: Systematic Review. *Journal of Medical Internet Research*, *19*(8), e281. https://doi.org/10.2196/jmir.7782

Elliott, R., & Tighe, T. (1968). Breaking the Cigarette Habit: Effects of a Technique Involving Threatened Loss of Money. *The Psychological Record*, *18*(4), 503–513. https://doi.org/10.1007/BF03393800

Ernsting, C., Dombrowski, S. U., Oedekoven, M., O'Sullivan, J. L., Kanzler, E., Kuhlmey, A., & Gellert, P. (2017). Using smartphones and health apps to change and manage health behaviors: A population-based survey. *Journal of Medical Internet Research*, *19*(4). https://doi.org/10.2196/jmir.6838

Farooqui, M. A., Tan, Y. T., Bilger, M., & Finkelstein, E. A. (2014). Effects of financial incentives on motivating physical activity among older adults: Results from a discrete choice experiment. *BMC Public Health*, *14*(1). https://doi.org/10.1186/1471-2458-14-141

Feehan, L. M., Geldman, J., Sayre, E. C., Park, C., Ezzat, A. M., Yoo, J. Y., Hamilton, C. B., & Li, L. C. (2018). Accuracy of Fitbit Devices: Systematic Review and Narrative Syntheses of Quantitative Data. *JMIR MHealth and UHealth*, *6*(8), e10527. https://doi.org/10.2196/10527

Fishbein, M., Triandis, H. C., Kanfer, F. H., Becker, M., Middlestadt, S. E., & Eichler, A. (2001). Factors influencing behavior and behavior change. *Handbook of Health Psychology*, *3*, 17.

Fitbit Inspire 2. (n.d.). https://doi.org/https://www.fitbit.com/global/en-ca/products/trackers/inspire2?utm_medium=sem&utm_source=google&utm_campaign=CA_PF_ROAS&gclid=Cj0KCQjw7MGJBhD-ARIsAMZ0eev391A0FGtgj4WihHN0IUj284BQZWVZo5kEoTe2-83RD6mqE--AroEaAotHEALw_wcB&gclsrc=aw.ds

Fonteyn, M. E., Kuipers, B., & Grobe, S. J. (1993). A Description of Think Aloud Method and Protocol Analysis. *Qualitative Health Research*, *3*(4), 430–441. https://doi.org/10.1177/104973239300300403

Forouzanfar, M. H., Liu, P., Roth, G. A., Ng, M., Biryukov, S., Marczak, L., Alexander, L., Estep, K., Hassen Abate, K., Akinyemiju, T. F., Ali, R., Alvis-Guzman, N., Azzopardi, P., Banerjee, A., Bärnighausen, T., Basu, A., Bekele, T., Bennett, D. A., Biadgilign, S., … Murray, C. J. L. (2017). Global Burden of Hypertension and Systolic Blood Pressure of at Least 110 to 115 mm Hg, 1990-2015. *JAMA*, *317*(2), 165. https://doi.org/10.1001/jama.2016.19043

Foster, D., Linehan, C., Kirman, B., Lawson, S., & James, G. (2010). Motivating physical activity at work. *Proceedings of the 14th International Academic MindTrek Conference on Envisioning Future Media Environments - MindTrek '10*, 111. https://doi.org/10.1145/1930488.1930510

Gavarkovs, A. G., Burke, S. M., & Petrella, R. J. (2017). The Physical Activity–Related Barriers and Facilitators Perceived by Men Living in Rural Communities. *American Journal of Men's Health*, *11*(4), 1130–1132. https://doi.org/10.1177/1557988315598368

Gong, Y., Trentadue, T. P., Shrestha, S., Losina, E., & Collins, J. E. (2018). Financial incentives for objectively-measured physical activity or weight loss in adults with chronic health conditions: A meta-analysis. *PLoS ONE*, *13*(9), 1–16. https://doi.org/10.1371/journal.pone.0203939

Greaves, M. (2019). *The new Medibank Live Better rewards app is here – helping you eat, move, feel better and save*. https://www.medibank.com.au/livebetter/newsroom/post/the-new-medibank-live-better-rewards-app-is-here-helping-you-eat-move-feel

Guertler, D., Vandelanotte, C., Kirwan, M., & Duncan, M. J. (2015). Engagement and

Nonusage Attrition With a Free Physical Activity Promotion Program: The Case of 10,000 Steps Australia. *Journal of Medical Internet Research*, *17*(7), e176. https://doi.org/10.2196/jmir.4339

Harkins, K. A., Kullgren, J. T., Bellamy, S. L., Karlawish, J., & Glanz, K. (2017). A Trial of Financial and Social Incentives to Increase Older Adults' Walking. *American Journal of Preventive Medicine*, *52*(5), e123–e130. https://doi.org/10.1016/j.amepre.2016.11.011

Hartung, V., Sarshar, M., Karle, V., Shammas, L., Rashid, A., Roullier, P., Eilers, C., Mäurer, M., Flachenecker, P., Pfeifer, K., & Tallner, A. (2020). Validity of Consumer Activity Monitors and an Algorithm Using Smartphone Data for Measuring Steps during Different Activity Types. *International Journal of Environmental Research and Public Health*, *17*(24), 9314. https://doi.org/10.3390/ijerph17249314

Hawkins, R. P., Kreuter, M., Resnicow, K., Fishbein, M., & Dijkstra, A. (2008). Understanding tailoring in communicating about health. *Health Education Research*, *23*(3), 454–466. https://doi.org/10.1093/her/cyn004

Health Seekers. (2020).

HealthLinkBC. (n.d.). https://www.healthlinkbc.ca/

Hypertension Canada. (2020).

J.B. Maverick. (2021). *What Is the Average Annual Return for the S&P 500?* https://www.investopedia.com/ask/answers/042415/what-average-annual-return-sp-500.asp

Jackson, N., & Waters, E. (2005). Criteria for the systematic review of health promotion

and public health interventions. *Health Promotion International*, *20*(4), 367–374. https://doi.org/10.1093/heapro/dai022

Johnson, S. S., Paiva, A. L., Cummins, C. O., Johnson, J. L., Dyment, S. J., Wright, J. A., Prochaska, J. O., Prochaska, J. M., & Sherman, K. (2008). Transtheoretical Model-based multiple behavior intervention for weight management: Effectiveness on a population basis. *Preventive Medicine*, *46*(3), 238–246. https://doi.org/10.1016/j.ypmed.2007.09.010

Jonathan, G. K., Pivaral, L., & Ben-Zeev, D. (2017). Augmenting mHealth with human support: Notes from community care of people with serious mental illnesses. *Psychiatric Rehabilitation Journal*, *40*(3), 336–338. https://doi.org/10.1037/prj0000275

Joseph, G., Marott, J. L., Torp-Pedersen, C., Biering-Sørensen, T., Nielsen, G., Christensen, A.-E., Johansen, M. B., Schnohr, P., Sogaard, P., & Mogelvang, R. (2019). Dose-Response Association Between Level of Physical Activity and Mortality in Normal, Elevated, and High Blood Pressure. *Hypertension (Dallas, Tex. : 1979)*, HYPERTENSIONAHA11913786. https://doi.org/10.1161/HYPERTENSIONAHA.119.13786

Kahneman, D., & Tversky, A. (1979). Prospect Theory: An Analysis of Decision under Risk. *Econometrica*, *47*(2), 263. https://doi.org/10.2307/1914185

Kaushal, N., Rhodes, R. E., Spence, J. C., & Meldrum, J. T. (2017). Increasing Physical Activity Through Principles of Habit Formation in New Gym Members: a Randomized Controlled Trial. *Annals of Behavioral Medicine*, *51*(4), 578–586. https://doi.org/10.1007/s12160-017-9881-5

Kelders, S. M., Kok, R. N., Ossebaard, H. C., & Van Gemert-Pijnen, J. E. (2012). Persuasive System Design Does Matter: a Systematic Review of Adherence to Web-based Interventions. *Journal of Medical Internet Research*, *14*(6), e152. https://doi.org/10.2196/jmir.2104

King, A. C., Castro, C. M., Buman, M. P., Hekler, E. B., Urizar, G. G., & Ahn, D. K. (2013). Behavioral impacts of sequentially versus simultaneously delivered dietary plus physical activity interventions: the CALM trial. *Annals of Behavioral Medicine : A Publication of the Society of Behavioral Medicine*, *46*(2), 157–168. https://doi.org/10.1007/s12160-013-9501-y

Kiss, N., Baguley, B. J., Ball, K., Daly, R. M., Fraser, S. F., Granger, C. L., & Ugalde, A. (2019). Technology-Supported Self-Guided Nutrition and Physical Activity Interventions for Adults With Cancer: Systematic Review. *JMIR MHealth and UHealth*, *7*(2), e12281. https://doi.org/10.2196/12281

Kjeldsen, S. E. (2018). Hypertension and cardiovascular risk: General aspects. In *Pharmacological Research*. https://doi.org/10.1016/j.phrs.2017.11.003

Kohl, L. F., Crutzen, R., & de Vries, N. K. (2013). Online Prevention Aimed at Lifestyle Behaviors: A Systematic Review of Reviews. *Journal of Medical Internet Research*, *15*(7), e146. https://doi.org/10.2196/jmir.2665

Krähmer, D., & Stone, R. (2013). Anticipated regret as an explanation of uncertainty aversion. *Economic Theory*, *52*(2), 709–728. https://doi.org/10.1007/s00199-011-0661-3

Kramer, J. N., Tinschert, P., Scholz, U., Fleisch, E., & Kowatsch, T. (2019). A Cluster-Randomized Trial on Small Incentives to Promote Physical Activity. *American*

Journal of Preventive Medicine, *56*(2), e45–e54. https://doi.org/10.1016/j.amepre.2018.09.018

Krebs, P., & Duncan, D. T. (2015). Health App Use Among US Mobile Phone Owners: A National Survey. *JMIR MHealth and UHealth*, *3*(4), e101. https://doi.org/10.2196/mhealth.4924

Kreuter, M. W., & Wray, R. J. (2003). Tailored and Targeted Health Communication: Strategies for Enhancing Information Relevance. *American Journal of Health Behavior*, *27*(1), 227–232. https://doi.org/10.5993/AJHB.27.1.s3.6

Lakens, D. (2013). Calculating and reporting effect sizes to facilitate cumulative science: a practical primer for t-tests and ANOVAs. *Frontiers in Psychology*, *4*. https://doi.org/10.3389/fpsyg.2013.00863

Lee, D.-H., Ha, M.-H., Kim, J.-R., & Jacobs, D. R. (2001). Effects of Smoking Cessation on Changes in Blood Pressure and Incidence of Hypertension. *Hypertension*, *37*(2), 194–198. https://doi.org/10.1161/01.HYP.37.2.194

Liu, S., Brooks, D., Thomas, S., & Nolan, R. (2015). EXAMINING THE EFFECTIVENESS OF USER AND EXPERT DRIVEN INTERNET-BASED LIFESTYLE INTERVENTIONS ON HYPERTENSION CONTROL: A RANDOMIZED CONTROLLED TRIAL. *Canadian Journal of Cardiology*, *31*(10), S296–S297. https://doi.org/10.1016/j.cjca.2015.07.731

Liu, Sam, Dunford, S. D., Leung, Y. W., Brooks, D., Thomas, S. G., Eysenbach, G., & Nolan, R. P. (2013). Reducing blood pressure with internet-based interventions: A meta-analysis. *Canadian Journal of Cardiology*, *29*(5), 613–621. https://doi.org/10.1016/j.cjca.2013.02.007

Liu, Sam, Husband, C., La, H., Juba, M., Loucks, R., Harrison, A., & Rhodes, R. E. (2019). Development of a self-guided web-based intervention to promote physical activity using the multi-process action control framework. *Internet Interventions*, *15*, 35–42. https://doi.org/10.1016/j.invent.2018.11.003

Liu, Sam, Tanaka, R., Barr, S., & Nolan, R. P. (2020). Effects of self-guided e-counseling on health behaviors and blood pressure: Results of a randomized trial. *Patient Education and Counseling*, *103*(3), 635–641. https://doi.org/10.1016/j.pec.2019.10.007

Lopez-Fernandez, O., & Molina-Azorin, J. F. (2011). The use of mixed methods research in the field of behavioural sciences. *Quality & Quantity*, *45*(6), 1459. https://doi.org/10.1007/s11135-011-9543-9

Lu, X., Yang, H., Xia, X., Lu, X., Lin, J., Liu, F., & Gu, D. (2019). Interactive Mobile Health Intervention and Blood Pressure Management in Adults. *Hypertension*, *74*(3), 697–704. https://doi.org/10.1161/HYPERTENSIONAHA.119.13273

Luong, M.-L. N., Hall, M., Bennell, K. L., Kasza, J., Harris, A., & Hinman, R. S. (2021). The Impact of Financial Incentives on Physical Activity: A Systematic Review and Meta-Analysis. *American Journal of Health Promotion*, *35*(2), 236–249. https://doi.org/10.1177/0890117120940133

Mahmood, A., Kedia, S., Wyant, D. K., Ahn, S., & Bhuyan, S. S. (2019). Use of mobile health applications for health-promoting behavior among individuals with chronic medical conditions. *DIGITAL HEALTH*, *5*, 205520761988218. https://doi.org/10.1177/2055207619882181

Markland, D. & Tobin, V. (2004). A modification of the Behavioral Regulation in

Exercise Questionnaire to include an assessment of amotivation. *Journal of Sport and Exercise Psychology*, *26*, 191–196.

McCoy, C. E. (2017). Understanding the Intention-to-treat Principle in Randomized Controlled Trials. *The Western Journal of Emergency Medicine*, *18*(6), 1075–1078. https://doi.org/10.5811/westjem.2017.8.35985

McGill, B., O'Hara, B. J., Bauman, A., Grunseit, A. C., & Phongsavan, P. (2019a). Are Financial Incentives for Lifestyle Behavior Change Informed or Inspired by Behavioral Economics? A Mapping Review. *American Journal of Health Promotion*, *33*(1), 131–141. https://doi.org/10.1177/0890117118770837

McGill, B., O'Hara, B. J., Bauman, A., Grunseit, A. C., & Phongsavan, P. (2019b). Are Financial Incentives for Lifestyle Behavior Change Informed or Inspired by Behavioral Economics? A Mapping Review. *American Journal of Health Promotion*, *33*(1), 131–141. https://doi.org/10.1177/0890117118770837

Mehdi, M., & Alharby, A. (2018). Purpose, Scope, and Technical Considerations of Wearable Technologies. In *Wearable Technologies* (pp. 1–19). IGI Global. https://doi.org/10.4018/978-1-5225-5484-4.ch001

Meyerowitz-Katz, G., Ravi, S., Arnolda, L., Feng, X., Maberly, G., & Astell-Burt, T. (2020). Rates of Attrition and Dropout in App-Based Interventions for Chronic Disease: Systematic Review and Meta-Analysis. *Journal of Medical Internet Research*, *22*(9), e20283. https://doi.org/10.2196/20283

Michie, S., Abraham, C., Eccles, M. P., Francis, J. J., Hardeman, W., & Johnston, M. (2011). Strengthening evaluation and implementation by specifying components of behaviour change interventions: a study protocol. *Implementation Science*, *6*(1), 10.

https://doi.org/10.1186/1748-5908-6-10

Michie, S., Ashford, S., Sniehotta, F. F., Dombrowski, S. U., Bishop, A., & French, D. P. (2011). A refined taxonomy of behaviour change techniques to help people change their physical activity and healthy eating behaviours: The CALO-RE taxonomy. *Psychology & Health*, *26*(11), 1479–1498. https://doi.org/10.1080/08870446.2010.540664

Michie, S., Richardson, M., Johnston, M., Abraham, C., Francis, J., Hardeman, W., Eccles, M. P., Cane, J., & Wood, C. E. (2013). The Behavior Change Technique Taxonomy (v1) of 93 Hierarchically Clustered Techniques: Building an International Consensus for the Reporting of Behavior Change Interventions. *Annals of Behavioral Medicine*, *46*(1), 81–95. https://doi.org/10.1007/s12160-013-9486-6

Mills, K. T., Stefanescu, A., & He, J. (2020). The global epidemiology of hypertension. *Nature Reviews Nephrology*, *16*(4), 223–237. https://doi.org/10.1038/s41581-019-0244-2

Mitchell, M. S., Goodman, J. M., Alter, D. A., John, L. K., Oh, P. I., Pakosh, M. T., & Faulkner, G. E. (2013). Financial incentives for exercise adherence in adults: Systematic review and meta-analysis. *American Journal of Preventive Medicine*, *45*(5), 658–667. https://doi.org/10.1016/j.amepre.2013.06.017

Mitchell, M. S., Goodman, J. M., Alter, D. A., Oh, P. I., & Faulkner, G. E. J. (2015). Development of the Health Incentive Program Questionnaire (HIP-Q) in a cardiac rehabilitation population. *Translational Behavioral Medicine*, *5*(4), 443–459. https://doi.org/10.1007/s13142-015-0330-3

Mitchell, M. S., Orstad, S. L., Biswas, A., Oh, P. I., Jay, M., Pakosh, M. T., & Faulkner,

G. (2019). Financial incentives for physical activity in adults: Systematic review and meta-analysis. *British Journal of Sports Medicine*, 1–12. https://doi.org/10.1136/bjsports-2019-100633

Mitchell, M., White, L., Lau, E., Leahey, T., Adams, M. A., & Faulkner, G. (2018). Evaluating the carrot rewards app, a population-level incentive-based intervention promoting step counts across two canadian provinces: Quasi-experimental study. *JMIR MHealth and UHealth*, *6*(9), 1–13. https://doi.org/10.2196/mhealth.9912

Mönninghoff, A., Kramer, J. N., Hess, A. J., Ismailova, K., Teepe, G. W., Tudor Car, L., Müller-Riemenschneider, F., & Kowatsch, T. (2021). Long-term Effectiveness of mHealth Physical Activity Interventions: Systematic Review and Meta-analysis of Randomized Controlled Trials. *Journal of Medical Internet Research*, *23*(4), e26699. https://doi.org/10.2196/26699

Morrison, L. G., Hargood, C., Lin, S. X., Dennison, L., Joseph, J., Hughes, S., Michaelides, D. T., Johnston, D., Johnston, M., Michie, S., Little, P., Smith, P. W. F., Weal, M. J., & Yardley, L. (2014). Understanding usage of a hybrid website and smartphone app for weight management: A mixed-methods study. *Journal of Medical Internet Research*, *16*(10), e201. https://doi.org/10.2196/jmir.3579

Mullen, S. P., & Hall, P. A. (2015). Editorial: Physical activity, self-regulation, and executive control across the lifespan. *Frontiers in Human Neuroscience*, *9*. https://doi.org/10.3389/fnhum.2015.00614

Mummah, S. A., Robinson, T. N., King, A. C., Gardner, C. D., & Sutton, S. (2016). IDEAS (Integrate, Design, Assess, and Share): A Framework and Toolkit of Strategies for the Development of More Effective Digital Interventions to Change

Health Behavior. *Journal of Medical Internet Research*, *18*(12), e317. https://doi.org/10.2196/jmir.5927

National Clinical Guideline Centre (UK). (2011). *Hypertension: The Clinical Management of Primary Hypertension in Adults. Update of Clinical Guidelines 18 and 34 [Internet]*.

Nazari Chamaki, F., Jenkins, G. P., & Hashemi, M. (2019). Social Impact Bonds: Implementation, Evaluation, and Monitoring. *International Journal of Public Administration*, *42*(4), 289–297. https://doi.org/10.1080/01900692.2018.1433206

Newgard, C. D., & Lewis, R. J. (2015). Missing Data. *JAMA*, *314*(9), 940. https://doi.org/10.1001/jama.2015.10516

Nolan, R. P., Liu, S., Feldman, R., Dawes, M., Barr, S., Lynn, H., Gwardy-Sridhar, F., Thomas, S. G., Goodman, J., Oh, P., Kaczorowski, J., Chessex, C., Hachinski, V., & Shoemaker, K. (2013). Reducing risk with e-based support for adherence to lifestyle change in hypertension (REACH): protocol for a multicentred randomised controlled trial. *BMJ Open*, *3*(8), e003547. https://doi.org/10.1136/bmjopen-2013-003547

O'Regan, A., García Bengoechea, E., Clifford, A. M., Casey, M., Gallagher, S., Glynn, L., Doyle, C., & Woods, C. (2020). How to improve recruitment, sustainability and scalability in physical activity programmes for adults aged 50 years and older: A qualitative study of key stakeholder perspectives. *PLOS ONE*, *15*(10), e0240974. https://doi.org/10.1371/journal.pone.0240974

Oaten, M., & Cheng, K. (2006). Longitudinal gains in self-regulation from regular physical exercise. *British Journal of Health Psychology*, *11*(4), 717–733.

https://doi.org/10.1348/135910706X96481

OECD. (2016). *Understanding Social Impact Bonds*. https://doi.org/https://www.oecd.org/cfe/leed/UnderstandingSIBsLux-WorkingPaper.pdf

Oliver, A. (2012). A Nudge Too Far? A Nudge at All? On Paying People to Be Healthy. *HealthcarePapers*, *12*(4), 8–16. https://doi.org/10.12927/hcpap.2013.23217

Omboni, S. (2019). Connected Health in Hypertension Management. *Frontiers in Cardiovascular Medicine*, *6*, 76. https://doi.org/10.3389/fcvm.2019.00076

Padwal, R. S., Bienek, A., McAlister, F. A., & Campbell, N. R. C. (2016). Epidemiology of Hypertension in Canada: An Update. *Canadian Journal of Cardiology*, *32*(5), 687–694. https://doi.org/10.1016/j.cjca.2015.07.734

Patel, M. S., Asch, D. A., Rosin, R., Small, D. S., Bellamy, S. L., Eberbach, K., Walters, K. J., Haff, N., Lee, S. M., Wesby, L., Hoffer, K., Shuttleworth, D., Taylor, D. H., Hilbert, V., Zhu, J., Yang, L., Wang, X., & Volpp, K. G. (2016). Individual Versus Team-Based Financial Incentives to Increase Physical Activity: A Randomized, Controlled Trial. *Journal of General Internal Medicine*, *31*(7), 746–754. https://doi.org/10.1007/s11606-016-3627-0

Patel, M. S., Asch, D. A., Rosin, R., Small, D. S., Bellamy, S. L., Heuer, J., Sproat, S., Hyson, C., Haff, N., Lee, S. M., Wesby, L., Hoffer, K., Wang, X., & Volpp, K. G. (2016). Framing Financial Incentives to Increase Physical Activity Among Overweight and Obese Adults: A Randomized Control Trial. *Annals of Internal Medicine*, *164*(6), 385–394. https://doi.org/10.7326/M

Patel, M. S., Volpp, K. G., Rosin, R., Bellamy, S. L., Small, D. S., Fletcher, M. A.,

Osman-Koss, R., Brady, J. L., Haff, N., Lee, S. M., Wesby, L., Hoffer, K., Shuttleworth, D., Taylor, D. H., Hilbert, V., Zhu, J., Yang, L., Wang, X., & Asch, D. A. (2016). A Randomized Trial of Social Comparison Feedback and Financial Incentives to Increase Physical Activity. *American Journal of Health Promotion*, *30*(6), 416–424. https://doi.org/10.1177/0890117116658195

Patel, M. S., Volpp, K. G., Rosin, R., Bellamy, S. L., Small, D. S., Heuer, J., Sproat, S., Hyson, C., Haff, N., Lee, S. M., Wesby, L., Hoffer, K., Shuttleworth, D., Taylor, D. H., Hilbert, V., Zhu, J., Yang, L., Wang, X., & Asch, D. A. (2018). A Randomized, Controlled Trial of Lottery-Based Financial Incentives to Increase Physical Activity Among Overweight and Obese Adults. *American Journal of Health Promotion*, *32*(7), 1568–1575. https://doi.org/10.1177/0890117118758932

Pathverse. (2021). www.pathverse.ca

Payne, H. E., Lister, C., West, J. H., & Bernhardt, J. M. (2015). Behavioral Functionality of Mobile Apps in Health Interventions: A Systematic Review of the Literature. *JMIR MHealth and UHealth*, *3*(1), e20. https://doi.org/10.2196/mhealth.3335

Pedersen, B. K., & Saltin, B. (2015). Exercise as medicine - evidence for prescribing exercise as therapy in 26 different chronic diseases. *Scandinavian Journal of Medicine & Science in Sports*, *25*, 1–72. https://doi.org/10.1111/sms.12581

Pescatello, L. S., Franklin, B. A., Fagard, R., Farquhar, W. B., Kelley, G. A., & Ray, C. A. (2004). Exercise and Hypertension. *Medicine & Science in Sports & Exercise*, *36*(3), 533–553. https://doi.org/10.1249/01.MSS.0000115224.88514.3A

Pfister, P., Tobler-Ammann, B., Knols, R. H., de Bruin, E. D., & de Bie, R. A. (2020). Usability and Acceptance of an Interactive Tablet-Based Exercise Application: A

Mixed Methods Study. *Frontiers in Digital Health*, *2*. https://doi.org/10.3389/fdgth.2020.578281

Qantas. (2016). *QANTAS FREQUENT FLYERS TO EARN POINTS FOR 'WALKEN.'* https://www.qantasnewsroom.com.au/media-releases/qantas-frequent-flyers-to-earn-points-for-walken/

Rabi, D. M., McBrien, K. A., Sapir-Pichhadze, R., Nakhla, M., Ahmed, S. B., Dumanski, S. M., Butalia, S., Leung, A. A., Harris, K. C., Cloutier, L., Zarnke, K. B., Ruzicka, M., Hiremath, S., Feldman, R. D., Tobe, S. W., Campbell, T. S., Bacon, S. L., Nerenberg, K. A., Dresser, G. K., … Daskalopoulou, S. S. (2020). Hypertension Canada's 2020 Comprehensive Guidelines for the Prevention, Diagnosis, Risk Assessment, and Treatment of Hypertension in Adults and Children. *The Canadian Journal of Cardiology*, *36*(5), 596–624. https://doi.org/10.1016/j.cjca.2020.02.086

Rehman, H., Kamal, A. K., Morris, P. B., Sayani, S., Merchant, A. T., & Virani, S. S. (2017). Mobile Health (mHealth) Technology for the Management of Hypertension and Hyperlipidemia: Slow Start but Loads of Potential. *Current Atherosclerosis Reports*, *19*(3). https://doi.org/10.1007/s11883-017-0649-y

Rhodes, R. E. (2017). *The Evolving Understanding of Physical Activity Behavior* (pp. 171–205). https://doi.org/10.1016/bs.adms.2016.11.001

Rhodes, R. E., & de Bruijn, G. (2013). How big is the physical activity intention–behaviour gap? A meta-analysis using the action control framework. *British Journal of Health Psychology*, *18*(2), 296–309.

Rhodes, R. E., Kaushal, N., & Quinlan, A. (2016). Is physical activity a part of who I am? A review and meta-analysis of identity, schema and physical activity. *Health*

Psychology Review, *10*(2), 204–225. https://doi.org/10.1080/17437199.2016.1143334

Rhodes, R. E., & Yao, C. A. (2015). Models accounting for intention-behavior discordance in the physical activity domain: a user's guide, content overview, and review of current evidence. *International Journal of Behavioral Nutrition and Physical Activity*, *12*(1), 9. https://doi.org/10.1186/s12966-015-0168-6

Rossi, A. M., Moullec, G., Lavoie, K. L., Gour-Provençal, G., & Bacon, S. L. (2013). The Evolution of a Canadian Hypertension Education Program Recommendation: The Impact of Resistance Training on Resting Blood Pressure in Adults as an Example. *Canadian Journal of Cardiology*, *29*(5), 622–627. https://doi.org/10.1016/j.cjca.2013.02.010

Rouleau, J. L., & Moody-Corbett, P. (2012). Canadian Strategy on Patient-Oriented Research. *NAM Perspectives*, *2*(5). https://doi.org/10.31478/201205h

Ryan, R. M., & Connell, J. P. (1989). Perceived locus of causality and internalization: Examining reasons for acting in two domains. *Journal of Personality and Social Psychology*, *57*(5), 749–761. https://doi.org/10.1037/0022-3514.57.5.749

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, *55*(1), 68–78. https://doi.org/10.1037/0003-066X.55.1.68

Ryde, G. C., Gilson, N. D., Burton, N. W., & Brown, W. J. (2013). Recruitment Rates in Workplace Physical Activity Interventions: Characteristics for Success. *American Journal of Health Promotion*, *27*(5), e101–e112. https://doi.org/10.4278/ajhp.120404-LIT-187

Saco-Ledo, G., Valenzuela, P. L., Ruiz-Hurtado, G., Ruilope, L. M., & Lucia, A. (2020). Exercise Reduces Ambulatory Blood Pressure in Patients With Hypertension: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. *Journal of the American Heart Association*, *9*(24). https://doi.org/10.1161/JAHA.120.018487

Samoocha, D., Bruinvels, D. J., Elbers, N. A., Anema, J. R., & van der Beek, A. J. (2010). Effectiveness of Web-based Interventions on Patient Empowerment: A Systematic Review and Meta-analysis. *Journal of Medical Internet Research*, *12*(2), e23. https://doi.org/10.2196/jmir.1286

Schnall, R., Mosley, J. P., Iribarren, S. J., Bakken, S., Carballo-Diéguez, A., & Brown III, W. (2015). Comparison of a User-Centered Design, Self-Management App to Existing mHealth Apps for Persons Living With HIV. *JMIR MHealth and UHealth*, *3*(3), e91. https://doi.org/10.2196/mhealth.4882

Semlitsch, T., Jeitler, K., Hemkens, L. G., Horvath, K., Nagele, E., Schuermann, C., Pignitter, N., Herrmann, K. H., Waffenschmidt, S., & Siebenhofer, A. (2013). Increasing Physical Activity for the Treatment of Hypertension: A Systematic Review and Meta-Analysis. *Sports Medicine*, *43*(10), 1009–1023. https://doi.org/10.1007/s40279-013-0065-6

Sequi-Dominguez, I., Alvarez-Bueno, C., Martinez-Vizcaino, V., Fernandez-Rodriguez, R., del Saz Lara, A., & Cavero-Redondo, I. (2020). Effectiveness of Mobile Health Interventions Promoting Physical Activity and Lifestyle Interventions to Reduce Cardiovascular Risk Among Individuals With Metabolic Syndrome: Systematic Review and Meta-Analysis. *Journal of Medical Internet Research*, *22*(8), e17790. https://doi.org/10.2196/17790

Sheeran, P., & Webb, T. L. (2016). The Intention-Behavior Gap. *Social and Personality Psychology Compass*, *10*(9), 503–518. https://doi.org/10.1111/spc3.12265

Simons, D., De Bourdeaudhuij, I., Clarys, P., De Cocker, K., Vandelanotte, C., & Deforche, B. (2018). Effect and Process Evaluation of a Smartphone App to Promote an Active Lifestyle in Lower Educated Working Young Adults: Cluster Randomized Controlled Trial. *JMIR MHealth and UHealth*, *6*(8), e10003. https://doi.org/10.2196/10003

Statistics Canada. (2021a). *Table 11-10-0239-01 Income of individuals by age group, sex and income source, Canada, provinces and selected census metropolitan areas*. https://doi.org/https://doi.org/10.25318/1110023901-eng

Statistics Canada. (2021b). *Table 22-10-0143-01 Smartphone personal use and selected smartphone habits by gender and age group*. https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=2210014301

Strohacker, K., Galarraga, O., & Williams, D. M. (2014). The Impact of Incentives on Exercise Behavior: A Systematic Review of Randomized Controlled Trials. *Annals of Behavioral Medicine*, *48*(1), 92–99. https://doi.org/10.1007/s12160-013-9577-4

Taj, F., Klein, M. C. A., & van Halteren, A. (2019). Digital Health Behavior Change Technology: Bibliometric and Scoping Review of Two Decades of Research. *JMIR MHealth and UHealth*, *7*(12), e13311. https://doi.org/10.2196/13311

Teixeira, P. J., Carraça, E. V, Markland, D., Silva, M. N., & Ryan, R. M. (2012). Exercise, physical activity, and self-determination theory: A systematic review. *International Journal of Behavioral Nutrition and Physical Activity*, *9*(1), 78. https://doi.org/10.1186/1479-5868-9-78

Thabane, L., Hopewell, S., Lancaster, G. A., Bond, C. M., Coleman, C. L., Campbell, M. J., & Eldridge, S. M. (2016). Methods and processes for development of a CONSORT extension for reporting pilot randomized controlled trials. *Pilot and Feasibility Studies*, *2*, 25. https://doi.org/10.1186/s40814-016-0065-z

Tremblay, M. S., Warburton, D. E. R., Janssen, I., Paterson, D. H., Latimer, A. E., Rhodes, R. E., Kho, M. E., Hicks, A., LeBlanc, A. G., Zehr, L., Murumets, K., & Duggan, M. (2011). New Canadian Physical Activity Guidelines. *Applied Physiology, Nutrition, and Metabolism*, *36*(1), 36–46. https://doi.org/10.1139/H11-009

Tudor-Locke, C., Bassett, D. R., Swartz, A. M., Strath, S. J., Parr, B. B., Reis, J. P., DuBose, K. D., & Ainsworth, B. E. (2004). A Preliminary study of one year of pedometer self-monitoring. *Annals of Behavioral Medicine*, *28*(3), 158–162. https://doi.org/10.1207/s15324796abm2803_3

Turner-McGrievy, G. M., Beets, M. W., Moore, J. B., Kaczynski, A. T., Barr-Anderson, D. J., & Tate, D. F. (2013). Comparison of traditional versus mobile app self-monitoring of physical activity and dietary intake among overweight adults participating in an mHealth weight loss program. *Journal of the American Medical Informatics Association*, *20*(3), 513–518. https://doi.org/10.1136/amiajnl-2012-001510

Tuso, P. (2015). Strategies to Increase Physical Activity. *The Permanente Journal*, *19*(4), 84–88. https://doi.org/10.7812/TPP/14-242

Vallerand, J. R., Rhodes, R. E., Walker, G. J., & Courneya, K. S. (2016). Explaining the Aerobic Exercise Intention-behavior Gap in Cancer Survivors. *American Journal of*

Health Behavior, *40*(5), 675–684. https://doi.org/10.5993/AJHB.40.5.15

Vallerand, J. R., Rhodes, R. E., Walker, G. J., & Courneya, K. S. (2017). Correlates of meeting the combined and independent aerobic and strength exercise guidelines in hematologic cancer survivors. *International Journal of Behavioral Nutrition and Physical Activity*, *14*(1), 44. https://doi.org/10.1186/s12966-017-0498-7

Ventura, H. O., & Lavie, C. J. (2016). Impact of comorbidities in hypertension. *Current Opinion in Cardiology*, *31*(4), 374–375. https://doi.org/10.1097/HCO.0000000000000302

Vo, V., Auroy, L., & Sarradon-Eck, A. (2019). Patients' Perceptions of mHealth Apps: Meta-Ethnographic Review of Qualitative Studies. *JMIR MHealth and UHealth*, *7*(7), e13817. https://doi.org/10.2196/13817

Walters, S. J., Bonacho dos Anjos Henriques-Cadby, I., Bortolami, O., Flight, L., Hind, D., Jacques, R. M., Knox, C., Nadin, B., Rothwell, J., Surtees, M., & Julious, S. A. (2017). Recruitment and retention of participants in randomised controlled trials: a review of trials funded and published by the United Kingdom Health Technology Assessment Programme. *BMJ Open*, *7*(3), e015276. https://doi.org/10.1136/bmjopen-2016-015276

Webb, T. L., Joseph, J., Yardley, L., & Michie, S. (2010). Using the Internet to Promote Health Behavior Change: A Systematic Review and Meta-analysis of the Impact of Theoretical Basis, Use of Behavior Change Techniques, and Mode of Delivery on Efficacy. *Journal of Medical Internet Research*, *12*(1), e4. https://doi.org/10.2196/jmir.1376

Whelton, P. K., Carey, R. M., Aronow, W. S., Casey, D. E., Collins, K. J., Dennison

Himmelfarb, C., DePalma, S. M., Gidding, S., Jamerson, K. A., Jones, D. W., MacLaughlin, E. J., Muntner, P., Ovbiagele, B., Smith, S. C., Spencer, C. C., Stafford, R. S., Taler, S. J., Thomas, R. J., Williams, K. A., … Wright, J. T. (2018). 2017 ACC/AHA/AAPA/ABC/ACPM/AGS/APhA/ASH/ASPC/NMA/PCNA Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Pr. *Hypertension*, *71*(6). https://doi.org/10.1161/HYP.0000000000000065

Wilson, P.M., Rodgers, W.M., Loitz, C.C., & Scime, G. (2006). "It's who I am…really!" The importance of integrated regulation in exercise contexts. *Journal of Biobehavioral Research*, *11*, 79–104.

Wilson, D. K., Sweeney, A. M., Law, L. H., Kitzman-Ulrich, H., & Resnicow, K. (2019). Web-Based Program Exposure and Retention in the Families Improving Together for Weight Loss Trial. *Annals of Behavioral Medicine*, *53*(4), 399–404. https://doi.org/10.1093/abm/kay047

World Health Organization. (2009). *WHO Guidelines on Hand Hygiene in Health Care: First Global Patient Safety Challenge Clean Care Is Safer Care*.

Wu, S., Cohen, D., Shi, Y., Pearson, M., & Sturm, R. (2011). Economic Analysis of Physical Activity Interventions. *American Journal of Preventive Medicine*, *40*(2), 149–158. https://doi.org/10.1016/j.amepre.2010.10.029

Wulfovich, S., Fiordelli, M., Rivas, H., Concepcion, W., & Wac, K. (2019). "I Must Try Harder": Design Implications for Mobile Apps and Wearables Contributing to Self-Efficacy of Patients With Chronic Conditions. *Frontiers in Psychology*, *10*(OCT),

1–12. https://doi.org/10.3389/fpsyg.2019.02388

Zeelenberg, M., & Pieters, R. (2004). Consequences of regret aversion in real life: The case of the Dutch postcode lottery. *Organizational Behavior and Human Decision Processes*, *93*(2), 155–168. https://doi.org/10.1016/j.obhdp.2003.10.001

Zhao, J., Freeman, B., & Li, M. (2016). Can Mobile Phone Apps Influence People's Health Behavior Change? An Evidence Review. *Journal of Medical Internet Research*, *18*(11), e287. https://doi.org/10.2196/jmir.5692

Zhou, L., Bao, J., Setiawan, I. M. A., Saptono, A., & Parmanto, B. (2019). The mHealth App Usability Questionnaire (MAUQ): Development and Validation Study. *JMIR MHealth and UHealth*, *7*(4), e11500. https://doi.org/10.2196/11500

Appendix A

Scripts for Meetings with Participants

E-Mail Response for Interested Individual

Hi there,

Thank you for your interest in the Financial Incentives for Physical Activity and Heart Health study at the University of Victoria. Included in this email is:

1. Background information about this study.
2. Inclusion and exclusion criteria.
3. A consent form should you choose that you are eligible and would like to proceed to the next steps upon signing.

If you have any questions, please feel free to email us at any time prior to completing any of the above-mentioned items.

Healthy blood pressure is less than 120/80mmHg. When our blood pressure is higher than this, but not yet as serious as hypertension, we recognize this to be "above optimal blood pressure." Above optimal blood pressure can lead to serious heart conditions, like hypertension and cardiovascular disease. Adjusting your lifestyle, including increasing your physical activity levels, can provide benefits to your blood pressure before developing serious conditions. This 8-week study aims to improve your physical activity to improve your health.

If you consent and are eligible to participate in this research, you will be randomized to one of three groups:

1. Pay-per-minute financial incentive group
    a. Earn money for every minute of at least moderate activity that you do each week, up to 150 minutes of moderate-to-vigorous physical activity
2. Social impact bond financial incentive group
    a. Earn a percentage of money based on how many weeks you meet your activity goals in the 8-week intervention
3. Control group
    a. No financial incentive given

Participants in all three groups will receive a Fitbit through the mail. You are encouraged to use your own Smartphone if you have one, but if not, we will mail a Smartphone for you to use for the duration of this study.
Both financial incentive groups (groups 1 and 2) will receive an incentive for meeting their physical activity goals. Additionally, these financial incentive groups will download a free mobile education app that covers topics about physical activity and heart health. The control group will not receive an incentive and be given a link to the Canadian Hypertension Education Program to improve their knowledge around heart health.

Inclusion Criteria:

- Adults aged 40-65 in British Columbia
- Not meeting Canadian Physical Activity Guidelines of 150 minutes moderate-to-vigorous physical activity
- English literate
- Normal to corrected normal vision

Exclusion Criteria:
- Diagnosis of diabetes
- Other heart conditions
- Other mobility restrictions

Attached is a consent form with more information about the study. If you believe you are eligible and would like to progress forward with this study, please return your signed consent form at your soonest convenience.
With your signed consent form, can you please include your **telephone number** so we can reach you for further eligibility testing.

Thank you again for your interest in this study. We look forward to hearing from you soon.

_____
School of Exercise Science, Physical and Health Education
University of Victoria, McKinnon Building 0026
Email: digitalhealth@uvic.ca; Tel: 250-721-8392

Eligibility Testing Script

Participant # _____ Date _____ RA _____

Hi, my name is _____and I'd like to thank you for your interest in the Financial Incentives for Physical Activity and Heart Health study. I have some information to share about the program and an eligibility process to walk through.

1) First, it's important for me to tell you that this program is for adults aged 40-65 who are currently getting less than 150 minutes of physical activity per week.
2) I also would like to go over what was outlined in the email response you received from us prior to this phone call. This is an eight-week study focussed on increasing your current physical activity levels in order to improve your heart health. You will randomly be put into one of three groups: either the pay-per-minute financial incentive group, the social impact bond group, or a control group. Do you have any further questions about these groups?
3) We will mail you a Fitbit that you will wear for the duration of the intervention. One week before the intervention starts, we want you to wear the Fitbit every day to get comfortable with using the device and charging it. That way, you'll be comfortable, and we will collect as accurate physical activity information from you as possible during the eight-week intervention.

4) If you're in one of the financial incentive groups, you will also be required to download an app that contains an eight-week education program surrounding physical activity and heart health
5) If this still interests you, I have a list of eligibility questions that I will ask you now, please answer truthfully.
    a) Have you experienced any of the following in the past 6 months?
        i) A diagnosis of or treatment for heart disease or stroke? Or any pain, discomfort, or pressure in your chest during activities of daily living or physical activity?
        ii) A diagnosis of or treatment for high blood pressure, or a resting blood pressure of 160/90mmHg or higher?
        iii) Dizziness or light-headedness during physical activity?
        iv) Shortness of breath at rest?
        v) Loss of consciousness or fainting for any reason?
        vi) A concussion?
    b) Do you currently have pain or swelling in any part of your body that affects your ability to be physically active?
    c) Has a healthcare provider told you that you should avoid or modify certain types of physical activity?
    d) Do you have any other medical or physical condition that may affect your ability to be physically active?

Prompts if needed for d:

	Diabetes
	Cancer
	Osteoporosis
	Asthma
	Spinal cord injury
	Amputation
	Other, please specify

If no to all:

Thank you for answering those questions. Do you have any questions so far before I ask a few more questions about your physical activity?

Great, now I just have two questions to assess your current physical activity levels.

1. During a typical week for you, on how many **days** do you do moderate-to-vigorous aerobic physical activity such as brisk walking, cycling, or jogging? _____ days/ week
2. On days that you do at least moderate-intensity aerobic physical activity, like brisk walking, for how many minutes do you do this activity? _____ mins/ day

CONTINUE TO ELIGIBLE NEXT STEPS

If yes to any questions in "a":

If yes to "i":

Since you said yes to having (1 or 2 below),

1. diagnosis of or treatment for heart disease or stroke
2. Pain, discomfort, or pressure in your chest during activities of daily living or physical activity

1→ I want you to know that physical activity is likely to be beneficial. If you have been treated for heart disease but have not completed a cardiac rehabilitation program within the past 6 months, consult a doctor – a supervised cardiac rehabilitation program is strongly recommended.

2→ I want you to know that physical activity is likely to be beneficial. If you are resuming physical activity after more than 6 months of inactivity, begin slowly with light- to moderate-intensity physical activity. If you have pain/discomfort/pressure in your chest and it is new for you, talk to a doctor. Describe the symptom and what activities bring it on.

CONTINUE TO NON-ELIGIBLE NEXT STEPS

If yes to "ii":

Since you said yes to (1 or 2 below),

1. A diagnosis or treatment for high blood pressure
2. Having a resting blood pressure of 160/90mmHg or higher

1→ I want you to know that physical activity is likely to be beneficial if you have been treated for high blood pressure. If you are unsure of your resting BP, consult a health care provider or a Qualified Exercise Professional to have it measured. If you are taking blood pressure medication and your blood pressure is under good control, regular physical activity is recommended as it may help to lower your BP. Your doctor should be aware of your physical activity level so your medication needs can be monitored

2→ I want you to know that physical activity is likely to be beneficial if you have been treated for high blood pressure. If your BP is 160/90 or higher, you should receive medical clearance and consult a Qualified Exercise Professional about safe and appropriate physical activity.

CONTINUE TO NON-ELIGIBLE NEXT STEPS

If yes to "iii":

Since you said yes to dizziness or light-headedness during physical activity, there are several possible reasons for feeling this way and many are not worrisome. Before becoming more active, consult a health care provider to identify reasons and minimize risk. Until then, refrain from increasing the intensity of your physical activity.

CONTINUE TO NON-ELIGIBLE NEXT STEPS

If yes to "iv":

Since you said yes to being short of breath at rest and this is because you're diagnosed with asthma that is relieved with medication, light-to-moderate physical activity is safe. If your shortness of breath is not relieved with medications, please consult a doctor.

CONTINUE TO NON-ELIGIBLE NEXT STEPS

If yes to "v":

Since you said you've been experiencing unexplained loss of consciousness/ fainting, I would like you to consult a doctor before becoming more active to identify the reason behind this and minimize any risks associated. Once you are medically cleared, consult a Qualified Exercise Professional about types of activity suitable for your condition!

CONTINUE TO NON-ELIGIBLE NEXT STEPS

If yes to "vi":

Since you said yes to having a concussion in the past 6 months, it is important to recognize that a concussion is an injury to the brain that takes time to recover. Increasing physical activity while still experiencing symptoms may worsen your symptoms, lengthen your recovery, and increase your risk for another concussion. A healthcare provider will let you know when you can start becoming more physically active, and a Qualified Exercise Professional can help get you started.

CONTINUE TO NON-ELIGIBLE NEXT STEPS

If yes to any questions in "b":

You mentioned that you have experienced pain OR swelling in any part of your body that affects your ability to be active.

1→If this swelling or pain is new, consult a health care provider.

CONTINUE TO NON-ELIGIBLE NEXT STEPS

2→ To keep joints healthy and reduce pain by moving your joints slowly and gently through the entire pain-free range of motion. If you have hip, knee or ankle pain, choose low-impact activities such as swimming or cycling. As the pain subsides, gradually resume your normal physical activities starting at a level lower than before the flare-up.

CONTINUE TO ELIGIBLE NEXT STEPS

If yes to any questions in "c":

You mentioned that your healthcare provider has told you that you should avoid or modify certain types of physical activity.

Listen to the advice of your healthcare provider. Please note that there is low risk for this study and low-risk activities, such as walking, are encouraged. If you are not comfortable with starting:

CONTINUE TO NON-ELIGIBLE NEXT STEPS

Listen to the advice of your healthcare provider. Please note that there is low risk for this study and low-risk activities, such as walking, are encouraged. If you are comfortable with starting this program,

CONTINUE TO ELIGIBLE NEXT STEPS

If yes to any questions in "d":

You mentioned that you have _____ (insert condition). Unfortunately, that is an exclusion criterion for this study, and you will not be able to participate.

CONTINUE TO NON-ELIGIBLE NEXT STEPS

ELIGIBLE NEXT STEPS

Thank you for taking the time to answer these questions. I have noted all of your answers down and will email you a copy of your answers for your record. I do ask that you sign and date where you're asked to do so and email a copy back to me. The next step from here is to collect some information from you prior to mailing your Fitbit.

Participant Information			
First Name		Last Name	
Date of Birth		Gender (M/F)	
Communication Preference: Telephone // Email // Zoom (1)			
Home Phone		Cell Phone	
Preferred method of communication indicated with *			
Email Address			
Address Line 1		Address Line 2	
City		Postal Code	
Province		Country	
Access to smartphone? (Y/N)			

If participant does not have access to Smartphone, this will be mailed with Fitbit.

(1) If Zoom is preferred:
When meeting on Zoom we will use the UVic-licensed Zoom service. You will also be able to protect identity by using a nickname or a substitute name while entering the Zoom chat and you don't need to have your camera on.

(2) If you do not know your most-recent blood pressure measurement, are you comfortable going to your local grocery store or pharmacy to obtain a reading?
   a. If yes→ collect results
   b. If no→ leave blank

SAFETY BRIEFING

Before we let you go, we would like to re-iterate some safety components in participating in this study. This is a physical activity study where we are strongly encouraging you to increase your activity. Taking rests when you desire and keeping a water bottle nearby

are highly recommended. You may also want to keep a granola bar or a different form of "quick sugar" snack nearby. You may experience minor discomfort or shortness of breath. If you feel any pain during your activity, please stop what you're doing. If this pain or any shortness of breath doesn't go back to normal in about 10 minutes, please contact your doctor immediately. We will also include a list of community resources for your reference. Please contact your doctor prior to participation if you are concerned about any discomfort or problems that may arise while doing physical activity in this intervention.

Thank you again for your time, we will be following up with you via _____ (preferred method) when your Fitbit (and smartphone) arrives. Do you have any questions?

NON-ELIGIBLE NEXT STEPS

Thank you so much for taking your time and reaching out to learn more about this study. Unfortunately, based on the information we've gathered today it is not safe to progress forward with you starting a physical activity intervention. If starting physical activity soon is important to you, I strongly encourage you to reach out to your healthcare provider in order to gain a safe direction for beginning physical activity. Thank you!

** Those who are not eligible to participate in the study will have their records destroyed at this time. **

Email After Eligibility Meeting, Before Baseline Meeting

Good morning,

Thank you so much for meeting with me yesterday to confirm your eligibility and hear a bit more about this 8-week study! Attached is a copy of the Get Active Questionnaire that we completed during our meeting for your records.

The next steps are as follows:

1. Sign your consent form. In this form is an explanation of study details, a safety briefing, and further information. Do not hesitate to send an email if any questions arise.
2. Receive your Fitbit. I will be mailing this out from Amazon shortly. You are welcome to wear it as soon as it arrives, however I will inform you when "baseline" week starts. You will also receive login credentials from me closer to the start date.
3. Record your blood pressure. Please obtain a blood pressure measurement prior to our baseline meeting.

Here are some reminders for taking your blood pressure as recommended by Hypertension Canada:

- **Do not smoke or drink caffeine 30 minutes** before you plan to take your blood pressure.

- **Rest** quietly for 5 minutes before starting.
- Sit with your **feet flat on the floor**, with your back and arm supported. Keep your **arm at heart level**.
- Apply the blood pressure cuff on a **bare arm.**
- Try **not to speak** while taking your measurement.

Here is our Zoom meeting link for our next meeting:

Please let me know if you have any questions!

Amanda

Zoom/ Telephone Meeting at Baseline

Good morning/ afternoon _____,

You should soon be receiving your Fitbit (and smartphone, if necessary). We're going to take about 10 minutes right now to fill out a motivation survey. I have the questions in front of me on SurveyMonkey and I will be filling out your answers on this platform. Thank you so much for your time today, I will be following up with you via email and include instructions to your Fitbit Inspire (and Pathverse instructions if in financial incentive group).

[INFORM OF STUDY GROUP ALLOCATION]

If you have any questions, please do not hesitate to reach out to us at the email we've been contacting you from, that's digitalhealth@uvic.ca! Do you have any questions at the time?

Email After Baseline Meeting

PAY-PER MINUTE FINANCIAL INCENTIVE GROUP

Hello!

Thank you so much for meeting for your baseline meeting today.

This is going to be a little bit of a lengthy email and will need a few things signed and returned from you when you have a chance!

1. Your Fitbit!

I am hoping it will get to you by <DATE>

Setting up your Fitbit:

Please download the Fitbit app onto your Smartphone. Once downloaded, please follow the instructions in the following link to connect your Fitbit to your phone: https://help.fitbit.com/articles/en_US/Help_article/1873.htm. Once you click the link, expand the "Trackers and watches" section, and then expand the "Fitbit app" section.

Login info:
Email:
Password:

When opening the app, you'll notice it says "Join Fitbit" and "Login". Please select login and type in the email and password above. When you go to set up your device, the name of the Fitbit is Fitbit Inspire 2 (there should be some details in the box!)

Your Profile: I have set the account to have your name, but used a random birthday, height, and weight. You are welcome to edit those details, however it will not impact your results in this study.

You are welcome to customize the features on your Fitbit dashboard. Currently it is set to only show exercise.

2. Pathverse

Pathverse is the name of the app that has the education program for the duration of the intervention. You are welcome to download the app now, however, you will not be enrolled in the program until <DATE>.

I have attached a user manual for using the app, Pathverse, so you can familiarize yourself with the app and refer back to the app at any time while using it.

3. Pay-Per-Minute

This begins [DATE]. Use the baseline week (May 3-9) to get an understanding of how much activity you're accumulating so you have a guide of how much activity you need to add on a weekly basis to maximize your earnings!

4. Important Dates

You will also find a PDF document of important dates throughout this program to refer to. Of course you can email me at any time if you have any questions!

5. Consent

I have also attached one more consent form for the Pathverse app. Can you please sign and return this at your soonest convenience!

Please let me know if I can help at all when your Fitbit arrives!

SOCIAL IMPACT BOND FINANCIAL INCENTIVE GROUP

Hello!

Thank you so much for meeting for your baseline meeting today.

This is going to be a little bit of a lengthy email and will need another signature from you when you have a chance!

1. Your Fitbit!

I am hoping it will get to you by <DATE>

Setting up your Fitbit:

Please download the Fitbit app onto your Smartphone. Once downloaded, please follow the instructions in the following link to connect your Fitbit to your phone: https://help.fitbit.com/articles/en_US/Help_article/1873.htm. Once you click the link, expand the "Trackers and watches" section and then expand the "Fitbit app" section.

Login info:
Email:
Password:

When opening the app, you'll notice it says "Join Fitbit" and "Log In". Please select log in and type in the email and password above. When you go to set up your device, the name of the Fitbit is Fitbit Inspire 2 (there should be some details in the box!)

Your Profile: I have set the account to have your name, but used a random birthday, height, and weight. You are welcome to edit those details, however it will not impact your results in this study.

You are welcome to customize the features on your Fitbit dashboard. Currently it is set to only show exercise.

2. Pathverse

Pathverse is the name of the app that has the education program for the duration of the intervention. You are welcome to download the app now, however, you will not be enrolled in the program until <DATE>.

I have attached a user manual for using the app, Pathverse, so you can familiarize yourself with the app and refer back to the app at any time while using it.

3. Social Impact Bond

In an attempt to make our mock Social Impact Bond as realistic as possible, an official contract has been included in this email. It outlines in detail a bit more of what a Social Impact Bond is and the terms of our agreement.

4. Important Dates

You will also find a PDF document of important dates throughout this program to refer to. Of course you can email me at any time if you have any questions!

5. Consent

I have also attached one more consent form for the Pathverse app. Can you please sign and return this at your soonest convenience!

Please let me know if I can help at all when your Fitbit arrives!

CONTROL GROUP

Hi,

Thank you again for meeting with me today!

Here is some more information about your Fitbit:

Please download the Fitbit app onto your Smartphone. Once downloaded, please follow the instructions in the following link to connect your Fitbit to your phone: https://help.fitbit.com/articles/en_US/Help_article/1873.htm. Once you click the link, expand the "Trackers and watches" section and then expand the "Fitbit app" section.

Login info:
Email:
Password:

When opening the app, you'll notice it says "Join Fitbit" and "Login". Please select login and type in the email and password above. When you go to set up your device, the name of the Fitbit is Fitbit Inspire 2 (there should be some details in the box!)

Your Profile: I have set the account to have your name, but used a random birthday, height, and weight. You are welcome to edit those details, however it will not impact your results in this study.

You are welcome to customize the features on your Fitbit dashboard. Currently it is set to only show exercise.

Important dates for you to note:

Baseline Week: <DATES>. Please have your Fitbit ready to go for this week!

Program Start Date: <DATE>. You will hear from me weekly at this point with a progress update, and tips and tricks to include more physical activity into your days!

Program End Date: <DATE>

Next steps: After the program ends, I will be in contact with you to set up a follow-up meeting and collect the Fitbit from you.

Please let me know if I can help you with any Fitbit set up!

Email For Follow-Up

Hello!

Congratulations! You made it through the 8-week Healthy Hearts program! The next steps are to set up a follow-up meeting (15-30 minutes in length) with me through Zoom and mail the Fitbit back! You will be reimbursed for the mailing fee (please send me a picture of your receipt!), for your earnings during the 8-week program, and for your time during the follow-up meeting. Please let me know your availability for the upcoming weeks and we can set up a time for this meeting.

Follow-Up Meeting Script

Good morning/ afternoon _____,

We're going to take about 10 minutes right now to fill out a motivation survey. I have the questions in front of me on SurveyMonkey and I will be filling out your answers on this platform.

Thank you! Were you able to get a blood pressure measurement?

FINANCIAL INCENTIVE GROUP:

I now have some questions about the Pathverse app that I would like to get your feedback on. We will be audio recording your answers for further clarity if necessary.

1) What do you feel are the benefits of using the app?
   Probe: Was it enjoyable to use?

Probe: What would have made it more enjoyable?

2) What do you perceive as barriers to using the game app?
Probe: What didn't you like?
Probe: What would have made you use it more?

3) Do you think that the game bike/stationary bike is a valuable piece of exercise tool?

4). Can you tell me what you liked best about the application?

Probes: *information, layout, animations, graphics, video clips, discussion board etc. Can you tell more about that?*

5. Can you tell me what you liked least about the application?

Probes: *information, layout, animations, graphics, video clips, discussion board etc. Can you tell more about that?*

6. Can you tell me about how easy it was to navigate or our find your way around the application?

Probes: *What were the challenges of navigating through the site? What would make it easier to navigate through the site?*

7. Can you tell me about what you thought about the overall look of the application?

Probes: *For example, the design, colours, and images on the web-site. Does the website feed warm and friendly or cold and technical? Can you tell me more about that? Do you think it is visually appealing? What would make the web-site more appealing?*

8) Is there anything else that you would like to add that you feel we have missed?

Thank you so much for your time and feedback! If you haven't already, please mail your Fitbit (and smartphone).

Appendix B

Pathverse Education Content

Note. Table flow reads from left to right

Baseline Week Lesson

Lesson 1: Program Introduction

Check-In Question: Are you ready to get started?
Tags: Introduction, Preface
Description: An introduction to what this 8-week heart health program will look like!

Welcome to the Program! Congratulations on taking another step towards a healthy lifestyle! We couldn't be more excited to help you start making changes in your life as you begin to gain better control of your heart health with physical activity!	**Lesson Objective** This lesson will introduce you to using physical activity to improve your heart health and will set the stage for the rest of the program.	**Hello!** My name is Amanda. I created this program and I'll be cheering you on throughout your journey.
Earning Money By this point we have been in contact about how you'll be earning money throughout this program. How much you earn is in your control!	**The Incentive** You will be rewarded for the number of MINUTES of activity you reach each week, to a maximum of 150 minutes. You'll soon learn why we picked 150 minutes!	**Program Overview** Each of the eight weeks will have a theme and you will have three lessons within each week. When you take time to do these lessons, try to make sure you have about 10 minutes to complete some activity!
Weeks 1-8 Introduction Reaching Your Goals Progressing Physical Activity Your Emotions and Physical Activity	**PA History Survey** Q1: Does your job involve any activity that gets your heart rate up? a. Often b. Sometimes c. Rarely	**Physical Activity** The Canadian Society for Exercise Physiology (CSEP) recommends 150 minutes of moderate-to-vigorous physical activity

Your Support System and Physical Activity Your Environment and Physical Activity Slippery Slope and Lifestyle Change Staying Motivated	d. Never Q2: What is your main form of transportation? a. Biking b. Walking c. Vehicle d. Other Q3: On a typical week, how many days oof the week doo you intentionally do activities that raise your heart rate? (1-7)	per week for adults aged 18-64.
Don't Worry! This number may seem intimidating but can be slowly accumulated in bouts as short as 10 minutes! Let's focus on adding 10 more minutes from this week to next and work up from there! Do you have time for one quick 10 minute walk this week?	**This Lesson** We hope this lesson helped explain what this program looks like for the next 8 weeks.	**Before Next Lesson** Once you complete this lesson, add a goal to the Goal Setting page. This goal can be as simple as "complete a 10 minute walk this week!" Then, get your heart rate up! Complete at least one activity before your next lesson- all it takes is 10 minutes!
Next Lesson We will dive into the benefits of physical activity as you age!		

Week 1

Lesson 2: Getting Started!

Check-In Question: Are you ready to learn about physical activity and your heart?
Tags: Week 1, Lesson 1, 5 mins
Description: This lesson will introduce you to the connection between physical activity and your heart health.

Welcome Back!	**Today's Objective**	**Just the Beginning**
Thanks for coming back to dive into your next lesson!	Today we will learn about how you can be in control of	Now your hard work will start to matter, and you'll

We hope that you have set an activity goal for yourself and have moved for at least 10 minutes since your last lesson!	your heart health by implementing a physical activity routine.	earn money for reaching your goals! Try to reach your goals every week in order to meet the Canadian Physical Activity Guidelines of 150 minutes of moderate-to-vigorous physical activity per week!
Fitbit As you maintain your activity, your Fitbit will track the steps you take and your heart rate data so you can see how intense your activity is. Make sure you're syncing your Fitbit to have the most up-to-date information!	**Defining Aerobic Activity** We refer to the activity that gets your breathing and heart rate up as aerobic activity. This activity counts towards your moderate-to-vigorous physical activity minutes and includes brisk walking, biking, swimming, or even gardening!	**In the past 7 days…** Q1: Have you gone for a 10+ minute walk or hike in the past 7 days? Yes/No Q2: Have you gone for a 10+ minute bike in the past 7 days? Yes/No Q3: Have you done an activity around your home, like gardening or heavy lifting, where you noticed an increase in your heart rate in the past 7 days? Yes/No Q4: If you did a different aerobic activity not mentioned, please list it below <Text box>
Activity and Blood Pressure As you complete physical activity more regularly, your heart becomes stronger. With a stronger heart, you can pump more blood through your body with less effort. If your heart can work less to pump, the force on your arteries decreases, lowering your blood pressure.	**Activity and Blood Pressure** It is recommended that completing 30-60 minutes of aerobic physical activity on 4-7 days a week can decrease total blood pressure by 4-10 mmHg. That's as good as some blood pressure medications!	**Wait, what was that measurement?** "mmHg" is the unit of pressure that we measure blood pressure in. It is an abbreviation for "millimetres of mercury" and blood pressure readings are always given in pairs. For instance, optimal blood pressure is 120/80 mmHg, which we would say as "120 over 80".
Fun Fact!	**This Lesson**	**Before Next Lesson**

Did you know your blood pressure can be lowered for up to 8 hours following a single session of exercise? This is known as post-exercise hypotension.	We hope this lesson began to introduce you to how you can use physical activity to improve your heart health. We learned about a few new terms, like “mmHg” and “post-exercise hypotension” that may come up again in the future!	Head over to the Goal Setting page and add a goal or two for the week. Keep it simple for now! Then, get your heart rate up! Complete at least one activity before your next lesson—all it takes is 10 minutes!
Next Lesson We will further discuss the benefits of physical activity and dive into tips to help you find time to move!		

Lesson 3: Finding Time to Move

Check-In Question: Have you set a goal for yourself this week on the Goal Setting page?
Tags: Week 1, Lesson 2, 8 mins
Description: Let’s talk about finding time to reach your goals!

Welcome Back!	**Lesson Objective**	**But First…**
Today we’re going to discuss the steps you will take to reach your maximum potential!	Today looks to reflect on your own activity levels and give you some tips to help you make time for enough activity to meet Canada’s guidelines!	Let’s test your memory. Here are four questions based off content from our first lesson. Let’s see how you do!
What is the recommended number of minutes per week of moderate-to-vigorous physical activity? 1. 75 mins/ week 2. 100 mins/ week 3. 150 mins/ week 200 mins/ week	150 minutes of moderate-to-vigorous physical activity is recommended by the Canadian Society of Exercise Physiology (CSEP)! Swipe LEFT to CONTINUE!	How many “bout minutes” of physical activity are necessary to start seeing positive health changes? 1. 5 minutes 2. 10 minutes 3. 15 minutes 4. 30 minutes
It is recommended to accumulate activity in AT LEAST 10-minute bouts! Swipe LEFT to CONTINUE!	Completing aerobic activity for 30-60 minutes on 4-7 days of the week can decrease your total	Completing 30-60 minutes of aerobic activity, like jogging, swimming or biking, on 4-7 days per week can decrease your

	blood pressure by what amount? 1. 0mmHg (no change) 2. 4-10mmHg 3. 10-14mmHg 4. 15-30mmHg	total blood pressure by 4-10mmHg! Swipe LEFT to CONTINUE!
Post-exercise _____ is the phenomenon where your blood pressure is lower for up to 8 hours after exercise. 1. Hypertension 2. Cardiosmosis 3. Warfarin 4. Hypotension	Post-exercise hypotension is the physiological phenomenon where your blood pressure can be lower for up to 8 HOURS after exercise! Crazy, right?! Swipe LEFT to CONTINUE!	**Congratulations!** You've finished the quiz for the day. I hope you were able to recall what we touched on earlier this week! When in doubt: 150 minutes of moderate-to-vigorous physical activity!
Let's reflect! Fill out the next couple pages with the activity you did yesterday. This will be helpful in the future!	About how many active minutes did you achieve yesterday?	What activities did you do to get to that number?
Was there anything preventing you from being more active?	**Bit by Bit** We want you to reach your FULL potential. But this isn't going to happen overnight. Let's talk about how we can reach your goals by starting small and working up to your bigger goals.	**Becoming your best self!** Physical activity has many proven benefits like reducing your risk of cardiovascular disease, hypertension, type 2 diabetes, osteoporosis, obesity, and different types of cancers! It is important to remember that at any age, physical activity is good for you, and being sedentary is far more dangerous!
Meeting the Guidelines It's okay to feel intimidated by 150 minutes of moderate-to-vigorous physical activity. We will	**"But I have no time!"** Here are some tips to get you up and moving a few more times in a day!	**Tip #1** Every hour, get up for a few minutes (your Fitbit can help you with this reminder!)

guide you how to get there. Don't sweat it! Think of the activity you completed yesterday again. Do you think you can add an extra 10 minutes to that activity?		
Tip #2 Listen to some music! A 10 minute walk is about 3 songs, so pick 3 of your favourites and groove out.	**Tip #3** Drink more water! This will lead to more bathroom breaks, and therefore (you guessed it) more movement!	**This Lesson** We hope this lesson has equipped you with a few tips to find ways to move more and has given you a better understanding of the benefits of physical activity.
Before Next Lesson Get your heart rate up! Complete at least one activity before your next lesson- all it takes is 10 minutes! Every moderate-to-vigorous activity minute is one step closer to reaching your goals and earning you money.	**Next Lesson** We will discuss the opportunities for physical activity around us and some helpful resources!	

Lesson 4: Opportunities for Activity

Check-In Question: Last lesson of the week. Are you ready?
Tags: Week 1, Lesson 3, 6 mins
Description: "In the middle of difficulty lies opportunity." - Albert Einstein

Welcome Back!	**Today**	**Benefits of Physical Activity**
Previously we talked about ways to slowly add more physical activity into your day-to-day life. We hope you're feeling more confident with slowly	Today we will further discuss some benefits of physical activity and then learn how to take advantage of activity opportunities around us!	We have specifically talked about the benefits of physical activity relating to heart health and the prevention of chronic diseases.

working small changes into your lifestyle.		
Benefits of Physical Activity II This list of benefits expands beyond disease prevention and includes benefits like improved posture, strengthening your bones and muscles, improving your overall quality of life and SO many other factors! https://www.cdc.gov/physicalactivity/basics/adults/pdfs/Health_Benefits_PA_Adults_Jan2021_H.pdf	**Opportunity** There are so many opportunities around us that allow us to be active and explore our environments… Sometimes we just need a push to expand our horizons.	**Opportunity II** How lucky are we that we get to live in such a beautiful province? Our year-round mild climate allows for plenty of outdoor time. (Occasionally recommended with an umbrella).
Opportunity III Sometimes you can get so lost in your own routine that you can forget about beautiful trails close by! Think of a nearby trail you can visit. It doesn't have to be a large endeavour. Even a walk through the neighbourhood can be refreshing!	**There's an app for that!** If you're stumped on what to do, there are a variety of apps, websites, and Facebook groups that show trails near you! Download an app like AllTrails, or Hiking Project.	**In case you're wondering…** How can you really take advantage of your environment?
Think of it like this If you want to get work done, minimize distractions around you. If you want to eat healthy, fill your home with nutritious foods.	**If you want to exercise…** … Wear something comfy, including clothes AND shoes. … Prioritize that goal! … Do an activity you enjoy!	We will start next week off with proper goal setting and learning about what you enjoy. Enjoy the rest of your week and we'll see you next week!
This Lesson To summarize, we learned about opportunities around us and some tips to get active. You can access apps like	**Before Next Lesson** It's almost the end of the week. Have you added an extra 10 minute activity into	**Next Lesson** Next week's lessons are focussed on setting you up for success to reach your physical activity goals.

AllTrails or Hiking Project for more inspiration around you!	your week yet? Get out there after this lesson if not!	We'll see you next week for 3 more lessons!

Week 2

Lesson 5: Setting SMART Goals

Check-In Question: Are you ready to learn about SMART goals?
Tags: Week 2, Lesson 4, 8 mins
Description: Learn the steps for effective goal setting!

Welcome Back! You are slowly becoming equipped with tools to motivate you to be more and more active. Let's talk about what physical activity means to you.	**Physical Activity and You!** WHERE do you most enjoy being physically active? <Text box>	What are some CONSIDERATIONS important to you in choosing which physical activity you participate in? (I.e., social aspect, alone time, etc.) <Text box>
Awesome! Thank you for reflecting. Remember to keep these reflections in mind as you develop your goals.	**Today** We will start to look at the components in creating sustainable physical activity goals. These components are: Goal Specificity Expectation Management Consistency > Intensity	**Goal Specificity** Announcing that you're finally going to get fit on Facebook isn't specific enough. Just showing up at the gym and doing something isn't enough either. That's where SMART goals come in.
SMART Goals When we think of goal setting, we want to consider making SMART goals. This stands for SPECIFIC, MEASURABLE, ATTAINABLE,	**SPECIFIC** What, where, when, and why? The more specific, the better! Ex: I am going to go for a run (what) in my neighbourhood (where) Tuesday and Thursday evenings at 5:00pm	**MEASURABLE** Use an indicator of progression so that you know when you've reached your goal. Ex: I will write this down on my calendar every time I go for a run. That way, I can refer back to see if I've

RELEVANT and TIME-BASED.	(when) to get my 30 minutes of cardio in for the day (why).	met my goal of 2 runs/ week.
ATTAINABLE Ensure your goal can be realistically achieved. Ex: Instead of telling myself that I will exercise 7x/ week, I will make it my goal to begin with 2x/ week.	**RELVANT** Make the goal meaningful to you. What are you benefiting from achieving this goal? Ex: Running 2x/ week will improve my cardio and prepare me for a 5km fun-run I plan on doing with my kids.	**TIME-BASED** Give yourself enough time to achieve the goal. Ex: I will be able to run 5km in 2 months.
Goal Setting Starting small and working your way up to bigger goals can go a long way. After completing this module, head over to the Goals tab to create your first SMART goal!	**Reference** Feel free to refer back to this lesson at any time if you need assistance with framing your goals!	**Considerations I** When doing activity, including a 10 minute warm up! This increases your heart rate and blood flow to the working muscles. Your warm-up should start slow and easy and work your way up to a moderate pace.
Considerations II Wrap up your activity with a cool down. This can be 5-10 minutes long to reduce your heart rate and stretch out your working muscles. The muscles are warm from exercising, and stretching warm muscles improves flexibility and range of motion by increasing blood flow to the muscles and reducing muscle stiffness and soreness.	**This Lesson** We learned the components of a proper SMART goal and touched on some warm-up and cool down tips!	**Before Next Lesson** Make sure you set your SMART goal before your next lesson is released! Pick an activity you enjoy and would like to incorporate to help you reach the Canadian Physical Activity Guidelines.
Next Lesson		

We will discuss the two other components of sustainable goal setting (Expectation Management and Consistency > Intensity) and tie that into enjoying your activity!		

Lesson 6: Enjoy What You're Doing!

Check-In Question: Have you set your SMART goal yet?
Tags: Week 2, Lesson 5, 10 mins
Description: This lesson is filled with tips to make sure you love what you're doing in order to reach your goals!

So nice to see you again! By now your SMART goal should be set and you should be familiar with how you like to be active!	**Previously** We discussed 3 components in creating sustainable physical activity goals: Goal Specificity Expectation Management Consistency > Intensity	**Today** We will discuss Expectation Management and Consistency > Intensity and discuss tips to help you remain consistent!
Expectation Management I If you set a goal to run a 10 km race under 1 hour by the end of the year, when you've never ran a 10 km race before, you have almost inevitably set yourself up to failure.	**Expectation Management II** Setting lofty goals is great, but they have to be realistic, and in most cases, incremental. A three-setup plan to running a 10 km race would be like this: Step 1: Be able to run 5km. Step 2: Be able to run 10 km non-stop, no time limit. Step 3: Be able to run 10 km under 1 hour. From there, the sky is the limit!	**Consistency > Intensity I** Consider working out like saving for retirement. You won't get there with one paycheck. It takes time, attention, and most importantly, consistency.
Consistency > Intensity II	**Consistency > Intensity III**	**Further Considerations**

The fittest person doesn't train the hardest every time, but they train the most consistent and remain focused.	You don't need to feel like you just went 10 rounds with Mike Tyson to have an effective workout. Just stay the course!	Here are some more considerations to consider in order to ensure that you're enjoying what you're doing!
Tip #1 Exercise at a comfortable intensity, especially at first! Rome wasn't built in a day.	**Tip #2** Listen to music. There are many free music streaming services to find a playlist you enjoy.	**Tip #3** Make physical activity a social event and spend time with friends or family.
Tip #4 Choose to be active outside as much as possible. The fresh air has so many benefits!	**Tip #5** Remember you are in control of the activity you're doing. Make sure you enjoy it and check in with yourself!	**Tip #6** Pair physical activity with other things you enjoy such as gardening, playing a sport, listening to podcasts, or talking with friends.
Think about it… If possible, how can you make the activities you chose to do more enjoyable?	**This Lesson** We wrapped up discussing the three components of sustainable physical activity goal setting and learned and applied tips to stay consistent.	**Before Next Lesson** Get your heart rate up! Complete at least one activity before your next lesson—all it takes is 10 minutes! Every moderate-to-vigorous activity minute is one step closer to reaching your goals and earning you money.
Next Lesson We will begin to learn about the FITT principles to set us up for progressing our activity!		

Lesson 7: FITTing in Activity!

Check-In Question: Are you ready to further improve your goals?
Tags: Week 2, Lesson 6, 8 mins
Description: Let's learn about incorporating the FITT principle into our SMART goals.

Pop Quiz! Did you think you'd get off easy this week without a quiz? Advance forward to answer some questions about what we talked about!	**Question #1** What is NOT a component of SMART goals? Specific Measurable Acute Time-Framed	The "A" in SMART goals typically stands for attainable! Swipe LEFT to CONTINUE!
Question #2 When do we include static stretching when exercising? During warm up During cool down	Dynamic stretching can be done during the warm up, however we encourage static stretching after your activity since your muscles will be warm. Swipe LEFT to CONTINUE!	**Question #3** What is NOT a component of sustainable physical activity goal setting? Goal Specificity Expectation Management Consistency > Intensity None of the above
Goal specificity, expectation management, and consistency > intensity are all components! Swipe LEFT to CONTINUE!	**How did you do?** Feel free to look over any completed modules at any time to refresh yourself on past content we've discussed.	**Today!** Today, we will be learning about the FITT principles. These four principles are what you need to think about when considering physical activity that fits your goals and current fitness level.
FITT The acronym stands for F: Frequency I: Intensity T: Type T: Time	**F: Frequency** This means the number of sessions you will complete per week. This usually depends on your goals, time constraints, and preference for the activity!	**I: Intensity** This refers to how much effort is put into the activity. There are 3 levels of intensity: light, moderate, and vigorous.
I: Intensity A simple way to determine the intensity you're working at is the Talk Test. In general, if you're doing moderate-intensity activity	**T: Type** The type of activity. This is often chosen first, and then you can incorporate the frequency, intensity, and time.	**T: Time** How long the activity is done per session. You may recall, the Canadian Physical Activity Guidelines recommends 150 minutes/ week.

you can talk, but not sing, during the activity. If you're doing vigorous-intensity activity, you will not be able to say more than a few words without pausing for a breath.		
Consider… Consider the SMART goal you made earlier this week. Is it lacking any of the FITT principles? Modify that goal if necessary!	**This Lesson** We learned about Frequency, Intensity, Time, and Type—our FITT principles!	**Before Next Lesson** Make sure you crush your activity goal for this week! Does that mean you need to go for a brisk walk right now? Make sure you set another goal for next week, as well!
Next Lesson We look forward to seeing you next week where we'll begin discussing progressions and habits!		

Lesson 8: Progressing your Activity

Check-In Question: Have you set your activity goal for this week?
Tags: Lesson 7, Week 3, 7 mins
Description: Learn how to safely progress the frequency and intensity of your activities!

Wow! Week 3 Already! You have already learned so much about exercise and goal setting. Let's apply that knowledge as we progress our physical activity!	**But of course,** Before we apply our knowledge, let's see how good your memory is!	**Question #1** The _____ is the number of sessions you will complete per week. Time Type Frequency
The frequency is the number of sessions you will complete per week. Swipe LEFT to CONTINUE!	**Question #2** What does the "I" in the FITT principle stand for?	The "I" stands for intensity, how much effort we put into activity. Swipe LEFT to CONTINUE!

	Intimidate Intensity Individuality	
Question #3 What is NOT a level of activity mentioned last lesson? Low Light Moderate Vigorous	The Canadian Physical Activity Guidelines recognizes light, moderate, and vigorous as the 3 intensity levels. Swipe LEFT to CONTINUE!	**Question #4** Time is one of the T's in the FITT principle. What is the other? Temperature Type Target Team
Type is what the other T stands for in FITT! We usually choose this first and then frame the remaining principles around it! Swipe LEFT to CONTINUE!	**Question #5** At what intensity do the Canadian Physical Activity Guidelines recommend exercising at for 150 minutes per week? Light-to-moderate Moderate Moderate-to-vigorous Vigorous	The Canadian Physical Activity Guidelines recommends 150 minutes of moderate-to-vigorous physical activity per week. Swipe LEFT to CONTINUE!
Today's Objectives Let's get started! We will break down each of the FITT principles into how we will progress them. Let's start with Frequency and Intensity today!	**Frequency** During this 8-week program you will progress the frequency of your activity ideally working up by 2 days! Now this isn't always possible for everyone, however work with what's best for YOU and meeting 150 minutes of moderate-to-vigorous activity!	**Frequency** After any form of exercise is performed your body completes a process of rebuilding and repairing. Research has shown that it is best to take a 24-48 hours of rest before each workout for your body to rebuild and repair.
Intensity Aim to work at an intensity hard enough to overload and in turn lower your blood pressure, but not so difficult that it results in	**Intensity** The type of exercise you do will determine how the intensity could change. Here are some examples for walking, jogging, and cycling.	**Intensity- Walking** To progress the intensity of walking, increase the speed of your walk. Increase your speed by no more than 1 minute per 1.6 kilometer (1

over-training, injury, or burnout.		mile) each time you progress your program.
Intensity- Jogging To progress the intensity of jogging, increase how often you jog or increase the length of time you jog in your routine.	**Intensity- Cycling** To progress the intensity of cycling, increase the speed (revolutions per minute) of your cycling or how much tension is on the fly wheel.	**Intensity and Financial Incentives** Remember, you are being PAID for your moderate-to-vigorous physical activity minutes each week. If we apply the Talk Test, you should be able to talk, but not sing, while doing MODERATE activity. Keep this consideration in mind!
Intensity Do NOT increase intensity if: 1. You feel unwell. 2, You have had a change in your medical status (new symptoms, new diagnoses).	**Intensity** Do NOT increase intensity if: 3. You are getting used to exercising in new weather conditions ... That hot summer's day may feel a bit different than a mild day! 4. You are happy with your current level of fitness!	**This Lesson** Keep these considerations in mind if you're wanting to progress the frequency or intensity of your activity.
Before Next Lesson Get your heart rate up! Complete at least one activity before your next lesson—all it takes is 10 minutes! Every moderate-to-vigorous activity minute is one step closer to reaching your goals and earning you money.	**Next Lesson** We'll discuss progressing our 2 T's, type and time! Enjoy your day and if you haven't already, get moving!	

Lesson 9: A Little More!

Check-In Question: Are you ready to progress your activity with FITT?
Tags: Lesson 8, Week 3, 5 mins
Description: Learn how to safely progress the time and type of your activities!

Hello Again! We hope you've found time to begin moving to reach your goals this week!	**Previously** Earlier this week we discussed progressing the FREQUENCY and INTENSITY of our activity.	**Today's Objectives** The objective of today is to understand HOW to PROGRESS TYPE and TIME of activity!
Type You may have heard that variety is the spice of life. Variety is important, especially if you feel bored with your current activities. Changing the type of physical activity you do is a way of progressing your goals.	**Time** The duration of your exercise is usually the first step in progressing your exercise program. You should increase the duration before you increase the intensity.	**Time** As a rule of thumb. Don't increase your time or distance by more than 10 to 20% each week.
Time For example, if you begin exercising for 10 minutes each session, only add 1 to 2 minutes each week for the first couple of months. Even if you feel you could progress more quickly, this gives your muscles and joints take longer to adapt to the stress of exercise than your heart and lungs.	**Let's refresh!** The Canadian Physical Activity Guidelines recommends adults complete 150 minutes of moderate-to-vigorous physical activity per week.	**Don't worry!** Yes, 150 minutes may seem like a lot. However, you can accumulate those minutes in 10 minute bouts!
Over time, let's slowly work our way up to reaching this guideline. Consider your goals from last week and how you can shape them using your new knowledge.	**Remember** Specific, Measurable, Attainable, Relevant and Time frame goals, or SMART goals, are best practice for goal setting.	**Remember** To consider our FITT principles, frequency, intensity, type, and time, when framing our SMART goals.
This Lesson That's all the content for today. We encourage you	**Before Next Lesson** Do you have time to get your heart rate up for at	**Next Lesson** Next lesson we will dive deeper into learning about

to take a look at your SMART goals created on your goals sheet.	least 10 minutes before our next lesson? We're halfway through the week. Make sure you're on track to reach your goals this week!	using physical activity to control our quality of life!

Lesson 10: Taking Charge of Your Behaviours

Check-In Question: Last lesson of the week. Are you ready?
Tags: Lesson 9, Week 3, 6 mins
Description: Today's lesson will teach you about factors that lead to an increase in blood pressure and how we can use physical activity to create balance.

Hello there! What a journey we've been on together! Can you believe we're already wrapping up our third week together?	**In the Beginning** We discussed using physical activity to have better control over our blood pressure.	**Today's Objectives** There is no better time than the present to increase our physical activity to prevent us from developing many chronic diseases long term. Today's objectives will be to learn about the factors that may lead to an increase in blood pressure and how we can act NOW to prevent damage down the road.
High Blood Pressure High blood pressure makes your heart work a lot harder and causes excess force on your artery walls.	**Cardiovascular Disease (CVD) I** This can scar the walls and trigger the buildup of plaque, which narrows the arteries and causes a type of cardiovascular disease (CVD) called coronary artery disease (CAD).	**Cardiovascular Disease (CVD) II** A narrowing artery can become completely blocked, leading to a heart attack. Also, plaques can break away from the artery wall, flow through the arteries, and cause a blockage elsewhere when it gets stuck.
High Blood Pressure High blood pressure is strongly linked to heart disease. In fact, "high	**High Blood Pressure** It has been called the silent killer because it often has no warning signs or	**Additionally,** There are many factors that can cause increased blood pressure, including:

blood pressure is the leading risk for death throughout the world.”	symptoms. You could have high blood pressure for years without knowing it, putting you at greater risk for cardiovascular disease and organ damage.	Insufficient exercise Having too much salt in your diet
Factors cont. Drinking alcohol excessively (males no more than two drinks per day; ladies no more than one per day) Being overweight Experiencing unmanageable stress	**…** These factors aren’t meant to scare you! You have control over many of them.	**Your Toolkit** You have been equipped with the foundational knowledge of developing a sustainable relationship with physical activity.
Goal Setting From incorporating our FITT principles to our SMART goals, these techniques will hopefully get you on your feet and progressing over the next 5 weeks of this program and beyond!	**Reflect** What FITT principles have you progressed over the course of this program so far? <text box>	Will you change any of the FITT principles in your activity goal for next week? <text box>
How confident are you in setting your SMART goal with the FITT principles for next week? (0%= not confident at all, 100%= totally confident) 0-100 slider in increments of 10	**This Lesson** We discussed some factors that may lead to heart complications over time. You also had the opportunity to reflect on what you have learned about the FITT principles and setting SMART goals.	**Before Next Week** Make sure you crush your activity goal for this week! Does that mean you need to go for a brisk walk right now? Prior to your next lesson, set another SMART goal for the week, as well!
Next Lesson We’ll see you next week for 3 lessons surrounding your emotions and physical activity.		

Week 4

Lesson 11: Your Emotions and Physical Activity

Check-In Question: Have you set your SMART goal for this week?
Tags: Lesson 10, Week 4, 6 mins
Description: Learn how physical activity can positively influence your emotional well-being!

Welcome to Week 4! Now that your weekly goal is all set, you're ready to dive into this week's lesson!	**Today's Objectives** In this lesson you will learn various emotional benefits of physical activity and be introduced to an emotional regulation strategy!	**What We Know** Your physical health is extremely crucial to your overall health, especially your heart health.
Above and Beyond However, we can expand beyond our physical well-being and consider the emotional benefits of physical activity.	**Benefit #1** Physical activity can reduce feelings of depression and stress.	**Benefit #2** Physical activity can enhance your mood and overall emotional well-being.
Benefit #3 Physical activity can improve sleep.	**Benefit #4** Physical activity can increase your energy level.	**Benefit #5** Physical activity can improve memory and perception.
Qi Gong Qi gong literally translates to "energy work" and has been used for thousands of years to harness willpower and improve focus.	**Introduction to Qi Gong** On the next page there will be a brief 90 second video of how Qi Gong improves heart health.	**Take 90 seconds…** https://www.youtube.com/watch?v=CU7nHMtlpPk&ab_channel=YMAAPublicationCenter
Consider Physical activity plays such an important role in regulating your emotions and how you feel. We hope that this lesson has made you aware of more benefits of physical activity!	**This Lesson** The purpose of this lesson was to inform you about the emotional benefits that physical activity provides you!	**Before Next Lesson** Make sure your current goals are aligned for how you're feeling this week and crush those goals! Do you have time now for a walk? Get your heart rate up prior to our next lesson!

Next Lesson We will discuss the effects of loneliness on the heart and the role the COVID-19 pandemic played in your heart health.		

Lesson 12: Loneliness and the Heart

Check-In Question: Are you ready to learn about COVID-19 and heart health?
Tags: Lesson 11, Week 4, 6 mins
Description: Coupling the science behind loneliness, COVID-19, and heart health.

2020 Was Stressful We think it would be very hard to find someone who doesn't agree with that statement worldwide.	**Today's Objective** Today we will discuss the effect that COVID-19 had on your heart health, talk about loneliness, and reflect on coping mechanisms you used throughout this pandemic.	**Coping Mechanisms** Your life may have changed in many ways and with that you may have learned a lot about how your body reacts to certain things: whether it be comfort foods, alcohol, or too much or not enough sleep.
Isolation While we know all of those unhealthy mechanisms are… well, unhealthy, the "isolation" component of the stress of 2020 has a negative impact on your heart health.	**Fact** Social isolation is actually a risk for heart disease, loneliness and socialization isolation. This was essentially inevitable for SO many people in 2020.	**Strategy** If you were feeling isolated or lonely at any point, fill out this survey to reflect on how you gained a sense of togetherness.
Isolation Survey Did you video chat (Skype, Zoom, FaceTime, etc.) between March 2020-present? Yes / No	Did you take a social-distanced walk with a friend or family member between March 2020-present? Yes/no	Did you have a window visit with a vulnerable person between March 2020-present? Yes/no
Did you stream an even online (like church service, sporting event, concert,	You don't realize how much social interaction you have in a day until it's	**On top of this**

fitness class, etc.) between March 2020-present? Yes/no	taken away from you. We applaud you for finding creative ways to reach out during these times!	We had added lingering stressors. Did I remember my mask? Am I standing in the right spot at the grocery store? Am I putting myself at an increased risk if I do this?
These little factors slowly add up and have negative effects on your body, including your heart!	Depending on the level of pressure these stressors made you feel, your body reacted to be in a state of battle with itself and its potential enemy.	**The Stats** Research suggests that loneliness and social isolation are linked to a 29% increased risk of a heart attack or angina and a 32% heightened risk of having a stroke.
This Lesson The purpose of this lesson was to help normalize your stress response to the COVID-19 pandemic.	**Before Next Lesson** Are you on track for reaching your goals this week? Do you have time for a 10 minute walk right now?	**Next Lesson** We will further dive into our triggers and what may be affecting us from reaching our full potential.

Lesson 13: Balancing Your Triggers

Check-In Question: Are you ready to create balance?
Tags: Lesson 12, Week 4, 7 mins
Description: 7 steps to help manage your triggers!

Hello! Today we will be talking about balancing the events that trigger us.	**Today's Objective** Learn the 7 steps in order to gain control of the situations that may trigger you to fall out of your new routine.	**Step-by-Step** We'll work through all 7 of those steps today and in our next lesson we will focus in on your specific triggers.
Step 1 Identify your most important trigger that interferes with your self-care behaviour.	**Step 1** Where and when does this problem occur? Be specific!	**Step 2** As a short-term solution, avoid your trigger situation for up to 2 weeks!
Step 2	**Step 3**	**Step 3**

During this 2 week period, practice steps 3-7 that we will go over. Feel free to go back to this module when you need to!	When you feel the urge to let go of your desire to maintain your self-care behaviour, counter this urge RIGHT AWAY!	For example, say words of affirmation about your personal strength and determination to make a heart healthy lifestyle change!
Step 4 Identify whether you need any special coping skills to manage your trigger situation.	**Step 4** Stress management or consulting with a professional could be a further option.	**Step 5** Change your physical set-up at home or work (wherever your trigger is located).
Step 5 Instead of eating a snack, go for a walk OR put a picture of something motivating on your fridge or cupboard.	**Step 6** Talk to someone who understands and supports your effort to make a heart healthy change in your self-care behaviour.	**Step 6** Use this conversation to fuel your motivation to commit to your self-care plan!
Step 7 After you have put in the effort to practice the previous steps, remember to celebrate your milestones!	**Step 7** This will further strengthen your inner motivation!	**Remember** This lesson will be accessible to you at any time to open and go over these tips!
This Lesson This lesson was the introduction to the 7 steps to coping with a trigger situation. Keep these in mind for future reflections.	**Before Next Lesson** It's almost the end of the week. Make sure you get your heart rate up to crush your goals! Every moderate-to-vigorous activity minute is one step closer to reaching your goals and earning you money.	**Ohh We're Halfway There!** We are halfway through the lessons of your healthy heart program! Do you have time to go for a brisk walk right now as a reward for your progress?
Next Lesson Our next lesson will be about managing YOUR triggers. We will apply the tips we learned from today in order to keep you on		

track with your activity goals.		

Week 5

Lesson 14: Managing Triggers

Check-In Question: Have you set your SMART goal for this week?
Tags: Lesson 13, Week 5, 9 mins
Description: Reflect on how you manage your triggers.

Today's Objective Today we'll be expanding on our previous lesson and have the opportunity to reflect on your triggers. We will also learn coping strategies for these triggers.	**The Plan** We'll be filling out today's lesson like a journal. Feel free to use this as your accountability lesson to take control over what's getting in the way of you reaching your goals.	**The Plan** We are now going to take you through a step-by-step exercise to manage your triggers (situations or events) that interfere with your plan to maintain your healthy behaviours!
Identify Your Key Triggers WHAT are the key situations or events that interfere with your ability to maintain your self-care behaviour? <text box>	**Identify Your Key Triggers** WHEN do these triggers occur? <text box>	**Remember…** It can be very helpful to avoid your trigger for a short period (< 2 weeks).
Remember… This can give you time to develop effective skills to manage your trigger situation.	**My Plan to Manage** Identify any skills that you believe would be helpful to manage your trigger <text box>	**Words of Affirmation** Feel free to read the following strategies out loud or write these phrases down in a journal as you swipe through the cards. Hearing yourself speak these strategies can be very reaffirming!
More Management Strategies	**More Management Strategies**	**More Management Strategies**

"I can prime positive self-talk to increase my strength and motivation to maintain my self-care behaviour."	"I can take a mini-break from the situation in order to calm down and focus my effort to get through the situation."	"I can decrease my physical and emotional stress by telling myself to relax and taking slow, deep breaths that are part of my relaxation exercise."
More Management Strategies "I can think or talk about something humorous to change the negative effect that the trigger is having on me."	**Let's Continue** What can you do to change your physical set-up at home or work (wherever your trigger is located), or change your weekly routine to support your new self-care habit? <text box>	**More Strategies** "I can make a change in my schedule to decrease the time that I am affected by my trigger situation."
More Strategies "I can make a change in my physical setting, either at home or at work, so that removes my trigger." (For example, hide snack food).	**More Strategies** "I can make a change in my physical setting, either at home or at work, to keep me motivated." (For example, an inspiring photo).	**Celebrate the Victories!** Research has shown clearly that there are several benefits, for our motivation and well-being, of using positive experiences to celebrate our success in learning a new skill.
Celebrate the Victories You have every reason to be proud of each successful step you take to manage a trigger situation or event that has been interfering with your self-care behaviour.	**This Lesson** This lesson we reflected on your own personal triggers and learned many positive coping strategies and words of affirmation to accompany us during tough times.	**Before Next Lesson** Take this time to think about what you will do to celebrate all of your personal milestones! This can be a daily, weekly, or monthly ritual- however you feel most rewarded!
Next Lesson We will shift gears in our next lesson to talk about the effect our support system has on us to help us maintain our goals.		

Lesson 15: Your Support System

Check-In Question: Have you thought of how you'll celebrate your personal milestones?
Tags: Lesson 14, Week 5, 5 mins
Description: This is an introductory lesson to learning about your support system.

Hello Again! We unpacked a lot of strategies earlier to deal with our trigger(s). Remember to refer back to those lessons when you need to!	**Today's Objective** By the end of today's lesson, you will know the 4 types of social support to prepare you for our reflection next lesson!	**Social Support** Social support can take many forms and looks different for different people.
Four Pillars The four pillars of social support are: 1. Emotional Support 2. Companionship Support 3. Informational Support 4. Tangible Support	**Let's Expand** Now let's look at examples of each of those four pillars of social support.	**Emotional Support I** Encouragement from a friend or partner.
Emotional Support II Being encouraged to engage in a healthy behaviour.	**Emotional Support III** Positive reactions from friends and loved ones.	**Companionship Support I** A friend or team to be active with.
Companionship Support II Going for a walk with a friend instead of sitting to catch up.	**Informational Support I** A friend who has been engaging in physical activity for a long time offering to help you get started.	**Informational Support II** Input from a trainer or fitness professional on how to build a training program that works for you.
Tangible Support I Family offering childcare or a gym that offers childcare.	**Tangible Support II** Finding space in your budget to pay for a gym membership or whatever equipment you may need.	**Tangible Support III** Your partner helping with housework, so you get time to exercise.
Question! Do you recognize any of these forms of support around you? Yes/ no	**This Lesson** This lesson was an introduction to the types of social support. We hope you can see this program as a form of informational	**Before Next Lesson** Your accountability check: what can you do today to help you get one step closer to your goals?

	support for you and that you can identify ways in which other forms of social support are around you.	A 10 minute walk? Bike? Get your heart rate up before we meet again!
Next Lesson In our next lesson, you'll have the chance to write and reflect on the social support around you.		

Lesson 16: Strength in Your Surroundings

Check-In Question: Can you think of someone close to you who motivates you?
Tags: Lesson 15, Week 5, 8 mins
Description: Reflect on the support you have from those around you!

Welcome Back! Today we're going to talk about who has a positive impact on your life!	**Today's Objectives** The objective of today is all about reflecting on those around you who motivate you in your health journey. But before we get into the lesson, let's refresh on forms of social support**!**	**Question 1** "Your partner helping with housework, so you get time to exercise" This is an example of: Emotional Support Companionship Support Informational Support Tangible Support
That is an example of tangible support! Swipe LEFT to CONTINUE!	**Question 2** "Going for a walk with a friend instead of sitting to catch up" This is an example of: Emotional Support Companionship Support Informational Support Tangible Support	That is an example of companionship support! Swipe LEFT to CONTINUE!
Question 3 "Encouragement from a friend or partner" This is an example of:	That is an example of emotional support! Swipe LEFT to CONTINUE!	**Question 4** "A friend who has been engaging in physical activity for a long time

Emotional Support Companionship Support Informational Support Tangible Support		offering to help you get started." This is an example of: Emotional Support Companionship Support Informational Support Tangible Support
That is an example of informational support! Swipe LEFT to CONTINUE!	**Keeping That in Mind…** Who is your role model?	**Write It Down** Identify one or two people who you respect or admire in their ability to maintain a heart healthy lifestyle. Enter their first name or initials. <text box>
Consider This Strategy Protecting time every other day for a positive lifestyle behaviour of choice.	**Consider This Strategy** Openly talking about the importance of healthy lifestyle behaviours to improve quality of life.	**Write It Down** With those strategies in mind, identify how your role model you mentioned above makes time in their weekly routine for their healthy lifestyle behaviour. What strategies do they use? <text box>
… Who understands and supports your effort to maintain your heart healthy lifestyle? <text box>	Identify at least one person who is a partner, family member, friend or healthcare professional. Be sure that you're comfortable talking with that person about personal issues. <text box>	**This Lesson** That wraps up another week. We hope you've enjoyed reflecting on who is around you to continue to achieve your goals throughout and beyond this program!
Before Next Lesson How close are you to reaching your goals for the week? Are you able to make time today or	**Next Lesson** The focus of next week is to look at the environment and physical activity.	

tomorrow to do some activity?	In our next lesson, we will look at your INTERNAL environment. See you then!	

Week 6

Lesson 17: Your Internal Environment

Check-In Question: Have you set your SMART goal for this week?
Tags: Lesson 16, Week 6, 6 mins
Description: Learn the 6 components of a healthy internal environment for change.

Week 6 Already?! We hope that day-by-day, lesson-by-lesson, you're feeling more and more equipped and confident to leading a healthy lifestyle!	**This Week** This week's lessons will focus on our environment and how that plays a role in our lifestyle.	**Today's Objectives** To expand on our social support lessons from last week, today we will be talking about our internal environment. By the end of today's lesson, you will understand how to create a healthy internal environment for behaviour change.
The Components In this program, we recognize six components that promote a positive internal environment surrounding our healthy lifestyle.	**The Components** Autonomy Challenge Culture Support Motivation The Mind	**Autonomy I** You are in control of your own F.I.T.T. principles!
Autonomy II If at any point you're not happy or are bored with any component of your goals, change it up! Feel free to review the earlier lessons for help.	**Challenge I** You have been challenging yourself every week to reach your goals, goals that you may not have ever set out for yourself before!	**Challenge II** You should be SO proud you have made it this far! Every active minute you've done so far has mattered and has earned you MONEY!
Culture I	**Culture II**	**Support**

As we previously learned, who we look up to and who we surround ourselves with is so important to reaching our own goals.	Creating this positive culture and surrounding yourself with people who values your goals is crucial for success.	This culture around us lifts us up through praise and encouragement.
Motivation I We hope that these lessons have helped motivate you throughout the program.	**Motivation II** As we work through this program, we hope you've noticed yourself gaining more confidence and being more in control of your health.	**The Mind I** Physical activity, improved mental well-being, and quality of life all go hand-in-hand(-in-hand)!
The Mind II We hope you have noticed an improvement in your mood and a reduction in stress after you complete your activity!	**The Mind III** If you haven't yet noticed this change, think back to when we identified your triggers. What is getting in your way from experiencing an increase of any size in mood post-activity?	**In Summary** These factors all play a crucial role in our internal environment and are both affecting our activity AND an effect of our activity. Read that statement again a few times.
… If you've never directly thought of any of these factors while doing activity, maybe take note and reflect when you're out reaching your goals this week!	**This Lesson** We learned about the 6 components that influence our internal environment and physical activity.	**Before Next Lesson** It's a new week! Make sure you get your heart rate up to crush your goals! Every moderate-to-vigorous activity minute is one step closer to reaching your goals and earning you money.
Next Lesson We will talk about our external built environment and how it affects our health!	**Later This Week** We will talk about our external environment and how we can use our neighbourhoods and this beautiful province to our advantage!	

Lesson 18: The Built Environment

Check-In Question: Are you on track to reach your SMART goal this week?

Tags: Lesson 17, Week 6, 8 mins
Description: Learn about how the environment you live in impacts your health.

Welcome Back! We hope you've been enjoying your week and staying active when possible!	**Today's Objective** By the end of today's lesson, you will know how our built environment affects our health.	**Attributes** We will look at built environment and ecological attributes in our built environment. These attributes can lead to either positive or negative behaviours, and in turn, impact our health.
Built Environment Attributes Open and green spaces Food destination (grocery stores and restaurants)	**Built Environment Attributes** Access to public transport Street layout	**Built Environment Attributes** Land use (residential and commercial) Safety
Ecological Attributes Factors like heat and air pollution also play a role in our behaviours.	**Results** These built environment and ecological attributes influence our behaviours daily.	**Behaviours** Types of behaviours that these attributes lead to include our diet, smoking, physical activity, sleep, and more!
The Side Effects As you can imagine, if any of those behaviours are poor or negative, like poor diet or lacking physical activity, that can be detrimental for our overall health.	**The Plus!** We are lucky to live in the most active province in Canada, British Columbia!	**In British Columbia** Not only is there an abundance of opportunity for year-round activities, but we also have great diversity in our built land use, types of housing and ideal destination proximity.
Environment Research According to research, with positive perceptions of your neighbourhood and environment, this leads to an increased overall walkability in these spaces.	**Let's Summarize** The bottom line is your environment has an impact on your behaviours and therefore an impact on your risk factors for developing chronic diseases.	**This or That!** Let's see if you can differentiate these attributes as either built environment attributes, ecological attributes, or behaviours!

Safety **Built environment attribute** Ecological attribute Behaviour	Safety is a built environment attribute! Swipe LEFT to CONTINUE!	Diet Built environment attribute Ecological attribute **Behaviour**
Our diet is a behaviour. Swipe LEFT to CONTINUE!	Food destination **Built environment attribute** Ecological attribute Behaviour	Food destination is a built environment attribute. Swipe LEFT to CONTINUE!
Air and noise pollution Built environment attribute **Ecological attribute** Behaviour	Air and noise pollution is an ecological attribute. Heat is another ecological attribute! Swipe LEFT to CONTINUE!	**Today's Lesson** Today we learned about attributes in our built environment that influence our behaviours.
Before Next Lesson We're about halfway through the week. Make sure you get your heart rate up to crush your goals! Every moderate-to-vigorous activity minute is one step closer to reaching your goals and earning you money.	**Next Lesson** We have one more lesson about our environment this week! We'll see you then!	

Lesson 19: Beautiful BC

Check-In Question: Are you ready to be inspired by YOUR surroundings?
Tags: Lesson 18, Week 6, 9 mins
Description: This lesson will help remind you of what's in your own backyard!

Hello There!	**Previously**	**Today's Objective**
I hope you're excited to wrap up this week's lessons about the environment and physical activity with opportunities for you in your own backyard!	We learned about built environment and ecological attributes that influence our behaviours and thus our overall health.	Today we will learn about resources that BC HealthLink has available and about physical activity statistics in our province!

Progress By now you should be familiar and comfortable with the activity you're needed to do every week to achieve your goals.	**Survey** Below, write down the types of activity you've done during this program that got your heart rate up. <text box>	**Beautiful BC** Consider trying a new hike, going kayaking or canoeing, stand up paddle boarding or surfing, of golfing!
Check This Out! Hello BC has many adventure ideas and planning tips. Take advantage of the landscapes this province has to offer! https://www.hellobc.com/things-to-do/adventure-outdoors/	**Quiz Time** This is a fun quiz with research about physical activity levels in British Columbia from 2015. Let's see how you do!	**Question 1** Which health service delivery area had the lowest physical activity levels? Okanagan Richmond Central Vancouver Island Northern Interior
From reported data, Richmond Health Service Delivery Area had the lowest physical activity levels at 53% of the population participating in physical activity. Swipe LEFT to CONTINUE!	**Question 2** True or false: those with higher levels of education report higher levels of leisure time physical activity.	This is TRUE, those with higher levels of education report higher levels of leisure time physical activity. Swipe LEFT to CONTINUE!
Question 3 How many minutes of moderate-to-vigorous physical activity for adults in British Columbia is recommended per week? 100 mins/ week 150 mins/ week 200 mins/ week 250 mins/ week	150 minutes of moderate-to-vigorous physical activity per week is recommended for British Columbian adults (and the rest of Canada!) Swipe LEFT to CONTINUE!	**Question 4** Which Health Service Delivery Area reported the highest physical activity levels? Okanagan South Vancouver Island Kootenay-Boundary North Shore- Coast Garibaldi
From reported data, Kootenay-Boundary Health Service Delivery Area had the highest physical activity levels with	**HealthLink BC** Public health initiatives in BC have compiled a research and tools,	**Are you Inspired?** Do you think you'll try a new activity or do an activity you're

70% of the population active. Swipe LEFT to CONTINUE!	including walking and other physical activity logs, in a familiar location. https://www.healthlinkbc.ca/physical-activity/everyone	familiar with somewhere new?
This Lesson We hope this lesson has at least sparked your imagination and provided you with some resources to use in the future.	**Before Next Lesson** Make sure you do what it takes to reach your goal this week and remember to set a new SMART goal for next week!	**Next Lesson** And on that note, we can wrap up for today! We'll shift gears next week to identity.

Week 7

Lesson 20: Exercise Identity

Check-In Question: Have you set your SMART activity goal for this week?
Tags: Lesson 19, Week 7, 8 mins
Description: In this lesson we will begin exploring the domains of exercise identity.

And just like that… It's week 7! Let's get started!	**Today's Objectives** Today we will reflect on how we identify ourselves currently and learn about the branches of exercise identity.	**Identity** "In the social jungle of human existence, there is no feeling of being alive without a sense of identity."-Erik Erikson
What do you identify as? A mom? Dad? Teacher? Accountant? Chef? Runner? Cyclist? Napper? Coffee-lover? Morning person? Night owl?	**Survey #1** What do YOU identify yourself as? <text box>	**Survey #2** What do you think those closest to you identify you as? <text box>
Awesome! Thank you for reflecting. Physical activity may or may not be a part of your identity yet.	**Developing Exercise Identity** Creating this sense of identity surrounding the physical activity or exercise you complete is	**Developing Exercise Identity** There are 6 branches of exercise identity that we are going to learn about today and see an example

	valuable in keeping yourself motivated.	for each. See if you can resonate with any of these.
Commitment and Sacrifice "What am I giving up?"	**Commitment and Sacrifice Example** Going for a walk instead of doing the dishes directly after dinner. You are sacrificing doing the dishes for the sake of your physical activity identity.	**Affective Judgement** "Do I enjoy doing it?"
Affective Judgement Example You love to dance. You find a nearby studio that offers adult dance classes and have so much fun every week. You start looking forward to these classes every week and now consider yourself a "dancer".	**Social Comparison** "What is normal for the people I surround myself with?"	**Social Comparison Example** Amanda and her friends love to get together and chat over coffee. However, physical activity is important to them. Once a week, Amanda and her friends get together and walk to the neighbourhood coffee shop, have a nice chat, and then walk back home.
Ability "Am I any good?"	**Ability Example** Henry is an avid rock climber. He brings his friend who has never climbed before. He isn't able to get to the top of any routes and no longer wants to try again because he is not good at it.	**Past Behavioural Experience** "What am I used to doing?"
Past Behavioural Experience Example Nicole grew up playing volleyball and is now in her 30's and continues to exercise regularly. When asked why, Nicole realizes physical activity is	**Passion** "Is this an activity I feel strongly about?"	**Passion Example** Bruno is passionate about playing soccer. This comes from a combination of enjoying the sport and also feeling skilled at it. This passion makes it easy for him to identify with soccer

something she has been doing for so long she can't imagine her life without it.		because it is something he feels so strongly about.
Exercise Identity That is an overview of the 6 branches of identity. Do any of those resonate with you?	**From Today's Lesson…** Do you feel you identify as anything else? <text box>	**This Lesson** We reflected on our identity and learned about branches of exercise identity that help tie ourselves to being an active person!
Before Next Lesson How about we start this week off strong and get your heart pumping now! You've got this! ☺ Every moderate-to-vigorous activity minute is one step closer to reaching your goals and earning you money.	**Next Lesson** We will further expand on our exercise identity next lesson as we discuss your role!	

Lesson 21: Identifying Your Roles

Check-In Question: Have you further considered your exercise identity?
Tags: Lesson 20, Week 7, 10 mins
Description: Identify and reflect on your personal roles.

Hello again! We hope you're ready to reflect and expand more on your roles in many domains of your life.	**Let's Refresh** Let's refresh on our identity and what domains will further fuel our exercise identity.	**Question #1** If you ask yourself "is this an activity I feel strongly about?", this is an example of what domain? Ability Past Behavioural Experience Passion Affective Judgement
This question falls under the PASSION domain. Swipe LEFT to CONTINUE!	**Question #2**	This question falls under the ABILITY domain. Swipe LEFT to CONTINUE!

	If you ask yourself "am I any good?", this is an example of what domain? Passion Past Behavioural Experience Ability Social Comparison	
Question #3 If you ask yourself "what is normal for the people I surround myself with?", this is an example of what domain? Past Behavioural Experience Social Comparison Commitment and Sacrifice Affective Judgement	The question falls under the SOCIAL COMPARISON domain. Swipe LEFT to CONTINUE!	**Today's Objective** Now let's think about you. Today we will reflect on your roles at home and work and begin an introduction to finding balance in your daily life.
Recognize With the COVID-19 pandemic, your roles may have shifted or become more or less demanding.	**Roles at Home and Work** Answer the following statements in response to the following roles and responsibilities.	**Roles at Home and Work** Being a provider to help make your home safe and secure for you and your family. Always/ sometimes/ rarely/ never
Roles at Home and Work Being a good partner who expresses care and support for your loved one(s). Always/ sometimes/ rarely/ never	**Roles at Home and Work** Being a good parent who can guide and support your children. Always/ sometimes/ rarely/ never	**Roles at Home and Work** Being a good family member or friend who supports those who are close. Always/ sometimes/ rarely/ never
Roles at Home and Work Being a good employee who shares tasks and demands with the team at work.	Which of these, or another role, is most important to you most recently? <text box>	**Act…** As a result of this role, it will be necessary to adjust the intensity or range of

Always/ sometimes/ rarely/ never		your physical activity because of it.
Balance It is okay to reweigh your priorities to fulfill your roles and responsibilities.	**Balance** Think about what roles and responsibilities you want to protect in order to maintain your quality of life.	**Solutions** Don't sweat it if finding this balance is unclear or difficult to you right now.
This Lesson This lesson was just the beginning of reflecting on your daily roles and responsibilities.	**Before Next Lesson** What can you do before the next lesson to get you closer to reaching your weekly activity goal? Make it happen!	**Next Lesson** In our next lesson we will discuss coping strategies that you can implement in order to balance your most important roles while still leading a healthy, balanced life.

Lesson 22: Coping Strategies

Check-In Question: Is your SMART goal still in sight?
Tags: Lesson 21, Week 7, 6 mins
Description: Tips to cope with your various roles and responsibilities day-to-day.

Hey There! Let's learn about how we can develop positive coping mechanisms to maintain or modify your roles or responsibilities!	**Today's Objective** Today we are building on our previous two lessons where we discussed exercise identity and our roles and responsibilities. We will identify 6 tips to help you cope to maintain your roles.	**Building the Bridge** Of course, at times different identities and roles will outweigh one another. But what can you do to help stay balanced during these times?
Tip #1 Organize your coping plan by identifying the top 3 roles and responsibilities that are most important to you.	**Think** Lately, what 3 roles and responsibilities are MOST important to you? <text box>	**Tip #1 Continued** Starting with this narrow range of goals is okay. Expand your priorities as you progress.
Tip #2 Self-care behaviour is the best way to secure the	**Tip #2 Continued** Exercise regularly to build and maintain your strength,	**Tip #3** Pace your daily activities to get through your day.

energy to maintain your key roles and responsibilities.	and most importantly your heart health!	
Tip #3 Continued Break up tasks into shorter steps with brief rest periods to help you feel more confident throughout your work week!	**Tip #4** If you're feeling increased stress, it's okay to take brief "time out" periods for a stress management exercise.	**Tip #4 Continued** In lesson 10 we learned about the benefits of Qi Gong. Qi Gong, along with other relaxation exercises, like yoga, Tai Chi, meditation, or even a regular sleep schedule, are crucial for relaxing your mind.
Tip #5 Schedule one or more pleasurable activities that are not physically demanding in your weekly routine.	**Tip #5 Continued** For example, watching a movie or sports game or sharing a nice meal with someone.	**Think** What's something enjoyable that you would schedule into your weekly routine? <text box>
Tip #6 Remind yourself that you are using each of the above coping strategies in order to STRENGTHEN your quality of life.	**Tip #6 Continued** As you put time and energy into your coping plan, do not lose sight of the fact that there are several important sources of strength and support in your life.	**Remember** Your coping plan should help you stay connected to your roles and responsibilities and help create a healthy balance in your life.
Remember Prioritize what's important to you when making heart healthy decisions.	**This Lesson** Today we discussed 6 tips to help you cope during difficult times. These tips should help you stronger identify with the roles you are upholding in your daily life!	**Before Next Lesson** A heart healthy decision right now would be to do what it takes to reach your goals for this week! Is now a good time for you to get one step closer to your weekly goals?.
Next Lesson Week 7 is now behind us! Reach your SMART goal and come back next week		

for your LAST three lessons that will help you stay motivated beyond this program!		

Week 8

Lesson 23: Getting Unstuck

Check-In Question: Have you set your SMART goal for this week?
Tags: Lesson 22, Week 8, 5 mins
Description: This lesson will remind you of your toolkit of knowledge you have obtained to help get you unstuck!

The Final Week! We can't believe we've made it to the last week! We are so proud of how far you've come.	**Today's Objective** The purpose of today's lesson is to remind you of tips and tricks we have discussed about avoiding trigger situations and coping along our journey through this program. You will also learn how to focus your attention on getting unstuck in unmotivating situations!	**We Get It** It may not have always been easy for you. A heart healthy lifestyle can be challenging.
… Whether you are considering a change that involves exercise, diet, medications, symptom-monitoring, or smoke-free living, it will take effort in the beginning.	**Over Time** We hope you feel equipped with knowledge to create goals and be active in your neighbourhood, but also with the drive to do so.	**Over Time** As your new heart healthy behaviour becomes a stable part of your lifestyle, we need to plan how to maintain our new routine as we respond to other demands of daily living.
Recall We discussed earlier how to manage triggers (lesson 12) and how to balance our roles and responsibilities (lesson 21).	**Recall** In these lessons, we listed step-by-step approaches on what to do when things get tough.	**Recall** Refer back to these lessons (lesson 12 and 21) to help you cope when you feel like you've hit a mental or physical roadblock.

Recall—Managing Triggers As a reminder, a short-term solution for our triggers is avoiding them for 2 weeks.	**Recall—Managing Triggers** This could be changing your environment, at home or at work, to avoid being triggered.	**Recall—Coping Strategies** Each coping strategy is implemented to help support and improve your quality of life.
Recall—Coping Strategies Take time to ground yourself, through sleep, meditation, or whichever strategy you prefer, and prioritize your values.	**…** The bottom line is that change CAN and WILL feel stressful, even when we know that it will have a positive influence on our life.	**Get Unstuck I** We hope this program can help you get unstuck from your old lifestyle habits so that you can feel more ready to move forward with a heart healthy change.
Get Unstuck II There are no tricks in this type of exercise to force us to change.	**Get Unstuck III** Rather, focus your attention on how heart health change fits into your life, and explore the difference between your old lifestyle vs your new lifestyle with self-care behaviour.	**Get Unstuck IV** This will allow you to see what aspects of your life you value most and wish to maintain.
One Final Go! Make this week count! Reach your goals, improve your heart health, and feel great while doing it!	**This Lesson** In today's lesson we drew attention to different ways in which we can feel unstuck, with an emphasis on making your healthy lifestyle fit into your life as much as possible.	**Before Next Lesson** How about we start this week off strong and get your heart pumping now! You've got this! Every moderate-to-vigorous activity minute is one step closer to reaching your goals and earning you money.
Next Lesson In our next lesson we will talk about how your choices throughout this program have led you to your current lifestyle. With that we will reflect on our		

choices over this program and plan for the future.		

Lesson 24: An Informed Choice

Check-In Question: Are you ready to stay motivated?
Tags: Lesson 23, Week 8, 8 mins
Description: Learn about the psychology behind positive behaviour changes!

Welcome Back! How goes the battle this week? Are you almost halfway to achieving your goal? Try to dish out sometime after this lesson to get your heart rate up and your body moving!	**Today's Objective** Today we will look at what lifestyle counselling research refers to as an "informed choice" and how this choice relates to you and your heart healthy lifestyle!	**An Inner Battle I** You may have wondered how anyone can maintain change when it is stressful.
An Inner Battle II And yet, you see so many people ARE SUCCESSFUL in making a heart healthy lifestyle change.	**An Inner Battle III** What is it that they have, or know, that enables them to stay on course with change?	**An "Informed" Choice I** A 30-year history of research on lifestyle counselling has documented how successful-long term change begins by making an "informed" choice.
An "Informed" Choice II Take a moment to think about the last time that you made a significant change in your life.	**An "Informed" Choice III** It is likely that you did not make this change using objective information alone.	**An "Informed" Choice IV** Instead, it is usually the case that we make full use of our personal insights and emotional intelligence to review our situation, and then initiate a change that feels right in a more holistic sense.
Quantum Change I A book written by two psychologists has gained lots of attention in the behaviour change realm.	**Quantum Change II** Drs. William Miller and Janet C'de Baca observed that the decision to make important changes in our	**Quantum Change III** During these times, we tend to look past the endless issues that can preoccupy our day-to-day

	life (or lifestyle) is commonly inspired by a deep conviction or strong feels about what we value most.	life, in order to better take care of what is essential for our well-being and loved ones.
Reflect You may not have an answer to these three questions, but what comes to mind first when you read these questions.	**#1** How can I best take care of myself so I can take care of those close to me? <textbox>	**#2** What kind of life do I most hope for—today, tomorrow, and beyond? <text box>
#3 How does a heart healthy lifestyle change fit into my life? <text box>	**Reflection Summary** Thank you for taking the time to reflect on those questions. We hope that has fuelled your mind and body to crush your goals for this week and beyond!	**This Lesson** This lesson we exposed you to the concept of an informed choice and discussed observations made in the book "Quantum Change".
Before Next Lesson Make this week count. Get your heart rate up! We'll see you later this week for one last reminder and push to keep you motivated in your heart healthy lifestyle!	**Next Lesson** In our LAST LESSON we will discuss a few more cues and reminders to help you stay motivated after this program! See you then!	

Lesson 25: Staying Motivated

Check-In Question: Are you confident that you can maintain your new health behaviour in the future?
Tags: Lesson 24, Week 8, 5 mins
Description: How to keep up with good habits

So nice to see you again! Thank you for joining us for your last lesson of this program.	**""** "Habits are not a finish line to be crossed, they are a lifestyle to be lived" – James Clear	**Today's Objective** Today we're going to discuss the art of the habit and tips to keep you motivated above and beyond this program. We will look at elements like

		the environment, cueing, and automatic activity.
Environment I We know that it is difficult to form a new habit when the environment feels unwelcoming or uncomfortable.	**Environment II** We are equipped with the knowledge to identify these triggers around us. The start of this path is paved for us with this coping mechanism.	**Cueing I** The simpler the cue to elicit behaviour of the new desired habit, the easier it will be to adopt the new habit!
Cueing II Drink more water = more bathroom breaks = breaking up sedentary behaviour and getting some steps in!	**Cueing III** Every day after dinner, I go for a walk.	**Survey—Cueing** List some cues you may have subconsciously made for yourself. <text box>
Automatic Activity The more automatic a habit becomes; the less conscious effort will be required to perform the associated behaviour.	**Automatic Activity** This can go hand-in-hand with your cues. For instance, when your after-dinner walks become habit, it won't even feel like a chore or an extra task to complete.	**Self-Monitoring Strategies** Incorporating self-monitoring strategies, like an activity journal, with your desired behaviour can enhance habit formation.
Self-Monitoring Strategies If you have a spare notebook that you could track in, try that. Or, HealthLinkBC has these printable sheets you can use.	**Walking Log** <link> If you choose to look at this link, remember to come back to the lesson!	**Physical Activity Log** <link> If you choose to look at this link, remember to come back to the lesson!
Strategies Different strategies work differently for everyone, and you know yourself best!	Just remember how good it makes you feel when you accomplish something for yourself.	**Survey** How confident are you (10 being extremely confident) that you will be able to maintain or further improve your activity for the next few weeks? (slider bar) 0→10
Next Steps	**Don't Forget**	**Follow Up**

Consider what you can do with the time you used to complete these lessons every week. That's about an extra half hour for activity.	Please return your Fitbit (and Smartphone, if you borrowed ours) once the week is up.	We'll follow up with you shortly via email to hear about your experience!
Crush Those Goals! Make this week YOUR week! Get your heart rate up and CRUSH! YOUR! GOALS!		

Appendix C

Social Impact Bond Contract

SOCIAL IMPACT BOND
AGREEMENT WITH THE DIGITAL HEALTH LAB

Thank you for your continued interest in this study. You have been randomized into the "Social Impact Bond" financial incentive group. Please read the following to understand your commitment to the Digital Health Lab and your health. The purpose of this document is to give you an understanding of how this social impact bond works and to provide agreement documentation between parties.

THIS AGREEMENT is made the [DAY] of [MONTH] 2021.

BETWEEN:

(1) Amanda Willms and Dr. Sam Liu of the Digital Health Lab at the University of Victoria; and
(2) [NAME] who is beginning this health journey.

DEFINING THE SOCIAL IMPACT BOND

As defined by Investopedia, a social impact bond (SIB) is a contract with the public sector or governing authority, whereby it pays for better social outcomes in certain areas and passes on the part of the savings achieved to investors. The "social outcome" we are bettering in this scenario is your health, as you have passed the screening criteria that indicates increasing your physical activity is an appropriate choice for you.

A social impact bond is not a bond, per se, since repayment and return on investment are contingent upon the achievement of desired social outcomes. SIBs derive their name from the fact that their investors are typically those who are interested in not just the financial return on their investment, but also in its social impact.

PURPOSE OF INVESTMENT

The purpose of this investment serves as a metaphor for you investing in your health. Whether or not you physically put money aside for the eight-week duration of this intervention study is up to you.

Starting on the agreed start date (outlined in TERMS OF THE SOCIAL IMPACT BOND), you will be treated as though you have invested $400 into reaching the Canadian Physical Activity Guidelines of 150 moderate-to-vigorous physical activity minutes per week. Only minutes that are tracked through your Fitbit Inspire can count towards this Guideline. Since this is a mock investment, you will only have the chance to earn money as a return.

TERMS OF THE SOCIAL IMPACT BOND

COMMENCEMENT DATE is on [DAY] of [MONTH] 2021.

The commencement date is selected as it is one week after baseline week. Each week will run from Monday-Sunday and are programmed in Fitbit accordingly. You will receive a status update via email every week.

EXPIRY DATE is on [DAY] of [MONTH] 2021.

This is the date that reflects the end of the eight-week intervention.

During this time period, the participant is eligible to receive a return of investment of:

0% return if goals are met 0-2 weeks of 8 weeks
+1.5% return if goals are met 3-4 weeks of 8 weeks
+3% return if goals are met 5-7 weeks of 8 weeks
+5% return if goals are met 8 weeks of 8 weeks

You will receive your return after the eight-week intervention.

You may verify the ethical approval of this method, or raise any concerns you might have, by contacting the Human Research Ethics Office at the University of Victoria (250-472-4545 or ethics@uvic.ca).

Your signature below indicates that you understand the above conditions of the Social Impact Bond for the purpose of this study.

Appendix D

Control Group Program

Baseline Week

Hello!

I hope you had a good weekend!

By now you should have received your Fitbit and hopefully have had a chance to login to your account and get that set up. If you have any questions. please send me an email ASAP so I can help you out.

As you are aware, baseline week starts tomorrow. This week (DATE HERE) serves to get you comfortable with your Fitbit and work out any kinks. The battery life on your Fitbit can last up to 10 days so you should hopefully make it through the week after a good charge!

I would also like to re-iterate some safety components in participating in this study. This is a physical activity study where we are strongly encouraging you to increase your activity. Taking rests when you desire and keeping a water bottle nearby are highly recommended. You may also want to keep a granola bar or a different form of "quick sugar" snack nearby. You may experience minor discomfort or shortness of breath. If you feel any pain during your activity, please stop what you're doing. If this pain or any shortness of breath doesn't go back to normal in about 10 minutes, please contact your doctor immediately.

I will be in touch with you again at the end of the week with some educational tips and tricks to add more activity into your days!

Have a good week and happy moving!

Amanda

Week 1

Hello!

I hope you had a good weekend!

Baseline week is wrapping up today meaning you will continue to hear from me weekly with tips and tricks to add more activity into your lifestyle.

HealthLinkBC has an awesome summary of some introductory information to becoming more active. Check it out: https://www.healthlinkbc.ca/health-topics/ftpln#hw155909

The key take-away from this article is the following: 150 minutes of moderate-to-vigorous activity, or 2.5 hours, per week is the ideal goal for health-related benefits. Although this amount may seem intimidating at first, research has shown that we can accumulate these benefits in 10-minute bouts of activity.

Embarking in a new physical activity journey won't always be easy. Remember that progress takes place outside of your comfort zone. I challenge you this week to find the time for yourself and take an extra 10 minutes to go for a walk around the block.

Please let me know if you have any questions and if not, I'll be in touch with you next weekend!

Happy moving,

Amanda

Week 2

Good morning,

Another week is in the dust and week 2 starts tomorrow!

This week's resources are going to focus on goal setting and doing activity you enjoy!

Check out this link from HealthLinkBC: https://www.healthlinkbc.ca/health-topics/aa165656#aa165656-sec

There are so many different types of moderate and vigorous activities to do- indoors, outdoors, in the water, and so on! While "housework" may not be enjoyable to everyone, activities around the house that you HAVE to do (sweeping, vacuuming, mowing the lawn, etc.) can typically be considered at least moderate activity. You can always turn on some music, a podcast, or a TV show to make certain activities more enjoyable!

Also in that link, note the "competition" section. While meeting the Canadian Physical Activity Guidelines is not a quite a competition, it is a goal and an awesome metric to work towards. We can make little changes every week, that in turn help us reach our goal. Some fun options are: parking a little bit further away at the grocery store, taking the stairs instead of the elevator, or dancing a little bit more to our favourite songs!

This second resource, linked below, is an Exercise Planning Form. Find some time this week to answer the questions, whether it be on a scrap piece of paper, in your head, in a word document, or in a journal.

Exercise Planning Form: https://www.healthlinkbc.ca/health-topics/zx3727#zx3727-sec

Please let me know if you have any questions and if not, I'll be in touch with you next weekend!

Happy moving,

Amanda

Week 3

Hi,

We've made it to week 3!

This week I am sharing with you Hypertension Canada's Health Behaviour Management Recommendations. It is no surprise that physical activity is the first health behaviour that they recommend is physical activity! Hypertension Canada's Guidelines align with the Canadian Physical Activity Guidelines, but they word their guidelines slightly differently.

Hypertension Canada's Exercise Prescription looks like this:

> An accumulation of 30-60 minutes of dynamic exercise of moderate intensity (such as walking, cycling, swimming) 4-7 days per week in addition to the routine activities of daily living. Higher intensities of exercise are no more effective at BP lowering.
>
> For non-hypertensive or hypertensive individuals with a blood pressure of 140-159/90-99 mmHg, the use of resistance or weight training exercise (such as free weight lifting, fixed weight lifting, or hand grip exercise) does not adversely influence BP.

We can use Hypertension Canada's recommended "accumulation" of exercise to meet our target of 150 minutes of moderate-to-vigorous physical activity each week! Also note that higher intensities of exercise are no more effective than moderate activities at lowering your blood pressure! Any activity is good activity!

For the full recommendations, please click this link:
https://guidelines.hypertension.ca/prevention-treatment/health-behaviour-management/

Another resource I would like to share with you addresses getting around barriers to exercise. Time, or lack thereof, is the number one reason why people don't exercise! While sometimes it may really feel like you don't have any hours left in the day… But it can also be because you haven't prioritized it to be a part of your day! Making exercise a priority, of course, won't happen overnight, in a week, or even in a month. You don't have to be extreme, just be consistent!

Here is HealthLink BC's resource guide to overcoming the time barrier and more: https://www.healthlinkbc.ca/health-topics/ta2537#ta2537-sec

Please let me know if you have any questions and if not, I'll be in touch with you next weekend!

Happy moving,

Amanda

Week 4

Hello!

Can you believe week 4 is starting tomorrow already?! Time flies when you're having fun! 😉

This week I am building on the "Health Behaviour Management" content we saw last week and sharing some key lifestyle factors to leading a heart-healthy lifestyle. Did you know that a lot of recommendations and lifestyle modifications apply to both hypertensive and "normotensive" individuals?

When we think about chronic conditions, like hypertension, stroke, diabetes, etc., there are *non-modifiable* and *modifiable* risk factors that can make us more susceptible to these conditions. Non-modifiable risk factors are what we can't control, like age or genetics. Modifiable risk factors are what can be controlled by leading a healthy lifestyle. For the full list of these risk factors, please click here: https://hypertension.ca/hypertension-and-you/about-hypertension/what-are-the-causes/.

The non-modifiable risk factors, that we refer to as lifestyle components/ factors/ changes, that the Canadian Hypertension Education Program wants individuals to improve are:

1. Eating healthy
2. Limiting salt intake
3. Being active
4. Managing stress
5. Limiting alcohol
6. Quitting smoking

For some considerations to accompany these components, please visit this link: https://hypertension.ca/hypertension-and-you/managing-hypertension/what-can-i-do/.

Your Fitbit actually can help out with many of these lifestyle changes. I know we know that it can track our physical activity, but another important lifestyle factor that our Fitbit helps track and manage is stress management. There are 3 resources available through Fitbit: Mindfulness, Relax, and the Stress Management Score. Please refer to this website

for more information about what these components include:
https://help.fitbit.com/articles/en_US/Help_article/2077.htm.
I do not want to belittle the detrimental effects of what stress can cause to ourselves. I acknowledge that guided breathing and meditation are only one step in handling stress, especially during the COVID-19 pandemic. If you feel you need additional resources, please refer to this website or contact your physician:
https://www.healthlinkbc.ca/mental-health-covid-19.

Please let me know if you have any questions and if not, I'll be in touch with you next weekend!

Happy moving,

Amanda

Week 5

Hello,

I hope you had a good weekend!

We're halfway through the 8-week program now!

This week we're going to learn about setting SMART goals! SMART goals are structured and trackable and will support you in reaching your goals and objectives! Grab a paper near by or make a note in your phone of the goal you want to set for yourself SMART is an acronym that stands for:

S- Specific
M- Measurable
A- Attainable
R- Relevant
T- Time-based

Specific refers to the what? Where? When? And why? Be as specific as possible!
Measurable indicates that we need a metric to track this goal. Like writing in a calendar when you do an activity that leads to reaching that goal.
It is important that the goal you're setting is **A**ttainable, or realistic. Instead of saying that you're going to exercise for one hour, seven days a week, set a goal that's more realistic to your lifestyle. Perhaps three days a week.
Relevant- make sure your goal means something to you!
And lastly **T**ime-based! Give yourself enough time to reach the goal, but not too much time!

I challenge you to set a SMART goal to be met before the end of this program (in 4 weeks' time!) Please refer to this link for more guidance with goal setting: https://www.healthlinkbc.ca/physical-activity/smart-goal-setting

Please let me know if you have any questions and if not, I'll be in touch with you next weekend!

Happy moving,

Amanda

Week 6

Hi,

We're entering the final few weeks of the program!

Today we're going to be debunking exercise and fitness myths that you may or may not have pondered about while exercising a bit more!

Myth #1: If you're not working up a sweat, you're not exercising hard enough.

False: Sweating or perspiring is not necessarily an indicator of exertion. Perspiring is your body's way of cooling itself. It's possible to burn a significant number of calories without breaking a sweat.

Myth #2: When it comes to physical activity, you've got to feel some pain if you're going to gain any benefits.

False: A fitness activity should not hurt while you are doing it, and if it does, then either you are doing it incorrectly, or you already have an injury. As for "working through the pain," experts advise against it. If it hurts, stop, rest, and see if the pain goes away. If it doesn't go away, or if it begins again or increases after you start an activity, see a doctor.

Myth #3: If you can't be active often enough, you might as well not even do it.

False: Any activity is better than no activity, even if it's only a 15-minute walk. Being physically active is important for heart health and is proven to reduce stress. So, even if you can't make it to the gym or yoga class, you can always do something active each day. Taking a walk, climbing the stairs instead of hopping on the elevator or escalator all count!

These myths were debunked by the Heart and Stroke Foundation. Please refer to this link for more myth busting: https://www.heartandstroke.ca/articles/are-these-common-fitness-myths-holding-you-back

HealthLinkBC also debunks a few fitness myths that you may be interested in. Please look here: https://www.healthlinkbc.ca/physical-activity/myths to debunk more fitness myths.

Bottom line is any bit of activity is better than being sedentary and if you hear a fitness "fact", make sure you do your own research to ensure that the information is indeed factual!

Please let me know if you have any questions and if not, I'll be in touch with you next weekend!

Happy moving,

Amanda

Week 7

Hello!

You've made it to week 7!

I hope that last week's tips of busting physical activity and exercise myths helped bring awareness to understanding where your health information is sourced from!

Being 6 weeks into a physical activity program, I hope you have noticed some changes as you complete more activity. A regular physical activity routine or habit has such a large impact on our bodies as a whole. I will break down some of the benefits that we see:

1. We know that physical activity is great for our **heart**. Not only does physical activity help lower our blood pressure, but it also helps reduce the risk for cardiovascular disease, stroke and many other chronic diseases, lower "bad" cholesterol levels, and helps improve bone mass to help prevent osteoporosis!
2. Brain **boosting** and stress release! By now, you may have noticed some positive changes in your mood, and even in your productivity or quick thinking. Research has shown that after just 30 minutes of exercise, these traits are improved! We know that physical activity helps reduce our blood pressure. This, in turn, helps us manage our stress levels better by improving our self-perception and our anxiety levels as a stress response.
3. Improved **quality of life**! Not only does routine physical activity help us live longer, it helps us live BETTER! Regularly completing 30 minutes of activity can help burn calories, reduce joint pain, increase your strength, and improve emotional functioning, resulting in better physical and mental health.

For more "secrets" about what physical activity and exercise does to help us live a better life, please refer to this link: https://www.heartandstroke.ca/articles/being-active-makes-you-smarter-and-other-secrets

Please let me know if you have any questions!

Happy moving,

Amanda

Week 8

Hi,

You've made it to the final week of the program! I am so proud of you for making it to week 8. Today's focus will be to make sure you have quick access to different resources to help you stay on track to continue with your physical activity journey!

While you will no longer have the Fitbit, you may want to familiarize yourself with the health app on your Smartphone. You can usually find basic activity information, like the number of steps you've taken (when you have your phone on you!)

You could also explore the Google Play/ App Store for any physical activity logs if that's something you'd be interested in to help keep you accountable!

First is some physical activity logs from the BC HealthLink:

1. https://www.healthlinkbc.ca/physical-activity/physical-activity-log
2. https://www.healthlinkbc.ca/physical-activity/walking-log

The accountability piece that comes along with writing/ typing out your activity is HUGE and there are so many free resources to help with this.

Next, I want to address SMART goals again… What are your goals for the next 8 weeks? 4 months?

Refer to this link to set up another SMART goal for yourself:
https://www.healthlinkbc.ca/physical-activity/smart-goal-setting

Last, here is a list of other resources through BC HealthLink has provided to help keep active:
https://www.healthlinkbc.ca/physical-activity/staying-active

The three tips that stick out most to me (that I haven't already listed above) are:

1. Get support from friends, family, and coworkers. They can provide encouragement and help during difficult times.
2. Be active in a variety of places (for instance, use stairs, park your car away from stores and walk, take a walking break at work).
3. Keep refining and reviewing your goals. If you're not making progress, change your goals or activity plan.

Our next step is to set up a follow-up meeting again through Zoom. What is your availability like the week of [date]?

I look forward to hearing from you soon!

Please let me know if you have any questions and if not, I'll be in touch with you next weekend!

Happy moving,

Amanda

Appendix E

Follow-Up Questionnaire

MY BLOOD PRESSURE, POST-INTERVENTION: _____/_____ mmHg

1) What do you feel are the benefits of using the app?
Probe: Was it enjoyable to use?
Probe: What would have made it more enjoyable?

2) What do you perceive as barriers to using the game app?
Probe: What didn't you like?
Probe: What would have made you use it more?

3) Do you think that the game bike/stationary bike is a valuable piece of exercise tool?

4). Can you tell me what you liked best about the application?

Probes: *information, layout, animations, graphics, video clips, discussion board etc. Can you tell more about that?*

5. Can you tell me what you liked least about the application?

Probes: *information, layout, animations, graphics, video clips, discussion board etc. Can you tell more about that?*

6. Can you tell me about how easy it was to navigate or our find your way around the application?

Probes: *What were the challenges of navigating through the site? What would make it easier to navigate through the site?*

7. Can you tell me about what you thought about the overall look of the application?

Probes: *For example, the design, colours, and images on the web-site. Does the website feed warm and friendly or cold and technical? Can you tell me more about that? Do you think it is visually appealing? What would make the web-site more appealing?*

8) Is there anything else that you would like to add that you feel we have missed?