Automated Technology Based Behavioural Intervention to Promote Exercise Adherence: A Pilot Study to Ascertain Efficacy

A thesis

submitted in partial fulfilment

of the requirements for the degree

of

Master of Applied Psychology

(Behaviour Analysis)

at

The University of Waikato

by

Vincent Thor Allen

THE UNIVERSITY OF

WAIKATO

Te Whare Wānanga o Waikato

2015

Abstract

Exercise has been shown to be an effective treatment for a range of physical and mental health problems. Development of automated exercise therapy options will result in greater accessibility of treatment for those who would be otherwise unable to access it. The purpose of this study was to design and evaluate an automated technology based behavioural intervention for the purpose of increasing the participant's physical exercise adherence.

The study was run as a non-concurrent multiple baseline across participants design over a 12 week period. Nine participants (2 male, 7 female) aged 18 to 34 (*M* = 23.11) took part in the study. They completed a baseline phase of three to six weeks during which exercise data were recorded. The intervention phase lasted seven to eight weeks, during which an intervention was delivered via email and online survey in an attempt to increase physical exercise, and promote long term exercise adherence. Effectiveness of the intervention was evaluated using measures of duration and intensity of exercise activity, and an 18 item Exercise Self-Efficacy Scale.

For most participants there was a significant increase in exercise activity and exercise self-efficacy score as a result of the intervention. Component analysis of the intervention provided information as to which aspects were effective, and which may need to be modified for subsequent iterations. These results show that an automated technology based behavioural intervention can increase exercise behaviour in such a way that promotes long term adherence. Future studies could focus on using a smartphone app as the delivery method for similar interventions as this would allow for additional features to be added, and more effective delivery of the aspects of the intervention that have been shown to work.

Keywords: Exercise adherence. Exercise self-efficacy. Technology. Behavioural exercise intervention. Automated.

Acknowledgements

First and foremost I would like to take this opportunity to thank my supervisors Mary Foster and Rod Corban for their guidance throughout this project. You have both been very supportive of my research interests, and have tried to steer me in the right direction without being discouraging. Instead of telling me that my research aspirations were too ambitious, you provided excellent guidance as to how I might overcome the problems that I had set myself up to encounter. The confidence that you have both shown in my ability is appreciated. I would also like to express my gratitude to the University of Waikato. Without the resources made available to me in the form of scholarships, and part-time work, I would not have been in a position to be able to undertake this thesis.

A big thank you to the team down at No. 3 Dairy; thesis writing can be a lonely affair and it was great having likeminded colleagues with whom I could commiserate when things were looking bleak. To the people who participated in my research; thank you for contributing your time to my research project. I hope that it has improved your lives. Keep exercising!

Last but not least, I would like to thank my friends and family (especially my wonderful partner Ana) for the support they have offered me throughout my studies. Success does not occur in isolation; my own accomplishments are a reflection of the people I choose to surround myself with. You're all great!

Table of Contents

List of Figures

List of Tables

Lack of Physical Exercise Globally

Engaging in regular physical exercise has been shown to be beneficial in several areas of physical and mental health (World Health Organisation [WHO], 2010). Despite this, 31% of the global population do not exercise at the level required to access these health benefits (WHO, 2014a). Each year approximately 3.2 million deaths are attributed to insufficient physical activity. As of 2010 physical inactivity was the fourth highest risk factor for mortality worldwide (WHO, 2010).

Data from the WHO show that physical inactivity is a major problem worldwide, but that it seems to be worse in developed countries; in the USA, 41% of adults over the age of 15 do not exercise at a level consistent with WHO guidelines, as compared to 17% in the South East Asian region (WHO, 2008). Over the past 50 years, the prevalence of individuals leading a sedentary lifestyle in the USA has increased significantly (Brownson, 2005). This can be attributed to several factors; a decline in walking for transportation, higher rates of automobile dependence, lower incidence of strenuous household activities, and a large decline in the prevalence of physically active occupations (Brownson, 2005).

This increase in sedentary lifestyle is not confined to the USA. Similar levels of physical inactivity can be seen in other developed regions; 43% of people in the Eastern Mediterranean Region, 45% in the Americas, 63.3% in the United Kingdom, 62.5% in the United Arab Emirates, 37.9% in Australia, and 47.6% in New Zealand do not exercise at a level consistent with WHO guidelines (WHO, 2008).

Physical Inactivity in New Zealand

Physical inactivity is a major problem here in New Zealand, as well as abroad. New Zealand is the 17th (out of 122) most inactive country worldwide, with almost 50% of the population not being sufficiently active (WHO, 2008). Physical inactivity is at pandemic level in New Zealand, as well as many other countries (Greater Wellington Regional Council [GWRC], 2013). In New Zealand there are also serious economic consequences associated with physical inactivity: The direct and indirect health costs that occurred as a result of physical inactivity were estimated at around $1.3 billion in 2010, which accounts for about 0.7% of the country's gross domestic profit (GWRC, 2013). There are numerous health problems that can occur as a result of physical inactivity, such as obesity, cardiovascular disease, and diabetes (WHO, 2014b).

Physical Health and Exercise

Obesity and being overweight are two of the most serious current global health concerns (WHO, 2014b). Worldwide prevalence of obesity has almost doubled since 1980; over 1.4 billion adults aged 20 or over were overweight in 2008, which is around 35% of the total global population (WHO, 2014b). Approximately 500 million of these overweight adults were classed as obese, accounting for around 11% of the total global population (WHO, 2014b). Obesity and being overweight result in 3.4 million deaths annually, largely due to an increased risk of cardiovascular disease and diabetes (WHO, 2014b). At an individual level, the main areas that should be addressed to combat the obesity epidemic are excessive dietary intake, and lack of physical activity. It has been suggested that increasing levels of physical exercise in the general population would be an effective method of addressing the overweight and obesity problem (Brownson, 2005; WHO, 2014).

Exercise provides benefits in many areas of physical and mental health, such as; cardiovascular disease, colon cancer, breast cancer, type 2 diabetes (Lee et al., 2012), bone density, low back pain, generalized anxiety disorder, and depression (Dishman, 1991). Engaging in regular physical activity can decrease the risk of developing a cardiac disorder by up to 30% (Williams, 2001). In light of this, it seems as though research directed toward increasing levels of physical activity in sedentary populations is a worthwhile pursuit.

Mental Health and Exercise

Physical health problems are not the only ones that can be addressed by increasing levels of physical activity; mental health disorders such as depression can also be treated by using physical exercise (Dishman, 1991; Dunn, Trivedi, Kampert, Clark, & Chambliss, 2002). Depression is a disorder that affects over 350 million people globally at any one time. It can severely impair everyday functioning, and is the leading cause of disability worldwide (WHO, 2004). In an international survey, one out of 20 people reported having had a depressive episode in the preceding year (Marcus, Yasamy, Ommeren, Chisholm, & Saxena, 2012).

There are effective, evidence based treatments available for depression. In spite of this most cases go untreated; fewer than half of those affected have access to treatment (WHO, 2012). Several factors could be contributing to this problem; stigma attached to the diagnosis, lack of patient resources such as money and spare time, and lack of treatment providers. In some countries, less than 10% of affected patients are able to receive treatment for the disorder (WHO, 2012). Global prevalence of depression is increasing, and it has been classed as a priority condition (WHO, 2012).

New Zealand is no exception to the global rise in mental health problems; 47% of the population will suffer from a mental illness or addictive disorder at some point in their life, with 20.7% being affected in any one year (Oakley, Wells, & Scotts, 2006). Prevalence of mental illness is higher amongst those who are disadvantaged. Those with less education and a lower household income are more likely to suffer from a mental illness (Oakley et al., 2006).

A survey conducted in 2012 by the Ministry of Health [MOH](2012) has shown that 16% of New Zealanders will have received a diagnosis for a common mental disorder (depression, anxiety, or bi-polar) during their lifetime. Depression was the most prevalent, accounting for 87.5% of the total. The same survey conducted in 2007 showed overall prevalence rates at 13% for the same set of disorders, which indicates that there was a 19% increase in number of diagnoses from 2007 to 2012. When the data were grouped according to socio-economic status, it was found that individuals living in the most deprived neighbourhoods were 1.7 times more likely to be diagnosed with a common mental disorder than those living in the least deprived neighbourhoods (MOH, 2012).

The number of patients using mental health and addiction services in New Zealand is quite low when compared with the prevalence rates of common mental illnesses. For the 2011/2012 year, only 137,346 people accessed mental health and addiction services (MOH, 2012). There is a large disparity between the number of people diagnosed with mental illness or an addictive disorder in any one year, approximately 900,000 (Oakley et al., 2006), and the number of people who receive treatment through mental health and addiction services. A common barrier to treatment is a lack of resources such as money and time on the part of the patient (WHO, 2012), which compounds the issue of poorer people being over-represented in these statistics; they are more susceptible to depression, and do not have the resources to seek treatment for it. Depression is a serious global health concern, and the lack of resources to deal with the ever increasing number of people who are being diagnosed with the disorder is a problem that needs to be addressed (WHO, 2004).

Automation of Therapy to Increase Availability

To address this problem, treatment options need to be made cheaper and more accessible. Most conventional treatments require the presence of a trained therapist. This limits accessibility for many people due to the insufficient number of trained therapists and high costs for patients. Development of treatments that do not require trained therapists will increase availability and drive down costs. This would be beneficial for making treatment available to a wider range of people; especially those in lower socio-economic brackets, who are over-represented in the statistics and less able to seek help.

The WHO has published recommendations for addressing the increasing prevalence of depression worldwide. They recommend increasing availability of alternative treatments that do not require specialist staff, with the proposed outcome being improved access to treatment through lower costs and greater availability (WHO, 2012).

An intervention to help increase physical exercise could be an effective way to treat depression without the need for a therapist. Exercise therapy has proven efficacy with a variety of depressive disorders across a range of different populations. Clinical trials using exercise as a treatment have been successful at reducing depression with; children, (Annesi, 2005), obese adolescents (Daley, Copeland, Wright, Roalfe, & Wales, 2006), college students (Mailey et al., 2010; Tyson, Wilson, Crone, Brailsford, & Laws, 2010), in-patients with major depression (Knubben et al., 2007), and in-patients with treatment resistant major depression (Mota-Pereira et al., 2010). Amount of exercise and severity of depressive symptoms have been shown to have a significant negative correlation in large scale population surveys (Brunes, Augestad, & Gudmundsdottir, 2013; Taliaferro, Rienzo, Pigg, Miller, & Dodd, 2009; Wiles, Haase, Lawlor, Ness, & Lewis, 2011). Exercise could possibly be used as an effective treatment for depression with quite a broad range of people.

In a recent meta-analysis, exercise was found to be as effective as pharmacological and psychological therapies in the treatment of depression (Cooney et al., 2013). This bodes well for the use of exercise as an alternative treatment; an exercise intervention could be just as effective as traditional therapies but be more accessible and have lower costs. Results from a study by Babyak et al. (2000) provide support for the use of exercise as a treatment option. This study evaluated the efficacy of exercise against the use of Sertraline; a selective serotonin reuptake inhibitor (SSRI). Three groups were used in the study; Sertraline alone, exercise therapy alone, and Sertraline combined with exercise therapy. All three groups had significant decreases in levels of depression after 4 months. However, at the 10 month follow up participants in the exercise therapy group had significantly lower rates of relapse as compared with the Sertraline group. Surprisingly, the combined exercise and Sertraline therapy was no more effective at reducing MDD symptoms than either of the others and had higher levels of relapse than the exercise therapy alone. These findings indicate that when exercise is used to treat major depression, it can be at least as effective as a common SSRI, with lower levels of relapse 10 months after treatment.

While an intervention aimed at increasing levels of physical activity could be an effective way to treat depression, it needs to be able to be delivered without a therapist. To increase availability of treatment options, new methods of delivery need to be explored. Technology based interventions look to be quite promising for this application due to the fact that it is possible to set them up to deliver an intervention without the need for any human interaction, which removes the need for a therapist. As has been previously stated, the necessity for a trained therapist is one of the major factors that limit availability of treatment.

Use of Technology to Change Health Related Behaviours

The use of technology to administer therapeutic physical activity interventions has been advocated in several studies and reviews (King et al., 2008; Lewis, 2007; Nigg, 2003; Steele, Mummery, & Dwyer, 2007; Vandelanotte, Spathonis, Eakin & Owen, 2007). Prior success with automated electronic physical activity interventions has shown that the presence of a therapist is not strictly necessary for success. King et al. (2008) designed and tested an automated PDA based exercise intervention program. They found significantly greater calorie expenditure and minutes spent exercising per week for the experimental group than for the control group. A systematic review of the use of non face-to-face interventions for increasing physical found that 14 of the 17 studies examined reported significant increases in physical activity (Muller & Khoo, 2014).

Similar results were found by a meta-analysis looking at the presence of behaviour change theory in internet delivered interventions to promote health behaviour (Webb, Joseph, Yardley, & Michie, 2010). There were 85 studies included, with a total sample size of 43,236 participants. It was found that more extensive use of behaviour change techniques in the intervention resulted in greater increases in exercise behaviour. These results indicate that the internet can be used effectively to bring about change in health related behaviour, but that active components of interventions should be based on relevant psychological theory.

Smartphone Apps for Delivering Interventions

Another possible method of delivery is the smartphone. With the advent of smartphone technology, it has become much easier for computer applications to be integrated into everyday life. This has created an opportunity for the development of physical activity interventions that can be delivered in an intuitive, accessible manner. Developing smartphone apps for increasing physical activity that are based on solid theory and research may be a useful way to automate an effective physical activity intervention.

A large scale content analysis of the presence of relevant psychological theory in current smartphone fitness apps was conducted by Cowan et al. (2013). They found that that the majority of fitness apps were lacking in relevant theoretical content. The scoring system used for the analysis was a 1 – 100 point scale. The observed range of scores for the apps was 1 – 28, with a heavy skew toward lower scores. It was proposed that the lack of theoretical content in exercise apps is not surprising due to the fact that most of these apps are developed by programmers who have little to no background in the area of exercise psychology. This presents an excellent opportunity for programmers and psychologists to work together to create effective, evidence based, theory rich smartphone apps for increasing physical activity (Cowan et al., 2013).

There are quite a few possible avenues to explore when deciding on a method of delivery for an intervention aimed at increasing levels of physical exercise. The use of technology such as the internet, email, and smartphone apps will enable the intervention to be delivered without the need for any human interaction, which will increase accessibility of the intervention as a therapeutic tool due to the lack of a requirement for a trained therapist.

Summary of Justification

Physical inactivity is a worldwide health concern that is steadily worsening. It is more prevalent in developed nations due to an increased reliance on automotive transportation, and a decrease in the number of physically demanding occupations. Many physical health problems such as diabetes, obesity, and cardiac disease can occur as a result of insufficient physical exercise. Physical exercise has many protective benefits for both physical and mental health; it can lower the risk of cardiovascular disease, colon cancer, breast cancer, diabetes, anxiety, and depression.

Depression is a serious health problem that affects more than 350 million people worldwide. It is the leading cause of disability worldwide, but most cases go untreated due to a lack of treatment providers. The prohibitive cost of therapy puts it out of reach of the demographic that is most affected; people in lower socio economic brackets. To make sure that treatment for depression is more readily available to those who need it, steps need to be taken to decrease associated costs, and improve accessibility. Alternative therapy options are needed that do not require the presence of a therapist. The necessity for a therapist is a significant barrier due to increased cost and the limited number of trained professionals.

Exercise can be used to address a variety of serious health issues; obesity, being overweight, cardiovascular disease, diabetes, and depression. These are some of the most serious global health risks, which are becoming increasingly prevalent in developed countries. Physical exercise has been shown to have a significant negative correlation with severity of depression in large scale population surveys. Clinical trials have shown that it can be at least as effective as traditional therapies and psychopharmacological treatments for the treatment of depression.

A treatment that gets people exercising regularly could be used with many different populations to treat a variety of health problems. To overcome the issue of accessibility, it would need to be cost effective, and able to be delivered without the presence of a therapist. The use of technology (internet and smartphone apps) to deliver an automated intervention aimed at promoting physical activity would help to provide a low cost, accessible treatment option. In previous studies there have been high attrition rates when exercise was used as an intervention to treat depression (Dunn et al., 2002). In light of this, any intervention aimed at increasing exercise behaviour should be designed to address some of the aspects of exercise which generally decrease levels of adherence, and promote those which have been shown to increase adherence.

Outline of the Exercise Intervention Used in the Current Study

The purpose of this study was to see whether an automated, email delivered intervention could be used to increase exercise behaviour in such a way that facilitates long term adherence to an exercise program. The intervention was delivered via email, but the active components were designed so that they could be easily incorporated into a smartphone app. Human interaction with the participants was minimised, so that the intervention could be delivered in a manner analogous to that of a smartphone app.

The aim was to slowly raise exercise behaviour from a low rate, whilst minimising punishment contingencies associated with exercise, maximising reinforcing contingencies, and teaching skills that facilitate long term exercise adherence such as proximal goal setting, scheduling, and management of exercise intensity and duration. The active components of the intervention included; weekly exercise targets, weekly tasks to complete, feedback on target completion, and management of intensity and duration of exercise through information provided to the participants. Inclusion of components that have been shown to increase rates of exercise adherence should help to address the issue of participant attrition which is a common problem with exercise based interventions (Dunn et al., 2002).

The experiment was run as a non-concurrent multiple baseline across participants design. This allowed for adequate control of confounds with a limited sample size. The primary measures used in the study were duration and intensity of exercise, and changes in exercise self-efficacy (ESE) scores. Exercise duration and intensity were measured by self report via weekly email survey as this was more representative than pedometers or heart-rate monitors of how a smartphone app would function. Exercise self-efficacy was used as a measure to predict likelihood for maintenance of the exercise behaviour, and efficacy of the intervention. Exercise self-efficacy was measured at three points during the study; pre-baseline, pre-intervention, and post intervention. This was to ensure that any changes in self-efficacy score during the baseline phase were not assumed to have occurred during the intervention phase.

There were several other outcome measures that were compared with ESE change and number of targets met. These included; average exercise increase from baseline to intervention, average time spent exercising during baseline, average time spent exercising during intervention, positive deviation from targets, negative deviation from targets, amount of vigorous activity performed, goal setting task completion, social task completion, and scheduling task completion. These measures reflect several of the components that were included in the intervention which will be discussed presently, such as; setting achievable targets, encouraging mastery experiences, slowly increasing the exercise requirement, prescribing moderate intensity exercise, setting proximal goals, facilitating social support, and teaching scheduling skills. Analysis of the relationships between these measures and the primary outcome measures should generate insight into which components of the intervention were the most effective, and which ones need to be removed or modified.

The ideal outcome of the intervention will be the participant exercising at a moderate intensity for at least 90 minutes per week, and experiencing a significant increase in exercise self-efficacy score. Increased self-efficacy scores, along with acquisition of the appropriate scheduling skills, goal setting skills, and reinforcement contingencies, should lead to ongoing maintenance of the exercise behaviour.

Exercise Self-Efficacy: Why It Is Being Used as a Measure

One of the primary goals of the intervention was to increase the likelihood of ongoing adherence to an exercise program. Due to time and budget constraints, it was not possible to gather long term exercise adherence data for this study, which raises the question of how to measure the likelihood of the participants adhering to their exercise program long term. This hurdle was overcome by using exercise self-efficacy as a measure to estimate the likelihood of the participants maintaining their exercise behaviour.

Predictive value of exercise self-efficacy: What it tells us about exercise behaviour. There is quite a lot of research supporting the use of exercise self-efficacy as an outcome measure for this study: Self-efficacy is one of the most reliable predictors of long term exercise adherence: Desharnais, Bouillon, and Godin (1986) found that exercise self-efficacy was the most central determinant of exercise adherence. DuCharme and Brawley (1995) had similar results when testing two different types of exercise self-efficacy; they found that self-efficacy beliefs around ability to overcome common barriers to exercise, and beliefs in ability to regularly schedule exercise sessions, were both predictive of ongoing adherence to the exercise program. Williams et al. (2008) found that exercise self-efficacy was a very strong predictor of physical activity maintenance at six months with a sample of initially sedentary adults. In a review conducted by Williams and French (2011) of 27 different interventions looking at changes in exercise behaviour and exercise self-efficacy, it was found that when there was a significant change in the physical activity measure, it was accompanied by a significant change in the exercise self-efficacy measure. In a review looking at the behavioural determinants of exercise, Sherwood and Jeffery (2000) state that "exercise self-efficacy is the strongest and most consistent predictor of exercise behaviour" (p. 25). These findings support the idea that by measuring changes in the exercise self-efficacy scores of the participants in this study, it will be possible to estimate the likelihood of them maintaining their exercise behaviour.

Another way that self-efficacy will be useful as a measure is for estimating the effectiveness of the intervention: Because of the way the exercise targets are set, and the goal of limiting the amount of exercise performed in the early stages, an increased level of exercise does not necessarily mean that the intervention was more successful. Using self-efficacy score changes as well as exercise time as a measure will provide more meaningful data for examining the efficacy of the various intervention components, and the overall effect of the intervention (Williams & French, 2011).

Bandura (1991) defines self-efficacy as an individual's belief in their ability to achieve what they set out to do. He states that self-efficacy beliefs regulate behaviour in many different ways; they have an effect on choices made, goals and aspirations, effort expended, and perseverance in the face of adversity (Bandura, 1991). When people perceive themselves to be more capable, they set themselves higher goals, and tend to be more committed to achieving them (Bandura, 1991). When a person's task performance falls short of their goal, whether this is motivating or discouraging depends on their level of self-efficacy (Bandura & Cervone, 1986; Locke & Latham, 1990). People with lower self-efficacy tend to be easily discouraged by failure, whereas people with higher self-efficacy are more likely to keep trying until they succeed (Bandura & Cervone, 1986; Locke & Latham, 1990). According to Bandura (1991), the effect that causal attributions have on subsequent performance has been shown to be mediated almost completely by an individual's self-efficacy beliefs. Self-efficacy beliefs modify how failures and successes are perceived; when a person with high self-efficacy fails they tend to ascribe the failure to a lack of effort, whereas somebody with low self-efficacy is more likely to ascribe the failure to a lack of ability (Bandura & Locke, 2003). The same is true of social comparisons; when self-efficacy is higher, viewing others performing a task will result in increased performance in the task. When it is lower, the same observation will result in decreased subsequent performance (Bandura & Jourden, 1991). This is all very important information that can be integrated into an exercise intervention to make sure that it functions in such a way as to maximise the exercise self-efficacy of the participants, which should allow them to set themselves higher goals, and limit the negative effect that failures have on their subsequent performance.

An issue that arises when using a construct such as exercise self-efficacy as an outcome measure is how to judge the significance of changes in the participant's score. It is difficult to look at an exercise self-efficacy score and use it to predict the likelihood of a participant maintaining their exercise behaviour long term; is an increase of one point on an 11 point self-efficacy scale significant, or is a more dramatic shift needed before we can say that there has been a meaningful effect. A way to deal with this issue would be to find another measure that correlates well with exercise self-efficacy changes, is reflective of actual exercise behaviour changes, and is sensitive enough that it can be used to judge the significance of any changes in exercise self-efficacy that occur during this study.

Using the Transtheoretical Model to determine the practical significance of exercise self-efficacy score changes. The Transtheoretical Model (TTM) could be used effectively for this purpose; it fits the previously mentioned criteria, and would be useful in this study for judging the significance of exercise self-efficacy changes. The TTM is a theory of behaviour change which proposes that there are a series of stages that an individual progresses through when initiating health related behaviour (Prochaska & Velicer, 1997). By using the TTM alongside the ESES, it will be possible to judge whether any ESE score increases are likely to result in changes in actual exercise behaviour.

As individuals move through the various stages of change for exercise related health behaviour, there is a corresponding increase in exercise self-efficacy scores (Kim, 2007; Marcus, Selby, Niaura, & Rossi, 1992). Research has shown that exercise self-efficacy scores can reliably differentiate between the stages of change in the TTM (Kim, 2007; Marcus et al., 1992). By looking at the ESE scores that Marcus et al. (1992) have found to be associated with particular stages of the TTM, it is possible to track the progress of the participants in the current study through the stages of the TTM.

The first stage of change in the TTM is called the pre-contemplation stage, during which the individual has no intention of taking action and often does not recognise that there is a problem with their current behaviour. The second is the contemplation stage, during which they begin to recognise the problem and begin to see the negative impacts of the unhealthy behaviour. The third is the preparation stage, during which intentions are made to address the problem in the near future, and small steps may be taken to get ready. The fourth is the action stage, during which the individual has started making progress in modifying the problematic behaviour. The fifth is the maintenance stage, during which the individual has managed to maintain their progress over a period of time, usually around six months for exercise related behaviour. The sixth is the termination stage, during which the individual has successfully integrated the new healthy behaviour into their life, and there is no chance of them reverting to the previous unhealthy behaviours (Prochaska & Velicer, 1997).

According to the TTM criteria outlined my Marcus et al. (1992), most of the participants in this study began the intervention in the pre-contemplation or contemplation stages, which is to be expected as the recruitment criteria stipulated that they must currently do no exercise, or very little exercise. The aim was to achieve increases in exercise self-efficacy scores that would raise them from the pre-contemplation and contemplation stages to the action or maintenance stages. Comparing the exercise self-efficacy score changes obtained in this study to those obtained in the study performed by Marcus et al. (1992) should indicate how far the participants have progressed through the stages of the TTM and give a meaningful measure of how successful the intervention was at increasing the probability of the participants maintaining their exercise behaviour long term.

How Can Exercise Self-Efficacy Be Increased?

Increases in exercise self-efficacy seem to be very beneficial with regard to increasing exercise behaviour, and ESE changes can be used to track progress through the TTM. Therefore it is important to discover how exercise self-efficacy scores can be increased during an automated exercise intervention. Several methods for increasing self-efficacy will be discussed, along with how they might be integrated into the proposed intervention.

According to Bandura (1977), there are four different factors that contribute to increases in self-efficacy beliefs; mastery experiences, vicarious learning, social persuasion, and physiological experiences. A recent study by Mcauley et al. (2003) supports this idea; a component analysis was performed to ascertain whether these factors did in fact contribute to levels of exercise self-efficacy. It was found that mastery experiences, the social environment, and affective experience of the individual during exercise all contribute individually in generating exercise self-efficacy expectations.

Mastery experiences. Mastery experiences are simply prior successes with the specified behaviour. They can also be thought of as the history of reinforcement associated with the behaviour. As the individual encounters more mastery experiences their self-efficacy scores improve (Bandura, 1977). When an individual does not have a history of mastery experiences with a certain task, failures tend to have a negative impact on subsequent performance (Bandura, 1991, Bandura & Cervone, 1986; Locke & Latham, 1990). Repeated mastery experiences generate higher self-efficacy, which decreases the negative impact of these failures (Bandura, 1977; Mcauley et al., 2003).

A good way to increase self-efficacy scores is through mastery experiences (Bandura 1991), which can be difficult when the individual has no prior experience with exercise. It has been proposed that educational approaches should be used to change perceptions of the difficulty of exercise and promote the benefits during the pre-contemplation, contemplation, and preparation stages (Prochaska & Velicer, 1997).

Integration into the intervention. The use of small achievable exercise targets will have allowed for mastery experiences to be accumulated early on, which should help to increase the reinforcing potential of the exercise and decrease the negative effect of subsequent failures. Providing participants with information concerning the usefulness of moderate intensity exercise in the early stages of the intervention should encourage early self-efficacy score increases.

Vicarious learning. Vicarious learning is the process of learning via observation of others (Bandura, 1977). When an individual witnesses somebody else successfully performing a task, this can raise their own efficacy beliefs concerning their ability to perform that task (Bandura, 1977, McAuley et al., 2003). This type of learning relies on inferences being made by social comparison. It is not as effective at improving self-efficacy scores as personal mastery experiences (Bandura, 1977).

Integration into the intervention. The proposed intervention was quite individualistic. It was designed to be implemented with a broad range of people, and there will not always be the opportunity for social comparison to occur. While there are some aspects of the intervention that may have resulted in a level of vicarious learning, it was not a primary focus of the intervention.

Social persuasion. Social persuasion can be thought of as the information and experiences that are provided by the social context surrounding the individual (Bandura, 1977). This covers things such as education concerning the task or behaviour, encouragement from peers, and discouragement from peers. Social persuasion must be used carefully when integrated into an intervention; when it is used by itself to modify outcome expectations without providing additional support structures for the participant, it can generate unrealistic expectations of capability that often result in failure and a subsequent decrease in self-efficacy (Bandura, 1977; Mcauley et al., 2003). Social persuasion is best used as an adjunct to other methods of increasing self-efficacy scores (Bandura, 1977). If conditions are arranged that facilitate successful completion of the task or behaviour, social persuasion can provide additional self-efficacy increases (Bandura, 1977).

Integration into the intervention. Social persuasion was integrated into the intervention in several ways: Participants were encouraged to inform their friends and family about their exercise goals, which should have generated praise for successful exercise behaviour. Information about exercise intensity and duration was provided to participants, which should have modified their own expectations of their ability to exercise (Mcauley et al., 2003).

Physiological experiences. According to Bandura (1977), physiological experiences are the physical responses elicited by a behaviour or task. He states that when a negative physiological response occurs as the result of attempting a challenging task, the individual may begin to question their ability to perform the task, which will have a negative effect on their self-efficacy beliefs (Bandura, 1977; McAuley et al., 2003). For example; a person begins a regular running routine but experiences shortness of breath and lactic acid build up; two physiological states that are quite unpleasant. The individual may now question their ability to perform the running task due to the fact that they cannot do it without experiencing these unpleasant consequences. These kinds of experiences also function as a punishment contingency for the running behaviour. If the individual tries to run, but their muscles burn and they have trouble breathing, they probably will not want to go running a second time.

Integration into the intervention. This intervention is targeted toward people who currently do little to no exercise, therefore if they attempt to exercise at an intensity or duration beyond their ability they are going to generate punishment contingencies in the form of unpleasant physiological experiences. Avoiding the discouraging and punishing physiological effects of exercise are likely to be important factors for increasing exercise behaviour and exercise self-efficacy scores. Attempts were made to control the intensity and duration of the participant's exercise activity by educating participants about the benefits of moderate intensity exercise, recommending lower durations of exercise, and setting low initial exercise targets.

Major Components of the Intervention: Justification for Inclusion, and Implementation Strategies

As has been previously stated, attrition is a significant issue when delivering interventions aimed at increasing exercise behaviour. So far there has been a specific focus on intervention components that will increase exercise self-efficacy, but it is also important to include intervention components that have been shown to increase actual exercise behaviour. A review of the literature has shown that there are quite a few different aspects of exercise that can be manipulated to increase the likelihood of the participants initiating and adhering to exercise behaviour, along with increasing their exercise self-efficacy scores. These usually involve minimising the punishment contingencies that are associated with exercise, introducing additional reinforcement contingencies, and teaching the necessary skills to facilitate both of these. Punishment contingencies can be avoided by controlling exercise intensity, gradually raising the exercise requirement, overcoming common barriers (time and access to facilities), and making the exercise more enjoyable. Reinforcement contingencies can be generated for participants by; setting exercise targets, creating opportunities for social reinforcement, teaching scheduling skills, using proximal goal setting, and increasing intrinsic motivation. Justification for these components will be outlined in the following sections, with each being followed by a brief explanation of how they were integrated into the intervention.

Prescribing moderate rather than vigorous exercise. As previously mentioned, regular exercise at a moderate intensity can be used effectively to treat depression (Dunn et al., 2002), and is recommended by the CDC (2011) and WHO (2010) for addressing public health concerns such as obesity, diabetes, and heart disease. Moderate intensity exercise has been shown to be more effective than vigorous intensity exercise at facilitating ongoing adherence to exercise programs (Peri et al., 2002). In a large scale study with varying exercise intensity prescriptions, the dropout rate for the vigorous intensity group was around 50%; almost double the dropout rate for the moderate intensity group (Sallis et al., 1986). A possible explanation for this is that vigorous exercise can be very unpleasant for people who do not exercise regularly. This could be due to physiological experiences such as muscle pain, shortness of breath, and lactic acid build up. By prescribing moderate intensity exercise the effect of these punishing contingencies is minimised.

One potential issue with prescribing moderate intensity exercise is that it can be perceived as being less effective than vigorous intensity exercise. Many fitness programs stress that it is important to push yourself and try your hardest.

Exercising in this way has been shown to be less effective than exercising at a moderate intensity for promoting long term adherence (Peri et al., 2002, Sallis et al., 1986).

Integration into the intervention. During the intervention, participants were only set moderate intensity exercise targets, and were discouraged from engaging in any vigorous intensity exercise. Information concerning the detrimental effects of vigorous intensity activity and the benefits of moderate intensity activity was provided to them before they began, and reminders were given throughout the intervention. Providing information regarding the positive effects of moderate intensity exercise should have helped to eliminate erroneous beliefs concerning the need for vigorous intensity exercise.

Slowly increasing the exercise requirement. The demographic being targeted for the intervention are those who currently engage in little to no exercise. Setting high initial requirements will not be effective, as there will be no initial history of reinforcement associated with the exercise behaviour for these people. A better approach would be to slowly increase the response requirement so that a history of reinforcement can be established. As positive reinforcement contingencies are created by meeting personal goals, achieving set targets, and building social support, the participant's exercise self-efficacy scores should increase. This increase in self-efficacy will increase the participant's resilience to setbacks and failures (Bandura & Cervone, 1986; Locke & Latham, 1990). As self-efficacy increases and a history of reinforcement is established, the exercise duration can be progressively increased. As the participant progresses through the intervention stages, they will begin to learn the goal setting and scheduling skills required to help them manage higher response requirements.

Integration into the intervention. Even though moderate intensity exercise causes less physical discomfort than vigorous exercise, participants with no exercise history may still experience aversive physiological effects when exercising at a moderate intensity. This can be mitigated by slowly increasing the exercise requirement; as their fitness increases, they will be able to exercise for longer, with fewer unpleasant physiological consequences. As the intervention progresses, self-efficacy should also increase. Increases in self-efficacy should decrease the negative outcomes of failing to meet goals, and can cause these failures to motivate rather than discourage the participant (Bandura & Locke, 2003). This means that targets and tasks can be increased as the intervention progresses, because as self-efficacy increases, potential failures will be less likely to result in decreased exercise participation.

The initial targets for participants to meet were based on their baseline exercise data. This was to ensure that they did not start out with an unrealistic target that they will fall short of. For each stage the target was be increased by only 20 minutes; which should have decreased punishment contingencies associated with excessive exercise, provided additional reinforcement contingencies via goal achievement, and increased exercise self-efficacy scores via mastery experiences.

Social support. The presence of social support has been shown to have a significant effect on increases in exercise self-efficacy scores (McAuley, Jerome, Marquez, Elavsky, & Blismer, 2003) and attendance rates within a structured exercise program (Fraser & Spink, 2001). The more support and encouragement that people get from those in their home and workplace, the more likely they are to engage in exercise behaviour (King, Taylor, Haskell, & DeBusk, 1990; Hovell et al., 1991; Hovell et al., 1989). This is true for both initiation and maintenance of exercise behaviour (Hooper & Veneziano, 1995). Exercising with a partner who is able to provide support and encouragement results in better adherence than exercising alone (Wallace, Raglin, & Jastremski, 1995).

These results show that increasing social support is an effective way to increase exercise behaviour, increase exercise self-efficacy scores, and promote higher levels of adherence. Therefore encouraging people to exercise with friends and emphasizing social aspects of physical activity interventions will be effective ways of improving exercise adherence (Sherwood & Jeffery, 2000).

Integration into the intervention. Social support was incorporated into the intervention by assigning simple tasks for the participants to complete; telling a friend about exercise successes, asking somebody to help motivate you to stick to your scheduled exercise days, and posting on social media sites about your successes. This should have created opportunities for praise from peers, encouraged exercising with others, and generated social expectations concerning their exercise behaviour.

Scheduling: Bridging the intention-action gap. Scheduling is a skill that seems to be very important for increasing exercise adherence. According to Gollwitzer (1999), intentions to exercise do not reliably translate into actual exercise behaviour; making a decision to exercise does not mean that you will actually do it. The relationship between intention and behaviour is mediated by the presence of planning skills; if specific implementation intentions are made concerning when, where, and how a person is going to exercise, it is more likely that they will initiate and maintain their exercise behaviour (Gollwitzer, 1999). Scheduling when where and how to exercise is a type of implementation intention. Implementation intentions are self regulatory skills that can be used to increase the likelihood of overcoming barriers to the target behaviour (Gollwitzer, 1999). The usefulness of incorporating implementation intentions such as scheduling into an intervention has been shown in a recent series of longitudinal studies (Schwarzer, Luszczynska, Ziegelmann, Scholz, & Lippke, 2008).

Implementation intentions are an important mediator in the relationship between goal setting and goal achievement; a meta-analysis has shown that when goal setting was combined with implementation intentions it was much more likely for the goal to be achieved (Gollwitzer & Sheeran, 2006). This is important because goal setting is a commonly used strategy to promote physical exercise adherence. If scheduling is not utilised, then the beneficial effects of goal setting may be diminished. Similar results were found in a study examining the role of action planning in maintaining physical exercise adherence (Sniehotta, Scholz, & Schwarzer, 2005); behavioural intentions did not necessarily predict exercise behaviour, but action planning was strongly predictive of exercise adherence and mediated the relationship between intention and behaviour. The definition of action planning is very similar to that of implementation intentions; making a plan concerning when, where, and how you are planning to exercise (Sniehotta et al., 2005).

Exercising to address health risks can be thought of as goal setting. Many traditional exercise interventions try to use health risk perception to motivate people to engage in exercise (Dishman, 1994). This is a problem because risk perception has been shown to be ineffective at predicting exercise behaviour (Dishman, 1994; Weinstein, 2003). If knowing about the health risks of a sedentary lifestyle was enough by itself to initiate and maintain maintenance of exercise behaviour, it would be a lot easier for people to stick to an exercise program. Even if a person were to state their intention to start exercising and set a goal for them self, such as lowering blood pressure or losing weight, this goal intention alone is usually not enough to initiate or maintain exercise behaviour. Additional skills such as action planning are needed for an exercise program to be effective (Gollwitzer & Sheeran, 2006; Schwarzer et al., 2008). Collectively, these results show that implementation intentions such as scheduling are an important part of mediating the relationship between intentions to exercise, and actual exercise behaviour. They can also be used to increase the effectiveness of goal setting.

Integration into the intervention. Teaching self regulatory planning skills to participants should be a useful way to increase their chances of maintaining adherence to an exercise routine. Action planning involves specifying the when, where, and how of the specified activity. Scheduling times for performing exercise is a type of action planning that was incorporated into the intervention. Assigning a simple scheduling task with a small reinforcement contingency for each stage of the intervention should help to bridge the intention-behaviour gap, and should result in participants being more likely to meet set exercise targets.

Proximal goal setting. The effectiveness of goal setting for increasing exercise behaviour was called into question in the preceding section, but research has shown that different types of goal setting are differentially effective for certain stages of exercise behaviour: Bandura and Schunk (1981) found that setting long term goals (distal goal setting) can be useful for initiating behaviour, but does not seem to be very helpful with long term adherence. They also found that setting short term, immediately achievable goals (proximal goal setting) is much more effective than setting distal goals for increasing self-efficacy, mastery of task related skills, and intrinsic interest in tasks.

Similar results were found in a study by Wilson and Brookfield (2009) in which they examined the effect that goal setting had on interest, enjoyment, and adherence in a six week exercise intervention. They found that exercisers who set proximal goals reported higher levels of interest and enjoyment than those who set distal goals, or no goals. This is important because increased enjoyment and interest in exercise behaviour should promote increased subsequent responding. At the beginning of the study, those who set proximal goals had significantly higher adherence during the intervention than the control group, and similar adherence to those who set distal goals. At three and six month follow ups, the proximal goal setting group had much higher adherence than the distal goal setting group. There was no difference between the distal goal setting group and the control group at three and six months (Wilson & Brookfield, 2009). These findings show that setting long term distal goals can be used effectively to initiate exercise behaviour, but that proximal goal setting is more useful for increasing long term exercise adherence.

Goal setting is important, but there are also moderating factors which can increase the effectiveness of goal setting. The usefulness of implementation intentions has already been discussed, but it is also important to include appropriate feedback on progress (Bandura & Cervone, 1983). The presence of feedback enables comparisons to be made between goals and actual performance. Without these comparisons goal setting is a lot less effective. The inverse is also true; feedback without goals to measure it against does not seem to be very effective at increasing subsequent performance with exercise tasks (Bandura & Cervone, 1983).

When both goals and feedback are present, subsequent task performance increases most when the actual performance is reasonably close to the set target or goal. When performance falls considerably short of the set goal, it can result in lowered self-efficacy, and poorer subsequent performance (Bandura & Cervone, 1983). These results indicate that proximal goal setting is useful for initiation and maintenance of exercise behaviour, while distal goal setting is only useful for initiation. Furthermore, to maximise the effectiveness of goal setting, appropriate feedback should be provided concerning goal achievement.

Integration into the intervention. Proximal goal setting has the potential to be a useful intervention component for both initiation and maintenance of exercise behaviour. Proximal goal setting was implemented into the intervention in two ways: Realistic, achievable goals were set for the participants in the form of weekly exercise targets, and a proximal goal setting task was set so that the participants acquired the skills to start setting their own proximal goals.

To minimise dissonance between goals and performance the set exercise targets needed to be realistic and achievable. Setting initial targets based on current baseline responding ensures that they are not too high, and increasing the requirement in small amounts as the stages progressed should ensure that there will not be a large dissonance between targets and the participant's ability to meet them. When setting their own proximal goals, participants should be trained to make sure that they are achievable, and inherent to the exercise activity itself. This was accomplished by explaining to participants that self-set proximal goals must be inherent to the activity being performed, realistic, and achievable within the session.

Overcoming common barriers: Access to facilities and time constraints. Prior research has shown that the most common environmental barriers to exercise are time and access to facilities (Dishman, 1991). Lack of time is the most prevalent reported reason for participants dropping out of clinical exercise programs (Dishman, 1991). Convenience of the exercise setting has been shown to discriminate between initiation of and adherence to exercise programs (Dishman, 1991; Shephard, 1987; Sherwood & Jeffery, 2000). Access to home based exercise equipment was shown to be a strong predictor of exercise adoption (Williams et al., 2008).

Overcoming these common barriers is an important step in promoting long term adherence. A useful strategy for doing this involves encouraging the participant to perform short duration lower intensity activities that can be incorporated easily into their daily routine (Sherwood & Jeffery, 2000). Shorter bouts of exercise have been shown to promote better long term adherence and participation than longer bouts (Jakicic, Wing, Butler, & Robertson, 1995), which further supports the usefulness of encouraging integration of shorter duration lower intensity exercise into the daily routine of people who want to start exercising.

Integration into the intervention. Encouraging participants to engage in multiple shorter bouts of exercise should be a good way to overcome the time constraints of a busy lifestyle. Using this strategy will remove the need for participants to set aside large blocks of exercise time. Because the activities are being incorporated into the daily routine there will be no need for specialised facilities, which means that access to facilities will not be as much of an issue.

These strategies were incorporated into the intervention in several ways: Throughout the intervention information was given to the participants regarding the effectiveness of shorter bouts of exercise, examples were provided concerning ways that everyday activities can be replaced with exercise, and tasks were given to participants to get them to replace an everyday activity with an exercise activity, such as walking or cycling instead of driving, doing housework more vigorously, and doing vigorous yard work.

Intrinsic and extrinsic motivators. Intrinsic motivators such as competence, social interaction, and enjoyment have been shown to be much better predictors of exercise adherence than extrinsic motivators such as weight loss, fitness, and appearance (Ryan, Frederick, Lepes, Rubio, & Sheldon, 1997). Usually when people start exercising, their behaviour is driven by extrinsic motivators, such as health and appearance. These extrinsic motivators can be enough to initiate the exercise behaviour, but unless other contingencies are introduced, over time adherence will decrease (Williams et al., 2008). Extrinsic goals such as health and appearance are necessary for adoption of exercise behaviour, and predict adherence during the first stages of an exercise program, but intrinsic motivators such as satisfaction and enjoyment are required for ongoing adherence (Williams et al., 2008).

Integration into the intervention. The purpose of this intervention was to facilitate long term maintenance of exercise behaviour. Introducing intrinsic motivators should be an effective way to achieve this. Enjoyment, satisfaction, competence, and social interaction are able to be incorporated into the intervention in many ways: Participants were encouraged to seek out activities that they like to do, rather than setting a specific type of exercise, which should result in increased enjoyment of the activity. Satisfaction can be increased by incorporating proximal goal setting into the intervention, and setting up achievable targets and tasks to be completed. Increased competence should occur due to mastery experiences, which will be facilitated by the low response requirement for the targets, and use of proximal goal setting. Social interaction was encouraged by the tasks that increase social reinforcement contingencies.

Expected Outcomes

By incorporating all of these components into an email delivered physical exercise intervention, it may be possible to develop an automated program to increase exercise behaviour that is based on relevant psychological theory. The expected outcomes of this study are that there will be a significant increase in exercise behaviour from baseline to intervention phase. The intervention will cause a significant increase in the exercise self-efficacy scores of the participants. Completion of the various tasks will be predictive of increases in exercise self-efficacy scores, and number of targets met. Adherence to the set targets will be predictive of exercise self-efficacy score increases. Adherence to moderate intensity exercise will be predictive of higher exercise self-efficacy score increases.

Specific outcome expectations are that: (a) Time spent exercising will be significantly higher post intervention, (b) exercise self-efficacy scores will be significantly higher post intervention, (c) the intervention phase will account for the increase in exercise behaviour and exercise self-efficacy scores, (d) number of tasks completed will correlate with number of exercise targets met, (e) number of tasks completed will correlate with higher exercise self-efficacy score increases, (f) adherence to targets will correlate with higher exercise self-efficacy score increases, and (g) adhering to the prescription of moderate intensity exercise will correlate with higher exercise self-efficacy score increases.

Method

Design

The study was run as a non-concurrent multiple baseline across participants design. The baseline lengths varied (3 – 6 weeks), as did the baseline and intervention start dates. This allowed for good control of potential confounds with a limited sample size.

Ethical Considerations

Ethics approval for this study was granted by the University of Waikato Psychology Research and Ethics Committee on the 8th of May 2014. Informed consent was obtained from all participants.

Participants

Nine participants (male = 2, female = 7) took part in this study. They were undergraduate students, postgraduate students, and working professionals. Ages ranged from 18 to 34 (mean age 23.11 years). All of the participants were native English speakers, and had no reported health problems that would have impaired them from performing moderate intensity physical exercise.

Recruitment

Participants were recruited via two different methods; an undergraduate email database, and posters advertising the study. The undergraduate email database included students who had expressed an interest in taking part in university research projects. The email contained a copy of the recruitment poster, and a short explanation of the study. The posters were put up on various notice-boards around the university campus.

Specific recruitment criteria were used to ensure that the correct demographic were being targeted: Potential participants must currently take part in little to no exercise, have no health problems that would impair their ability to exercise, and have a desire to incorporate exercise into their lifestyle. This was important because the intervention is designed to promote exercise behaviour for those who currently perform little to no exercise. No other reward or incentive was offered for taking part in the study to ensure that the primary reason for participation was increasing their own exercise frequency

Description of Measures

Exercise Self-Efficacy Scale (ESES). The ESES (Bandura, 2006) is an 18 item self-efficacy questionnaire that measures perceived ability to engage in exercise three or more times per week (see Appendix A). Participants were presented with 18 different conditions, and for each one they were asked to rate how confident they are that they can perform their exercise routine regularly. Some examples of the conditions are “when I am feeling tired”, “during bad weather”, and “when I am feeling anxious”. The items are rated using an 11 point scale ranging from 0 – 10, with 0 being ‘cannot do at all’, 5 being ‘moderately can do’, and 10 being ‘highly certain can do’. The original questionnaire used a scale of 0 – 100. This has been modified to a 0 – 10 scale for ease of use with no impact on test validity (Everett, Salamonson, & Davidson, 2009).

Several other exercise self-efficacy scales have been developed since the ESES was first used. Most of these have been attempts to create more parsimonious tests by limiting the number of items. The decision to use the 18 item ESES for this study was made primarily because of how general it is. This exercise program is not aimed at a particular social, cultural, ethnic or age group, therefore a generalised measure of exercise self-efficacy is preferable to a more focused one that may be too sensitive to differences across demographic variables.

Validity for the ESES has been shown across a diverse range of populations. Validity was excellent when used with a sample of Australian cardiac rehabilitation patients; the ESES was able to accurately discriminate between different levels performance on a walking task. Changes in ability (distance walked) during the study were reflected in changes in scores on the ESES (Everett et al., 2009). Similar results were found with a sample of Korean adults with chronic diseases (Shin, Jang, & Pender, 2001), as well as a general sample of Korean adults (Young & Cardinal, 2009), a Dutch sample with spinal cord injuries (Nooijen et al., 2013), and a sample of diabetic Iranian women (Noroozi et al., 2011). These studies show that the ESES can be used effectively with a broad range of people. Adequate test-retest reliability was shown by

Noojien et al. (2013); an intra-class correlation coefficient of 0.81 was found across two administrations, two weeks apart.

Physical activity. Exercise intensity was broken down into three levels of intensity; light, moderate, and vigorous. Participants were shown how to discriminate between the different intensities in the initial recruitment interview. This was done by providing them with a list of example activities for each intensity, and teaching them how to use the 'talk test' as outlined by the WHO (2014c) and CDC (2011). A printout with this information was given to them for reference purposes during the initial interview (see Appendix B).

Baseline measures. Baseline physical activity measures consisted of weekly surveys which were emailed to the participants. To improve reliability of the data, paper forms were used by the participants to track their daily exercise intensity and duration (see Appendix C). Baseline duration ranged from 3 – 6 weeks. The duration was dependent upon the stability of the exercise behaviour, and the staggered intervention starting requirement.

Intervention measures. Intervention physical activity measures were similar to those of the baseline phase; paper forms were used for day to day recording (see Appendix D). A weekly email survey was used to track exercise activity, task completion, and target completion (see Appendix E). Targets for each stage were included for the intervention phase; these were initially set based on the averaged baseline activity and increased by twenty minutes for each successive stage.

Participants were required to complete a series of tasks throughout the intervention phase. These were designed to teach helpful skills, and introduce additional reinforcement contingencies. Task completion was also recorded via email survey (see Appendix E).

Summary of measures. ESES1, ESES2, ESES3, target completion, baseline exercise activity, intervention exercise activity, intervention task completion, and exercise intensity.

Materials and Apparatus

Materials used for recruitment and the initial interview were a recruitment poster (see Appendix F), a standard consent form (see Appendix G), information regarding how to measure exercise activity (see Appendix B), and the initial ESES survey form (see Appendix A).

Materials used for the baseline phase were the baseline exercise recording sheets (see Appendix C for example), baseline survey emails (see Appendix H for example), and the second ESES survey (see Appendix A).

Materials used for the intervention phase and post program debrief were the intervention exercise recording sheets (see Appendix D), the intervention stage feedback and target emails (see Appendix I for example), the intervention survey emails (see Appendix E for example), the third ESES survey (see Appendix A), and a personalised debriefing email explaining their results to them. After the participant had completed the intervention, they were sent a post program email which included several items to help them maintain their exercise program; a post program information sheet (see Appendix J), and a post program exercise recording sheet (see Appendix K).

Apparatus required for participation in the study were a computer with internet access, and a valid email address. Google forms were used to generate the surveys that were emailed to participants.

Procedure

Recruitment interview. The purpose of this interview was to ascertain participant eligibility for the study, give an overview of the purpose of the study, and explain what would be expected of them if they decided to participate. This involved asking them about their current exercise behaviour and physical health to make sure that they met eligibility criteria.

The complete procedure was explained in detail, including; an explanation of the baseline and intervention phases, an outline of the components of the study and their purpose, and an explanation concerning how to correctly fill out the recording forms and survey emails. They were then asked if they were still interested in participating. If so, their rights as participants were explained to them, and if they wanted to participate they were required to sign a consent form (see Appendix G).

A folder with the various recording forms and an information sheet was given to participants after they had agreed to participate. This included an operational definition of the various exercise intensities, information on how to judge their exercise intensity (see Appendix B), and the various exercise recording forms (see Appendices C and D for examples).

An opportunity was then provided for participants to raise questions or concerns. Following this, they were asked to fill out the pre-baseline Exercise Self-Efficacy Scale (see Appendix A).

Baseline phase. The initiation date and duration of the baseline phase were assigned according to the order in which the participant signed up to participate in the study. Some flexibility was allowed for cases in which additional time was needed to obtain a stable baseline. The minimum duration was three weeks, and maximum was six weeks. A variety of different combinations of start date and duration were set, with one week separating the start dates, and either three, four, five, or six weeks assigned for the baseline duration. Due to time constraints, the baseline phase was terminated at six weeks regardless of whether responding was stable.

Data were delivered by the participants via self report; at the end of each week an online email survey was sent to the participant (see Appendix H for example). The survey required participants to specify the time spent exercising each day, and the level of exercise intensity. To assist with accurate reports, they were given paper recording forms to keep track of their daily exercise behaviour throughout the week (see Appendix C). The individual baseline exercise data were averaged, and this average was used to set the exercise targets to be used in the intervention.

Pre intervention email. After participants had completed the baseline phase, they were sent an email communication. The purpose of this email was to give participants an opportunity to raise any questions or concerns, remind them of the intensity criteria, provide information about the specifics of the intervention phase, and administer the second Exercise Self-Efficacy Scale (see Appendix A). The goals and targets for the first intervention phase were listed at the bottom of this email.

Intervention phase. This phase consisted of five separate stages. Expected time for completion of this phase was six to eight weeks. This varied across participants because progression to the next stage was contingent on the participant returning their completed survey for the previous stage.

Participants were sent emails containing exercise targets, and tasks to complete. The exercise targets were an allocated amount of time that they had to spend exercising within a seven day period. The target requirements were increased by twenty minutes for each stage. The purpose of the various tasks was to teach useful skills that have been shown to increase exercise adherence, and introduce additional reinforcement contingencies. Specifics of the target and task requirements can be seen in the emails that were sent to the participants at the beginning of each stage (see Appendix I for example).

Feedback was provided via graphs embedded in the stage emails. The graphs contained the participant’s targets, intervention, and baseline data. Included in the email were either congratulatory messages for successfully meeting targets or motivational messages and helpful tips when they failed to meet targets.

Data collection for the intervention phase was similar to that of the baseline phase; each participant received a survey request email seven days after they were sent their stage email containing the targets and tasks. If five days had passed without a response, a reminder email was sent. Task completion was also recorded in the intervention survey forms, along with a check box to signal completion of the stage target (see Appendix E for example).

Post program email. After the participant had completed the intervention phase, they were sent a follow up email. The purpose of this email was to address any questions or concerns they might have, report their overall results, provide them with a post program exercise recording sheet (see Appendix K), and provide strategies that would enable them to continue their exercise routine (see Appendix J). A summary of their exercise activity and ESES scores was provided, with an explanation of what the results mean. Participants were asked whether they wished to receive a summary of the findings once the study was completed.

Data Analysis

Measures used in analysis. (a) Number of targets met, (b) average time spent exercising per week during baseline, (c) average time spent exercising per week during intervention, (d) average increase in time spent exercising from baseline to intervention, (e) total positive deviation from exercise targets during intervention, (f) total negative deviation from exercise targets during intervention, (g) minutes of vigorous intensity exercise during intervention, (h)scheduling task completion, (i) social task completion, (j) goal setting task completion, (k) ESES 1 – 2 difference (baseline effect), (l) ESES 2 – 3 difference (intervention effect), and (m) ESES 1 – 3 difference (cumulative effect).

T-test overall. The overall averaged baseline exercise data and averaged intervention exercise data were compared via a repeated measures t-test to ascertain whether there was a significant increase in time spent exercising between the two different phases across all participants.

T-test individual. Repeated measures t-tests were performed on the individual baseline exercise data and individual intervention exercise data for each participant to ascertain whether the intervention had a significant effect on time spent exercising for each participant.

Linear regression to show trend differences. Linear regression was used to show the overall difference in trend between the baseline and intervention exercise times. A regression line was calculated separately for the baseline and intervention phases based on the collated data for all participants. The un-standardised coefficients were compared to ascertain whether the slopes were different. This was an appropriate test to use because the units were identical across the two phases, it allowed for a straightforward measure of linear trend, and it provided exact information regarding the ratio increase across weeks.

ANOVA. A repeated measures analysis of variance (ANOVA) was performed on the three ESES measures to ascertain whether there were any significant differences between them. Post-hoc pairwise comparisons were conducted to identify where any identified differences lay.

Correlations. Several variables were tested against each other for correlation to ascertain which components of the exercise program were the most and least effective at increasing exercise self-efficacy scores, and helping the participant to meet their exercise targets. The Spearman rank order test for correlation was used to compare measures of target completion with; ESE intervention effect (ESES 2 – 3), average exercise increase from baseline to intervention, average time spent exercising during baseline, average time spent exercising during intervention, positive deviation from targets, negative deviation from targets, amount of vigorous activity performed, goal setting task completion, social task completion, and scheduling task completion.

The same test was used to compare the difference in scores between ESES 2 and ESES 3 (the intervention effect) with; number of targets met, average exercise increase from baseline to intervention, average time spent exercising during baseline, average time spent exercising during intervention, positive deviation from targets, negative deviation from targets, amount of vigorous activity performed, goal setting task completion, social task completion, and scheduling task completion.

These variables that the two main outcome measures were correlated against were selected because they reflect aspects of the intervention that have been discussed in the introduction as being likely to increase the likelihood of participants initiating an exercise routine, and maintaining their exercise behaviour long term.

Results

Exercise Data

Figure 1 includes a graph for each participant that shows their minutes spent exercising on the y axis, and the progression by weeks through the baseline and intervention phases on the x axis. Baseline data points and indicated by a diamond marker, intervention data points are indicated by a square marker, and the targets set for the participant during the intervention are indicated by a cross marker. Week one on the x axis was the same calendar week for all participants, this shows how the baseline start dates were staggered. The vertical dashed line indicates the week that each participant started the intervention, and shows how the intervention start dates were staggered. The differences between the intervention data points and target markers show the participant's deviations from the program targets during the intervention phase.

Most participants recorded no baseline exercise activity, with the exception of Participants 6 and 8 who recorded quite high baseline exercise activity. Participants 4 and 11 performed some exercise during one of the baseline weeks, but had no activity for the majority of the baseline phase. There was a marked increase in exercise activity from baseline to intervention for most participants; with the exceptions being Participants 8 and 10. Participant 8 had an overall increase, but showed a lot of variability across weeks during both baseline and intervention. Participant 10 started out on the intervention phase with steady increases, but reverted back to baseline levels as the intervention progressed. For most participants the difference in trend from baseline to intervention is quite obvious, with the exception of Participants 6 and 8. There was a slight increase in the upward trend for Participant 6, and no systematic change in trend observed for Participant 8.

Table 1 shows the number of minutes spent exercising for each week during the baseline phase. Week 1 as shown in the table refers to the week that the participant started the baseline phase, which was not the same calendar week for all participants; this can be seen presented graphically in Figure 1. Most participants performed no exercise during the baseline phase. Participants 4 and

11 performed a small amount during one of the weeks, and Participants 6 and 8 performed quite a lot more than the others.

Table 2 shows the number of minutes spent exercising for each week during the intervention phase, and the total positive and negative deviation in minutes spent exercising from the set targets for each participant. Targets varied according to baseline exercise activity. Most participants exercised at a low enough frequency during baseline to have the default targets set for them, with the exception of Participants 6 and 8 who had recorded higher baseline exercise. An asterisk is used to indicate when the participant failed to meet the target for that stage.

Exercise Data Summary

Table 3 shows the average number of minutes spent exercising per week for the baseline and intervention phases. The difference between these two is shown as the average change in exercise behaviour between the two phases. The average of the set weekly targets during the intervention was 51 minutes for all participants except 6 and 8 who both had higher baseline responding. Detailed data showing the baseline and intervention exercise duration, including whether targets were met, are available in Table 1, and Table 2. These data show that for most participants, there was a fairly large change in the amount of exercise performed between the baseline and intervention phases. Most of the participants achieved an average exercise increase which was higher than the average of the targets.

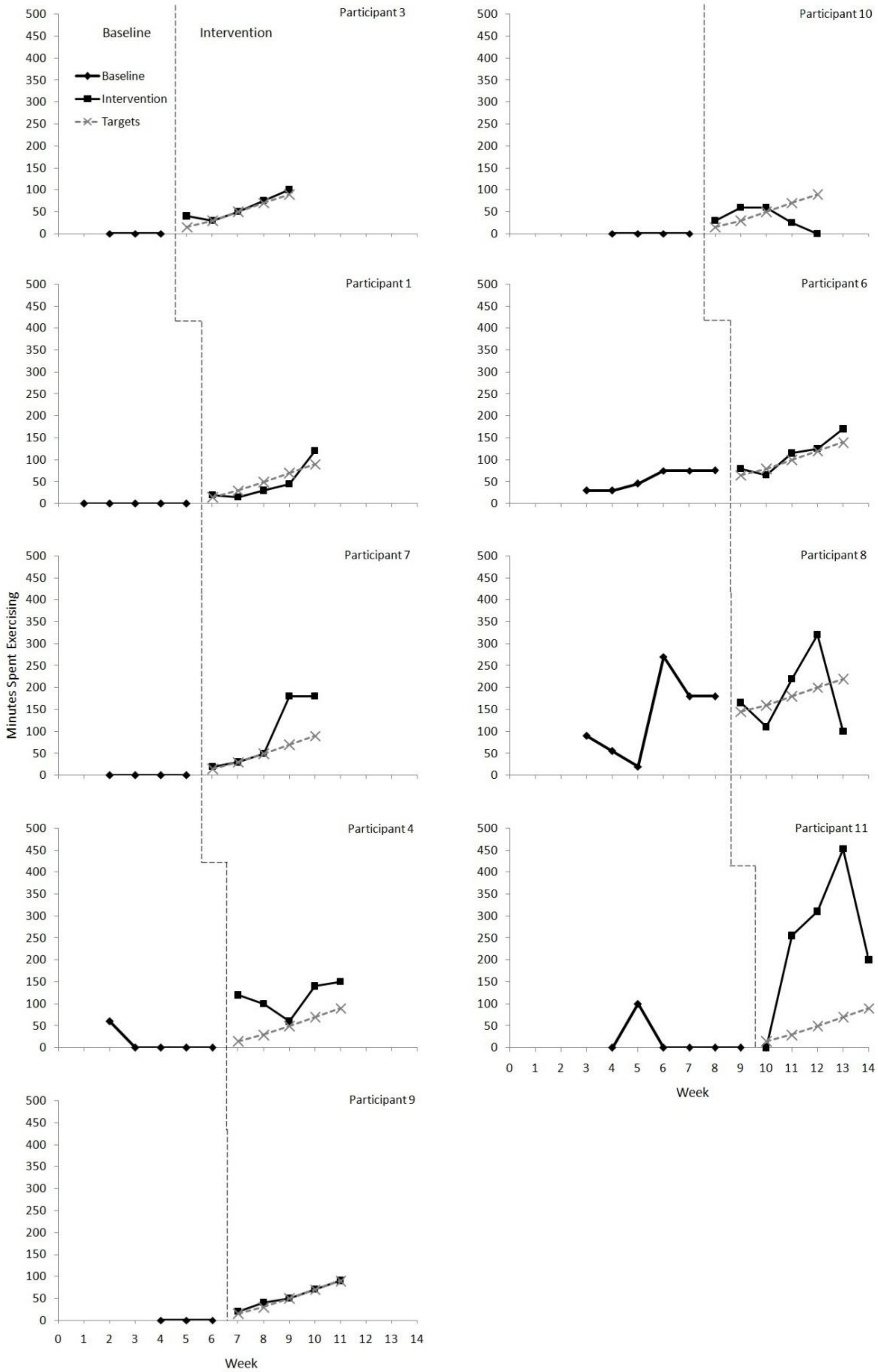


Figure 1. Time spent exercising per week for baseline and intervention phases across all participants, targets for intervention phase are included.

Table 1

Minutes spent exercising per week during the baseline phase for each participant.

Participant	Week 1*	Week 2	Week 3	Week 4	Week 5	Week 6
1	0	0	0	0	0	-
3	0	0	0	-	-	-
4	60	0	0	0	0	-
6	30	30	46	75	75	76
7	0	0	0	0	-	-
8	90	55	20	270	180	180
9	0	0	0	-	-	-
10	0	0	0	0	-	-
11	0	100	0	0	0	0

**Week 1 as shown in this table is not the same calendar week for each participant; it is the week that they started the baseline phase. See Figure 1 for information on how the baseline start dates were staggered.*

Table 2

Minutes spent exercising per week during the intervention phase and total positive and negative deviation from targets for each participant.

Participant	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Total Positive deviation from targets	Total Negative deviation from targets
1	20 (15)	15* (30)	30* (50)	45* (70)	120 (90)	35	60
3	40 (15)	30 (30)	50 (50)	75 (70)	100 (90)	40	0
4	120 (15)	100 (30)	60 (50)	140 (70)	150 (90)	315	0
6	80 (65)	65 (80)	115 (100)	125 (120)	170 (140)	70	15
7	20 (15)	30 (30)	50 (50)	180 (70)	180 (90)	205	0
8	165 (145)	110* (160)	220 (180)	320 (200)	100* (220)	180	170
9	20 (15)	40 (30)	50 (50)	70 (70)	90 (90)	15	0
10	30 (15)	60 (30)	60 (50)	25* (70)	0* (90)	55	135
11	0* (15)	255 (30)	310 (50)	453 (70)	200 (90)	978	15

Targets for each stage are shown in brackets, failures to meet the stage targets are indicated by an asterisk.

Table 3

Average minutes spent exercising per week for baseline phase, and intervention phase. The average increase from baseline to intervention, and average of set targets for each participant.

Participant	Baseline Average	Intervention Average	Average Change	Average of Targets
1	0	46	+46	51
3	0	59	+59	51
4	12	114	+102	51
6	55.33	111	+55.67	101
7	0	92	+92	51
8	132.50	183	+50.50	181
9	0	54	+54	51
10	0	35	+35	51
11	16.66	243.60	+226.94	51

T-tests: Change in Exercise Time from Baseline to Intervention for Each Participant

Table 4 shows the results of a series of paired t-tests comparing minutes spent exercising during baseline, and minutes spent exercising during intervention for individual participants. The test groups were paired by matching the participant's baseline data to their intervention data according to week. Due to the nature of the experimental design, the number of baseline weeks and number of intervention weeks was not equal for many participants. This was accounted for by manipulating the number of baseline phase data points so that they could be matched with the five intervention phase data points. Fortunately the only participants who required additional data to be added to their baseline phase had perfectly stable baseline exercise data. Participants 6 and 8 had six baseline data points, so for each of these a data point needed to be removed to match the intervention data. The lowest baseline exercise data point was removed to minimise the chance of data manipulation resulting in a type I error. For most participants, there was a significant difference in minutes spent exercising between baseline phase and intervention phase. Exceptions were Participants 1, 7, and 8. Participants 1 and 7 were only just outside the 5% confidence limit, with p values of .075 and .064 respectively. There was no significant difference between baseline and intervention average exercise time for Participant 8. A high effect size was observed for all participants except Participant 8, who had a low effect size.

Table 4
Paired t-test results comparing time spent exercising during baseline and intervention for individual participants.

Participant	*t*	*df*	*p*	*d*
1	-2.40	4	.075	1.70
3	-4.65	4	.009	3.29
4	-5.35	4	.006	3.78
6	-4.13	4	.014	2.92
7	-2.54	4	.064	1.80
8	-0.38	4	.721	0.27
9	-4.47	4	.011	3.16
10	-3.07	4	.037	2.17
11	-2.94	4	.042	2.08

T-test: Overall Change in Exercise Time from Baseline to Intervention

A paired t-test was performed on the grouped baseline and intervention exercise data to test for overall change in exercise time from the baseline to intervention phase. The data for the paired groups consisted of the average time spent exercising during the baseline phase and intervention phase for each participant. A significant difference in minutes spent exercising between the baseline phase (M=34.67) and intervention (M=125.58) phase was found; $t(8) = -4.06$, $p = .003$, $d = 2.87$. The intervention phase was higher than the baseline phase, with a difference between means of 80.12. The effect size was large. Detailed data of each participant's exercise data for both phases can be seen in Table 1 and Table 2.

Trend Differences from Baseline to Intervention

Table 5 shows the difference in trend between the baseline and intervention phase for overall participant data. Generalized linear regression was used to test whether there was a difference in the slope for time spent exercising between the phases. A regression line was calculated separately for the baseline and intervention phases based on the grouped data from all participants. Comparing the slope co-efficient from one data set against the other should indicate whether one of the phases has a steeper slope than the other, and is therefore trending upward relative to the other phase. The beta value (b_1) is the slope co-efficient; it refers to the average increase in time spent exercising for each successive week of the phase, a higher number reflects a steeper slope. There was no significant increase in time spent exercising per week during the baseline period; $b_1 = 7.96$, $p = 0.20$. There was a significant increase of 21.76 minutes in time spent exercising per week during the intervention period; $b_1 = 21.76$, $p = 0.02$.These results show that there was a significant upward trend for time spent exercising during the intervention phase, and no significant trend observed in either direction during the baseline phase.

Table 5

Difference in slope between baseline and intervention phase calculated using generalized linear regression.

Baseline		Intervention	
b_1	p	b_1	p
7.96	0.20	21.76	0.02

ESES Data

Table 6 shows the scores obtained on the ESES for each participant at three different stages of the study; pre-baseline (ESES1), pre-intervention (ESES2), and post-intervention (ESES3). Baseline effect refers to the change in score from pre-baseline score to pre-intervention score, intervention effect refers to the change in score from pre-intervention score to post-intervention score, and cumulative effect refers to the overall change in score from pre-baseline to post-intervention. These data show that there was a slight decrease in ESE scores for most participants from pre-baseline to pre-intervention, and a moderate increase from both pre-baseline and pre-intervention to post-intervention.

Table 6
ESES score changes across the study for each participant.

Participant	ESES1	ESES2	ESES3	Baseline Effect	Intervention Effect	Cumulative Effect
1	4.44	3.88	2.77	-0.56	-1.11	-1.67
3	5.33	5.05	7.16	-0.28	2.11	1.83
4	3.05	2.44	6.72	-0.61	4.28	3.67
6	4.33	5.27	6.55	0.94	1.28	2.22
7	5.16	5.33	7.11	0.17	1.78	1.95
8	6.27	5.05	5.27	-1.22	0.22	-1
9	1.33	0.66	7.33	-0.67	6.67	6
10	2	1.77	4	-0.23	2.23	2
11	3.33	3.88	5.61	0.55	1.72	2.28

ESES Repeated Measures ANOVA

Table 7 shows the means and standard deviations of the participant's ESES scores for the three administration times. A repeated measures ANOVA was performed on these data to ascertain whether there were any significant differences between the scores obtained on the ESES for the three successive administration times. There was a significant difference between the means of the three ESES measures taken, and a large effect size was observed; $F(1.133, 16) = 6.986$, $p = .024$, $\eta_p^2 = .466$. This shows that there was a significant difference between the means of the three ESES administrations.

Table 8 shows the results of the post-hoc pairwise analysis of the three ESES administration times. There were two significant differences found between the means for the three administration times: ESES3 scores were significantly higher than ESES1 scores, $t(8) = -2.53$, $p = .035$, $d = 1.20$, the mean of the differences was 1.92, and a large effect size was observed. ESES3 scores were significantly higher than ESES2 scores, $t(8) = -2.85$, $p = .022$, $d = 1.29$, the means of the differences was 2.13 and a large effect size was observed. There was no significant difference between ESES1 scores and ESES2 scores, $t(8) = -0.95$, $p = .368$, $d = 0.12$, with a small effect size observed.

Table 7

Means and standard deviations of ESES measures for three successive administration times.

	Mean	Standard Deviation	N
ESES1: Pre-Baseline	3.91	1.62	9
ESES2: Pre-Intervention	3.70	1.71	9
ESES3: Post-Intervention	5.84	1.58	9

Table 8

Post-hoc pairwise comparisons of ESES scores for three successive administration times.

Pair	Mean Differences	*t*	*p*	*d*
ESES3 – ESES1	1.92	-2.53	.035	1.20
ESES3 – ESES2	2.13	-2.85	.022	1.29
ESES1 – ESES2	0.21	0.95	.368	0.12

ESES Scaled Scores

Table 9 shows the scaled 18 item ESES scores. These have been scaled down so that meaningful comparisons can be made with the results obtained by Marcus et al. (1992) regarding use of ESE scores to predict progression through the stages of the TTM. The ESE measures obtained from Marcus et al. (1992) were based on a five item questionnaire with a seven point scale. To be compared meaningfully, the scores obtained in the current study were scaled down to what they would have been if a five item seven point ESE measure had been used.

Table 10 shows the ESE score ranges that Marcus et al. (1992) found to be predictive of the associated stage of progression through the TTM. The scaled scores presented in Table 12 can be compared meaningfully against the score ranges outlined in Table 13 to estimate participant’s progress through the stages of the TTM in the current study.

Table 9

Scaled 18 item ESES scores for predicting TTM stage progression for each participant.

Participant	ESES1	ESES2	ESES3
1	14.13	12.37	8.83
3	16.96	16.08	22.79
4	9.72	7.77	21.38
6	13.78	16.78	20.85
7	16.43	16.96	22.61
8	19.96	16.07	16.78
9	4.24	2.12	23.32
10	6.36	5.65	12.72
11	10.6	12.35	17.84

Table 10

ESE score ranges for predicting TTM stage progression as outlined by Marcus et al. (1992).

Stage	ESE Score	*SD*
Pre-Contemplation	12.4	5.1
Contemplation	17.7	6.2
Preparation	18.1	5.9
Action	21.6	6.1
Maintenance	24.9	5.7

Tasks/Targets Met and Vigorous Intensity Exercise Performed

Table 11 shows the number of targets and tasks met for the individual participants. Most participants were able to meet four or five of the exercise targets, with only one participant scoring below three. There was quite a lot of variability across participants for number of tasks met. This was true for scheduling, social, and goal setting tasks.

Table 12 shows the number of minutes spent performing vigorous intensity exercise at each stage of the intervention for each participant. Instances of vigorous intensity exercise were quite low, with only four participants exercising at this intensity, and only two of them spending more than 50 minutes total at vigorous intensity.

Table 11

Number of targets and tasks met during the intervention stage for each participant.

Participant	Targets Met	Total Tasks Met	Scheduling Tasks Met	Social Tasks Met	Goal Setting Tasks Met
1	2 (5)	3 (11)	1 (5)	2 (4)	0 (2)
3	5 (5)	10 (11)	5 (5)	4 (4)	1 (2)
4	5 (5)	11 (11)	5 (5)	4 (4)	2 (2)
6	4 (5)	11 (11)	5 (5)	4 (4)	2 (2)
7	5 (5)	5 (11)	2 (5)	2 (4)	1 (2)
8	3 (5)	8 (11)	5 (5)	2 (4)	1 (2)
9	5 (5)	7 (11)	5 (5)	0 (4)	2 (2)
10	3 (5)	3 (11)	1 (5)	1 (4)	1 (2)
11	4 (5)	7 (11)	3 (5)	3 (4)	1 (2)

Total number of possible targets and tasks that could have been met shown in brackets.

Table 12

Minutes spent exercising at vigorous intensity for each participant during the intervention stage.

Participant	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Total
1	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
6	0	15	15	0	0	30
7	0	0	0	0	60	60
8	0	30	0	30	40	100
9	0	0	0	0	0	0
10	0	0	0	25	0	25
11	0	0	0	0	0	0

Correlations

Table 13 shows Spearman rank order correlations between the number of targets met during the intervention and a range of other measures including; ESES score change, task completion, and various measures of exercise duration and intensity. These data show how certain aspects of the intervention correlate with an increased number of targets being met during the intervention. The measures chosen for the correlations reflect various components of the intervention outlined in the introduction which were expected to increase the number of targets met by the participants, and their ESE scores.

Table 13
Spearman correlations between number of targets met, and a range of other exercise measures.

	Number of Targets Met	
Measure	*rs*	*p*
ESE change (ESES 2 – 3)	0.70	0.03
Exercise increase from baseline to intervention	0.66	0.05
Amount of Exercise Performed During Baseline	-0.23	0.55
Amount of Exercise Performed During Intervention	0.17	0.67
Positive deviation from targets (minutes of exercise)	0.13	0.74
Negative deviation from targets (minutes of exercise)	-0.94	< 0.001
Amount of vigorous intensity exercise performed	-0.23	0.55
Goal setting task completion	0.59	0.09
Social task completion	0.26	0.49
Scheduling task completion	0.53	0.14

Table 14 shows Spearman rank order correlations between the overall change in ESES scores from pre-intervention to post-intervention and a range of other measures including; number of targets met, task completion, and various measures of exercise duration and intensity. These data show how certain aspects of the intervention are correlated with exercise self efficacy score changes. The measures chosen for the correlations reflect various components of the intervention outlined in the introduction which were expected to increase the number of targets met by the participants, and their ESE scores.

Table 14

Spearman correlations between ESES score change, and a range of other exercise measures.

	ESE Change (ESES 2 – 3)	
Measure	*rs*	*p*
Number of targets met	0.70	0.03
Exercise increase from baseline to intervention	0.20	0.63
Amount of exercise performed during baseline	-0.42	0.26
Amount of exercise performed during intervention	-0.23	0.55
Positive deviation from targets (minutes of exercise)	-0.1	0.81
Negative deviation from targets (minutes of exercise)	-0.62	0.07
Amount of vigorous intensity exercise performed	-0.37	0.33
Goal Setting task completion	0.60	0.09
Social task completion	-0.17	0.86
Scheduling task completion	0.26	0.50

Discussion

Overall Increase in Exercise Behaviour

The intervention was successful at increasing the amount of time that the participants spent exercising. There was significantly more exercise performed during the intervention phase than in the baseline phase for almost all participants, as shown in Figure 1 and Table 3, and a significant overall increase, as shown by the paired t-test for overall data. Table 2 shows that most participants achieved an exercise time of at least 90 minutes during a seven day period, which was the maximum target at stage five for those with little to no exercise recorded during baseline.

As shown in Figure 1 and Table 5, there was a significant upward trend observed for time spent exercising during the intervention phase, but no significant trend in either direction observed during the baseline phase. Exercise duration increased by an average of 21.76 minutes for each successive intervention stage, which is in line with the targets set for the intervention. This difference in trend across the phases shows that the difference in exercise behaviour was not due to an increasing trend across both the baseline and intervention phases, but rather that the exercise behaviour began to increase only after the intervention was implemented. The staggered intervention start dates shown in Figure 1 show that the increase in exercise behaviour coincided with the start of the intervention regardless of when the participant started the intervention or how long their baseline period was. Figure 1 and Table 1 provide further detail concerning the staggered start date and variable baseline duration. Collectively these results show that the intervention was successful at increasing the exercise behaviour of most participants up to the targeted level of 90 minutes per week.

Overall Increase in Exercise Self-Efficacy Scores

Exercise self-efficacy was used as a measure to ascertain overall efficacy of the intervention, and likelihood of participants maintaining exercise behaviour long term. This was measured at three points during the study; pre-baseline (ESES1), pre-intervention (ESES2), and post intervention (ESES3). Scores obtained for ESES3 were significantly higher than those from ESES2 and ESES1, and there was no significant difference observed between ESES1 and ESES2, as shown in Tables 7 and 8. The increase in scores from ESES1 and ESES2 to ESES3, the lack of a significant difference between ESES1 and ESES2 and the use of staggered starting dates and variable baseline duration collectively show that the increase in exercise self-efficacy scores most likely occurred as a result of the intervention.

What do these exercise self-efficacy score changes mean? These results show that the intervention successfully increased the average exercise self-efficacy scores of the participants from pre-intervention to post intervention. There was an average increase in exercise self-efficacy scores of approximately two points across all participants. Exercise self-efficacy is one of the most reliable predictors of long term exercise adherence (Desharnais, Bouillon, & Godin, 1986; DuCharme & Brawley, 1995; McAuley et al., 2003; Sherwood & Jeffery, 2000; Williams et al., 2008; Williams & French, 2011). An increase of this magnitude should increase the probability of the participants maintaining their exercise behaviour long term.

An average increase of two points on the ESES has been found to be quite meaningful when used to predict progress through the stages of the TTM. Previous research has shown that exercise self-efficacy scores can reliably predict which stage of change a person is currently at (Kim, 2007; Marcus, Selby, Niaura, & Rossi, 1992). To find out how the exercise self-efficacy score increases obtained in this study relate to the TTM, the exercise self-efficacy scores obtained from a study by Marcus et al. (1992) were converted for comparison with Bandura's (2006) 18 item ESES. The exercise self-efficacy measure used by Marcus et al. (1992) had fewer items, and was scored on a seven point scale rather than the 18 item 11 point questionnaire used in the current study. Scaling the present scores to reflect what they would have been on a five item seven point scale allowed the ESES scores of the current study to be meaningfully compared to the scores that Marcus et al. (1992) found to be predictive of stage progression through the TTM. These scaled 18 item ESES scores are presented in Table 9, and the score ranges that Marcus et al. (1992) found to be predictive of the stages of the TTM are shown in Table 10.

Comparison of the scaled ESES scores against those obtained by Marcus et al. (1992) showed that Participants 3, 4, 6, 7, and 9 started the intervention with scores that reflected the pre-contemplation or contemplation stages, and finished the intervention in the score range for the action and maintenance stages. Participant 11 progressed from the pre-contemplation to the preparation stage. Participant 8 started in the preparation stage and finished in the contemplation stage. Participants 1 and 10 both started and finished in the pre-contemplation stage, although Participant 1's score decreased by 1.11 while Participant 10's score increased by 2.33. These results show that according to their self-efficacy score changes, most participants started in the first two stages of the TTM, and finished in the action or maintenance score ranges, which bodes well for the likelihood of them maintaining their exercise behaviour long term.

Interesting Findings from Atypical Participants

Analysis of the participant's individual exercise behaviour shows that the intervention was most successful for those with lower levels of exercise behaviour during the baseline phase. In most cases, exercise self-efficacy score increases were bigger for participants who recorded little to no exercise during the baseline phase. When exercising was higher during the baseline phase, the intervention was less successful. This was most evident with Participant 8; for whom a paired t-test showed no significant difference between exercise performed during the baseline and intervention phases. The ESES results for Participant 8 followed a similar pattern; there was an initial decrease from 6.27 to 5.05 over the baseline period, followed by a minimal increase from 5.05 to 5.27 over the intervention period.

Participant 8 had quite erratic exercising during both the baseline and intervention phases. They had the highest amount of vigorous activity performed during the intervention (100 minutes), and the highest negative deviation from the set targets. Even though it was quite variable, their average baseline responding was the highest of any participant. This resulted in them being set intervention targets that were significantly higher than the other participants, which may explain why they were only able to meet three of the five targets. Not achieving the set targets would have limited initial exposure to mastery experiences, which are very important for self-efficacy increases (Bandura, 1977; Mcauley et al., 2003). They performed an excessive amount of vigorous intensity activity, which can decrease exercise self-efficacy due to aversive physiological experiences (Bandura, 1977; Mcauley et al., 2003) and introduce a punishment contingency that will decrease subsequent exercise behaviour (Peri et al., 2002; Sallis et al., 1986). The fact that they had quite high targets combined with variable responding and vigorous activity was a problem because meeting targets, achieving proximal goals, and managing negative physiological experiences are three important components of the intervention that this participant would not have been able to benefit from. In light of this, it is not surprising that this participant did not have any significant increase in ESES score, or exercise behaviour.

Participant 6 also had higher than normal baseline responding, but for them the intervention was more effective than for Participant 8. They had a significant increase in exercise performed between the baseline and intervention phases. They also had a modest increase in their ESES score; an initial increase from 4.33 to 5.27 over the baseline period, and a further increase from 5.27 to 6.55 over the intervention period. There were several differences between Participant 6 and Participant 8 that may account for this. The baseline exercise performed for Participant 6 was quite a lot lower than Participant 8, but was a lot more stable with less variation in weekly duration across the baseline and intervention periods. Participant 6 deviated less from the set targets, met more of the set targets, had better task completion, and performed much less vigorous intensity exercise. The difference between how these two atypical participants performed during the study provides further support for the efficacy of several components of the intervention; limiting vigorous intensity exercise, setting achievable targets, not deviating excessively from the targets, and setting achievable targets.

Which Aspects of the Intervention Were Successful?

There were notable differences in the target adherence, self-efficacy score increase, exercise duration increase, and task completion of the participants. The number of targets met ranged from two to five, exercise self-efficacy score changes ranged from -1.11 to +6.67, and overall tasks met ranged from three to eleven. This variance in outcome measures invites further analysis into which components of the intervention were most successful at increasing exercise self-efficacy scores, and adherence to exercise targets.

Did meeting targets increase exercise self-efficacy scores? There was a significant strong positive correlation between changes in exercise self-efficacy scores, and number of targets met; $rs(7) = .70$, $p = .03$. This was the expected outcome based on prior research. Meeting set targets in this manner can be likened to achieving proximal exercise goals, which has been shown to be effective at increasing self-efficacy (Bandura & Schunk, 1981; Wilson & Brookfield, 2009). As participants progressed through the intervention stages, they were given feedback on their performance relative to their targets. This feedback may have allowed the participants to evaluate their performance relative to the targets, which has been shown to moderate the effect of goal setting on self-efficacy score increases (Bandura & Cervone, 1983).

Helping participants to meet exercise targets seems to have contributed to increases in the exercise self-efficacy scores of the participants in this study. Because meeting targets requires performing exercise, this also increases amount of exercise performed. Incorporating proximal exercise targets with appropriate feedback into an automated intervention for increasing exercise behaviour seems to be a useful way to increase self-efficacy scores. This is a promising outcome in terms of long term exercise adherence because increased self-efficacy scores have been shown in many studies to reliably predict maintenance of exercise behaviour (Desharnais, Bouillon, & Godin, 1986; DuCharme & Brawley, 1995; McAuley et al., 2003; Sherwood & Jeffery, 2000; Williams et al., 2008; Williams & French, 2011).

Unsurprisingly, there was a significant moderate positive correlation between the number of targets met, and average exercise increase; $rs(7) = .66$, $p = .05$. This is the expected outcome because without large variation between the amount of exercise performed across the intervention stages, meeting targets should result in a higher amount of exercise performed than not meeting targets.

The effect of failure to meet targets on exercise self-efficacy scores. There was a non significant moderate negative correlation observed between changes in exercise self-efficacy scores, and total negative deviation from the set targets in minutes spent exercising; *rs*(7) =-.62, *p* = .07. This result provides additional support for the usefulness of using exercise goals to increase self-efficacy scores. It also highlights the importance of making sure that these goals are achievable. It seems that when set exercise goals are not achieved, there is no corresponding self-efficacy score increase. This is most obvious in the exercise data obtained from Participant 1; exercising was steady during the intervention, but they missed three of the five targets by a small amount, and had an overall decrease in their exercise self-efficacy score.

It is important to have mastery experiences and to meet goals in the early stages of an exercise program, and if a participant is not meeting the targets set for them it is a problem with the exercise intervention rather than with the participant. If the targets are higher than the participant can manage, then they are not going to be effective for increasing self-efficacy scores. Extra customisability of the exercise targets would be useful if this intervention was going to be developed into a smartphone app. Participants should be able to set an initial target that they feel comfortable with and have a range of weekly increases to choose from. Both of these options will need to be capped at a reasonably low number so that optimistically high exercise targets are not selected. Progression to the next target should also be contingent on meeting the previous target. This would limit the number of failures to meet set targets, and mitigate the negative effect that the failure has on the participant's exercise self-efficacy.

Does performing more exercise result in higher self-efficacy score increases and more targets completed? There was no significant correlation found between increases in exercise self-efficacy scores and positive deviations from exercise targets; *rs*(7) = -.10, *p* = .81. This is an interesting finding because it indicates that performing extra exercise over and above the set targets does not result in additional self-efficacy score increases. This is further supported by the fact that there was no significant correlation between increases in exercise self-efficacy scores and the average exercise increase during the intervention phase *rs*(7) = -.23, *p* = .55, or the baseline phase *rs*(7) = -.42, *p* = .26. It seems that performing additional exercise did not produce additional benefits for exercise self-efficacy scores at any stage of the experiment.

It was also found that there was no significant correlation between the number of targets met and the average amount of exercise performed during the intervention phase *rs*(7) = .17, *p* = .67, or the positive deviation from the exercise targets *rs*(7) = .13, *p* = .74. Participants who did more exercise did not seem to have an increased chance of meeting their exercise targets. A possible reason for this is that performing high amounts of exercise during an earlier stage can introduce a punishment contingency that causes lowered responding in the following stage. This would generate a high average for exercise performed, but would result in the participant missing some targets during the stages following the high level of responding. This is most evident in the data for Participant 8, as shown in Figure 1.

Limiting the amount of exercise performed in the early stages of an exercise intervention is important because it makes achieving targets easier and diminishes physiological punishment contingencies associated with exercise. It is useful to know that by encouraging people to limit their exercise by sticking to the set targets they are not being deprived of potential exercise self-efficacy score increases.

The effect of vigorous intensity exercise on self-efficacy score increases and number of targets met. There was no significant correlation found between minutes of vigorous intensity exercise performed and increases in exercise self-efficacy scores; *rs*(7) = -0.37, *p* = .33. Neither was there was a significant correlation found between minutes of vigorous activity performed and number of targets met; *rs*(7) = -0.23, *p* = .55. It seems that performing vigorous intensity exercise did not increase the likelihood of meeting exercise targets or generate any additional increases in exercise self-efficacy scores. These findings reflect previous research in the area which has shown that performing vigorous intensity exercise has no beneficial effect on adherence to exercise programs (Peri et al., 2002; Sallis et al., 1986).

The majority of the vigorous intensity exercise was performed by Participants 6, 7, and 8; two of whom were the atypical participants who did not fit the demographic criteria for the intervention due to their high baseline exercise activity. Participant 8 had both the highest baseline exercise activity and highest duration of vigorous intensity exercise performed.

It seems that the participants who had little to no exercise activity during the baseline phase were better able to stick to moderate intensity exercise during the intervention phase. These participants are the demographic at which the intervention is targeted, so the component of the intervention in which participants are discouraged from performing vigorous intensity exercise appears to be reasonably effective for the targeted demographic.

Efficacy of the Task Components

It was possible to measure adherence to the task components of the intervention via the task completion section of the stage questionnaire. The tasks were designed to initiate and maintain scheduling behaviour and proximal goal setting behaviour, and introduce social reinforcement contingencies. Other measures included in the intervention included; intensity of exercise, duration of exercise, and exercise self-efficacy scores. Looking at the relationships between all of these measures will provide valuable information as to which components were effective, and in what way they were effective. This will be useful information for deciding what to include in subsequent iterations of this intervention, and which components may need to be modified.

It is important to note that the task completion measures do not comprise the entirety of their respective components in the intervention. The proximal goal setting and scheduling components are embedded into the intervention in other ways: Proximal goal setting is not only present in the assigned tasks, but also occurs in the progressive weekly exercise targets. Scheduling also occurs outside of the task requirements; the participants already have half of their scheduling done for them by having set exercise targets to meet. The scheduling task is quite specific, and requires the participant to actively write out their exercise plans. This is quite a convoluted method of scheduling that may not be necessary for most people. Scheduling exercise times can be done quite easily without the task requirements being fully met. Negative results with the task outcome measures do not necessarily mean that their respective components are not an important factor for promoting exercise adherence, but only that how the tasks were delivered in this intervention was not very effective, and may need to be modified in future iterations.

Effectiveness of proximal goal setting tasks. A non significant moderate positive correlation was observed between the number of proximal goal setting tasks completed and increases in exercise self-efficacy scores; $rs(7) = .60$, $p = .09$, and also between the number of proximal goal setting tasks completed and the number of targets met; $rs(7) = .59$, $p = .094$. This finding reflects prior research which states that proximal goal is a useful tool for increasing exercise self-efficacy scores and long term exercise adherence (Bandura & Schunk, 1981; Wilson & Brookfield, 2009). There were only two proximal goal settings tasks throughout the intervention. The purpose of these tasks was to teach participants how to set their own proximal goals. There were other proximal goal setting components present in the intervention, such as encouraging participants to schedule specific durations of exercise time for specific days, and the exercise targets themselves. Meeting the targets was type of proximal goal setting, and was also strongly correlated with increases in exercise self-efficacy scores. This provides additional support for the effectiveness of proximal goal setting. It seems as though completion of the proximal goal setting tasks have had an effect over and above that of the goal setting components such as meeting the targets, which were already embedded into the intervention.

More research is required to get a better understanding of the usefulness of the proximal goal setting tasks as it is quite difficult to draw conclusions with only three data points. The present results are promising; encouraging participants to set their own proximal goals appears to be an effective component of the intervention. It would be interesting to see whether increasing the number of proximal goal setting tasks would increase the efficacy of the intervention. This aspect of the intervention should be explored and developed further in subsequent iterations.

Effectiveness of social tasks. There is very little evidence for the efficacy of the social tasks. No significant correlation was observed between social task completion and exercise self-efficacy score change; $rs(7) = -0.17$, $p = .857$, or number of targets met; $rs(7) = 0.26$, $p = .493$. Increasing social support, and encouraging group exercise activities has been shown to increase self-efficacy scores (McAuley et al., 2003), and exercise adherence (Fraser & Spink, 2001; Hovell et al., 1991; Hovell et al., 1989; King, Taylor, Haskell, & DeBusk, 1990; Hooper & Veneziano, 1995; Wallace, Raglin, & Jastremski, 1995). In light of the extensive evidence supporting the effectiveness of social support for promoting exercise adherence, it is surprising that completion of social tasks did not seem to have any effect on either of the primary outcome measures.

Perhaps the nature of the social tasks discouraged people from completing them. The participants were instructed to post on social media concerning their successes, and tell their friends and family about their exercise program. It is possible that these tasks were not appropriate for all of the participants; people may not necessarily want their friends and family to know that they have started an exercise program. They may also perceive the low amount of exercise that they complete in the early stages as not being particularly praiseworthy.

Different methods need to be employed to promote social support and social reinforcement contingencies. In the early stages of the intervention it may be more appropriate to focus on creating opportunities to generate support from family and friends, rather than simply seeking out praise via social media. The low level of completion of the social tasks suggests that people are apprehensive about posting about their successes on social media. As participants progress through the exercise program and there exercise behaviour increases, it may be more effective to have an automated system in place to post updates following successful exercise sessions and target completion. This would allow for social reinforcement contingencies to be introduced without the participant having to actively post about their successes. This would be a good feature to trial in a smartphone app.

Effectiveness of scheduling tasks. There was no significant correlation observed between completion of scheduling tasks and increases in exercise self-efficacy scores; $rs(7) = 0.26$, $p = .504$, or number of targets met; $rs(7) = 0.53$, $p = .144$. This was a surprising result due to the amount of research showing that scheduling is an important factor in bridging the gap between an intention to exercise, and actual exercise behaviour (Gollwitzer & Sheeran, 2006; Schwarzer et al., 2008; Sniehotta, Scholz, & Schwarzer, 2005).

Participants were required to write down their exercise plan or put it into a calendar. It is possible that the presence of set targets, the low exercise requirement, and encouraging participants to fit exercise into their everyday life removed the need for the type of strict scheduling that was required to complete the scheduling task requirements. The type of scheduling behaviour required to complete the task would probably become more useful as the participant began to spend more time exercising and needed to set aside specific times to do it. The participants may have seen the task as superfluous for most of the intervention, as they did not find that they needed to write out their exercise plan when the requirement was so low.

Better integration of scheduling into the intervention could be a useful way to increase its effectiveness. If the intervention were to be delivered via a smartphone app there would be many different ways to implement a scheduling component; the participant could be required to schedule in their exercise times when they are given their weekly targets, and reminders could be used to prompt the participant when it is almost time to exercise. This would require the participant to engage in scheduling behaviour regardless of whether they think it is necessary.

Summary. There were quite a few different components used in this intervention to increase exercise behaviour and exercise self-efficacy scores. Some of the more successful components were; facilitating mastery experiences, setting achievable targets, slowly increasing exercise targets, encouraging participants to adhere to set targets, avoiding vigorous intensity exercise, and use of proximal goal setting.

There was little evidence found for the effectiveness of social task completion, and scheduling task completion. This was surprising as they are both well supported in the literature with regard to increasing exercise adherence, and exercise self-efficacy scores. As has been stated previously, this may be due to the way that they were implemented into the intervention. Future research could focus on different ways that they could be used within a smartphone based automated exercise intervention.

Delivery without a Therapist

One of the major objectives of this study was to discover whether an exercise intervention could be successfully delivered with minimal person to person contact. The point of this was to take the therapist out of the picture; if an intervention could be effectively automated, this would increase accessibility, and decrease the associated delivery costs. Steps were taken to try and minimise person to person contact during this study; it was made clear to the participants that the program would be delivered via an automated email system, and the only personalised contact that they had with the researcher was during the initial screening interview. This was to try and mimic how a smartphone app would work, as that is what was seen as being the most effective method of delivery for an automated exercise intervention.

Most participants achieved a significant increase in the number of minutes spent exercising per week as a result of the intervention phase. The average exercise increase for each stage during the intervention phase was 21 minutes, which adheres to the recommended increase of 20 minutes per stage set out in the targets. There were significant increases in ESE scores for most participants. As discussed earlier, there is a wealth of research showing the value of exercise self-efficacy measures for predicting long term exercise adherence. ESE score increases have also been shown to predict progression through the stages of the TTM. When considered in the light of prior research, the ESE increases of the participants in this study should result in an increased probability of long term exercise adherence.

These results show that an automated intervention based on appropriate psychological theory can be used to significantly increase exercise behaviour in such a way that promotes ongoing adherence. As stated previously, obesity and depression are two very serious global health concerns which can be treated with regular exercise. When one considers the large dissonance between the number of people diagnosed with common mental disorders, and the number of people able to access treatment, the value of studies looking at alternative forms of treatment becomes clear. While this is a pilot study with a fairly small sample size, the results are very encouraging and have exciting implications for future study in this area.

Limitations

There were several limitations present in this study; the small sample size, the use of self report to measure exercise behaviour, and the fact that the intervention was not long enough to measure ongoing exercise adherence. These limitations were due to practical constraints such as time and budget.

Steps were taken to mitigate the effect of these limitations on the experiment: The issue of limited sample size was addressed by using a non-concurrent multiple baseline across participant design in which each participant acted as their own control group. Generalisability of the results is somewhat limited due to the small sample size, and demographic makeup of the participants. The participants were mostly aged between 20 and 30, and were primarily university students. A more representative sample would be required before these results could be extrapolated to the general population.

Due to the nature of the intervention and variety of exercise types available to the participants, using pedometers to record exercise duration and intensity was not a viable option. Self report for recording exercise duration and intensity was used instead because it is more representative of how a smartphone app would function. The short length of the intervention and subsequent inability to obtain long term data was addressed by using exercise self-efficacy as a measure to predict the likelihood of ongoing adherence.

A further limitation of the study was the method of delivery. Email and online surveys were used to deliver the intervention, and record the appropriate exercise and task completion data. The ideal method of delivery would have been to use a smartphone app, but due to limited time and budget, that was not possible for this study. Email and online surveys were judged to be the closest possible analogue available within the practical constraints.

Future Studies

There are several areas of this study that would benefit from further research; use of a larger sample size, development and use of a smartphone app to deliver the intervention, modification of the components that did not work as expected, and refinement of components that did work as expected. As has been previously stated, the aim of this study was to test intervention components that could be easily integrated into a smartphone app. Development of a smartphone app would allow a lot more customizability of the components that have been shown to work, and more options for integration of the components that were not effective in the current intervention. Use of a smartphone app would also make it easier to record long term exercise data, which would give a more reliable indication of the effectiveness of the intervention for promoting ongoing exercise adherence.

Conclusion

This study shows that by using an automated intervention based on simple behavioural principles and other relevant psychological research, it is possible to significantly increase the exercise behaviour of people who currently do little to no exercise in such a way the promotes ongoing adherence. These findings are important from a therapeutic perspective due to the fact that exercise can be used to effectively treat a variety of mental and physical health problems, such as; obesity, cardiovascular disease, generalized anxiety disorder, and depression (Dishman, 1999; Lee et al., 2012).

Worldwide prevalence of depression and obesity are on the rise, and there is already a large dissonance between the number of diagnoses, and the availability of effective treatment options (WHO, 2012). A lack of trained professionals, and the high costs of training and employing these professionals, is a contributing factor to the disparity between number of diagnoses and availability of treatment. Removing the requirement of a therapist to deliver an intervention would help to increase availability of treatment for those who would not otherwise be able to access it (WHO, 2012). This highlights the importance of research aimed at the development of automated treatment options; if treatment is to be made available to those who need it, it needs to be affordable, effective, and accessible (WHO, 2012). Using technological advances such as smartphone apps and email to deliver an automated intervention to increase levels of exercise behaviour seems to be a promising method of accomplishing this.

References

Annesi, J. J. (2005). Correlations of depression and total mood disturbance with physical activity and self-concept in preadolescents enrolled in an after-school exercise program. *Psychological Reports, 96*(3), 891-898.

Babyak, M., Blumenthal, J. A., Herman, S., Khatri, P., Doraiswamy, M., Moore, K., Graighead, E., Baldewicz, T. T. & Krishnan, R. (2000). Exercise treatment for major depression: Maintenance of therapeutic benefit at 10 months. *Psychosomatic Medicine, 62*(5), 633-638.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, *84*(2), 191–215. doi:10.1037/0033-295X.84.2.191

Bandura, A. (1991). Social cognitive theory of self-regulation. *Organizational Behavior and Human Decision Processes, 50*(2), 248–287. doi:10.1016/0749-5978(91)90022-L

Bandura, A. (2006). Guide for constructing self-efficacy scales. In: Pajares, F., Urdan, T. (Eds.), Self-*efficacy Beliefs of Adolescents* (pp. 307–337). Greenwich, CT: Information Age Publishing.

Bandura, A., & Cervone, D. (1983). Self-evaluative and self-efficacy mechanisms governing the motivational effects of goal systems. *Journal of Personality and Social Psychology*, *45*(5), 1017–1028. doi:10.1037/0022-3514.45.5.1017

Bandura, A., & Cervone, D. (1986). Differential engagement of self-reactive influences in cognitive motivation. *Organizational Behavior and Human Decision Processes*, *38*(1), 92–113. doi:10.1016/0749-5978(86)90028-2

Bandura, A., & Jourden, F. J. (1991). Self-regulatory mechanisms governing the impact of social comparison on complex decision making. *Journal of Personality and Social Psychology*, *60*(6), 941–951. doi:10.1037/0022-3514.60.6.941

Bandura, A., & Locke, E. A. (2003). Negative self-efficacy and goal effects revisited. *Journal of Applied Psychology*, *88*(1), 87–99. doi:10.1037/0021-9010.88.1.87

Bandura, A., & Schunk, D. H. (1981). Cultivating competence, self-efficacy, and intrinsic interest through proximal self-motivation. *Journal of Personality and Social Psychology, 41*(3), 586–598. doi:10.1037/0022-3514.41.3.586

Brownson, R. C., Boehmer, T. K., & Luke, D. A. (2005). Declining rates of physical activity in the United States: What are the contributors? *Annual Review of Public Health*, *26*, 421–443.

Brunes, A., Augestad, L. & Gudmundsdottir, S. (2013). Personality, physical activity, and symptoms of anxiety and depression: the HUNT study. *Social Psychiatry & Psychiatric Epidemiology, 48*(5), 745-756. doi: 10.1007/s00127-012-0594-6

Centers for Disease Control and Prevention [CDC] (2011). *Physical Activity for Everyone: Measuring Intensity | DNPAO | CDC.* Retrieved March 21, 2014, from http://www.cdc.gov/physicalactivity/everyone/measuring/index.html?s_cid=tw_ob290

Cooney, G. M., Dwan, K., Greig, C. A., Lawlor, D. A., Rimer, J., Waugh, F. R., McMurdo, M., & Mead, G. E. (2013). Exercise for depression. *Cochrane Database of Systematic Reviews*. John Wiley & Sons, Ltd. Retrieved from http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD004366.pub6/abstract

Cowan, L. T., Wagenen, S. A. V., 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? A content analysis of exercise apps for presence of behavior change theory. *Health Education & Behavior*, *40*(2), 133–139. doi:10.1177/1090198112452126

Daley, A. J., Copeland, R. J., Wright, N. P., Roalfe, A. & Wales, J. K. H. (2006). Exercise therapy as a treatment for psychopathologic conditions in obese and morbidly obese adolescents: A randomized controlled trial. *Pediatrics, 118*(5), 2126-2134. doi:10.1542/peds.2006-1285

Desharnais, R., Bouillon, J., & Godin, G. (1986). Self-efficacy and outcome expectations as determinants of exercise adherence. *Psychological Reports*, *59*(3), 1155–1159. doi:10.2466/pr0.1986.59.3.1155

Dishman, R. K. (1991). Increasing and maintaining exercise and physical activity. *Behavior Therapy*, *22*(3), 345–378. doi:10.1016/S0005-7894(05)80371-5

DuCharme, K. A., & Brawley, L. R. (1995). Predicting the intentions and behavior of exercise initiates using two forms of self-efficacy. *Journal of Behavioral Medicine*, *18*(5), 479–497. doi:10.1007/BF01904775

Dunn, A. L., Trivedi, M. H., Kampert, J. B., Clark, C. G., & Chambliss, H. O. (2005). Exercise treatment for depression: Efficacy and dose response. *American Journal of Preventive Medicine*, *28*(1), 1–8. doi:10.1016/j.amepre.2004.09.003

Everett, B., Salamonson, Y., & Davidson, P. M. (2009). Bandura's exercise self-efficacy scale: Validation in an Australian cardiac rehabilitation setting. *International Journal of Nursing Studies, 46*(6), 824–829.

Fraser, S. N., & Spink, K. S. (2002). Examining the role of social support and group cohesion in exercise compliance. *Journal of Behavioral Medicine*, *25*(3), 233–249. doi:10.1023/A:1015328627304

Gollwitzer, P. M. (1999). Implementation intentions: Strong effects of simple plans. *American Psychologist*, *54*(7), 493–503. doi:10.1037/0003-066X.54.7.493

Gollwitzer, P. M., & Sheeran, P. (2006). Implementation intentions and goal achievement: A meta-analysis of effects and processes. In Mark P. Zanna (Ed.), *Advances in Experimental Social Psychology*, *38*, 69–119. Academic Press. Retrieved from http://www.sciencedirect.com/science/article/pii/S0065260106380021

Greater Wellington Regional Council. (2013). *Physical inactivity costs almost one percent of GDP » Greater Wellington Regional Council.* Retrieved June 24, 2014, from http://www.gw.govt.nz/physical-inactivity-costs-almost-one-percent-of-gdp/

Hooper, J. M., & Veneziano, L. (1995). Distinguishing starters from nonstarters in an employee physical activity incentive program. *Health Education Quarterly*, *22*(1), 49–60.

Hovell, M. F., Sallis, J. F., Hofstetter, C. R., Spry, V. M., Faucher, P., & Caspersen, C. J. (1989). Identifying correlates of walking for exercise: an epidemiologic prerequisite for physical activity promotion. *Preventive Medicine*, *18*(6), 856–866.

Hovell, M., Sallis, J., Hofstetter, R., Barrington, E., Hackley, M., Elder, J., Kilbourne, K. (1991). Identification of correlates of physical activity among Latino adults. *Journal of Community Health*, *16*(1), 23–36.

Jakicic, J. M., Wing, R. R., Butler, B. A., & Robertson, R. J. (1995). Prescribing exercise in multiple short bouts versus one continuous bout: Effects on adherence, cardiorespiratory fitness, and weight loss in overweight women. *International Journal of Obesity and Related Metabolic Disorders: Journal of the International Association for the Study of Obesity*, *19*(12), 893–901.

Kim, Y.-H. (2007). Application of the transtheoretical model to identify psychological constructs influencing exercise behavior: A questionnaire survey. *International Journal of Nursing Studies*, *44*(6), 936–944. doi:10.1016/j.ijnurstu.2006.03.008

King, A. C., Ahn, D. K., Oliveira, B. M., Atienza, A. A., Castro, C. M., & Gardner, C. D. (2008). Promoting physical activity through hand-held computer technology. *American Journal of Preventive Medicine*, *34*(2), 138–142. doi:10.1016/j.amepre.2007.09.025

King, A. C., Taylor, C. B., Haskell, W. L., & DeBusk, R. F. (1990). Identifying strategies for increasing employee physical activity levels: Findings from the Stanford/Lockheed exercise survey. *Health Education & Behavior*, *17*(3), 269–285. doi:10.1177/109019819001700304

Knubben, K., Reischies, F. M., Adli, M., Schlattmann, P., Bauer, M., & Dimeo, F. (2007). A randomised, controlled study on the effects of a short-term endurance training programme in patients with major depression. *British Journal of Sports Medicine*, *41*(1), 29–33. doi:10.1136/bjsm.2006.030130

Lee, I. M., Shiroma, E. J., Lobelo, F., Puska, P., Blair, S. N., Katzmarzyk, P. T., & Lancet Physical Activity Series Working Group. (2012). Effect of physical inactivity on major non-communicable diseases worldwide: An analysis of burden of disease and life expectancy. *Lancet*, *380*(9838), 219–229. doi:10.1016/S0140-6736(12)61031-9

Lewis, B. A. (2007). Should the internet be used to promote healthy living? *The Lancet*, *370*(9603), 1891–1892. doi:10.1016/S0140-6736(07)61794-2

Locke, E. A., & Latham, G. P. (1990). *A theory of goal setting & task performance* (Vol. xviii). Englewood Cliffs, NJ, US: Prentice-Hall, Inc.

Mailey, E. L., Wojcicki, T. R., Motl, R. W., Hu, L., Strauser, D. R., Collins, K. D. & McAuley, E. (2010). Internet-delivered physical activity intervention for college students with mental health disorders: A randomized pilot trial. *Psychology, Health & Medicine, 15*(6), 646-659.

Marcus, B. H., Selby, V. C., Niaura, R. S., & Rossi, J. S. (1992). Self-efficacy and the stages of exercise behavior change. *Research Quarterly for Exercise and Sport*, *63*(1), 60–6.

Marcus, M., Yasamy, M. T., Ommeren, M. V., Chisholm, D., & Saxena, S. (2012). Depression: A global public health concern. Retrieved July 22, 2014, from http://www.who.int/mental_health/management/depression/who_paper_depression_wfmh_2012.pdf?ua=1

McAuley, E., Jerome, G. J., Marquez, D. X., Elavsky, S., & Blissmer, B. (2003). Exercise self-efficacy in older adults: Social, affective, and behavioral influences. *Annals of Behavioral Medicine*, *25*(1), 1–7. doi:10.1207/S15324796ABM2501_01

Ministry of Health. (2012). *The Health of New Zealand Adults 2011/12.* Retrieved July 29, 2014, from http://www.health.govt.nz/publication/health-new-zealand-adults-2011-12

Mota-Pereira, J., Silverio, J., Carvalho, S., Ribeiro, J. C., Fonte, D. & Ramos, J. (2010). Moderate exercise improves depression parameters in treatment-resistant patients with major depressive disorder. *Journal of Psychiatric Research, 45,* 1005-1011.

Müller, A. M., & Khoo, S. (2014). Non-face-to-face physical activity interventions in older adults: A systematic review. *International Journal of Behavioral Nutrition and Physical Activity*, *11*(35). doi:http://dx.doi.org.ezproxy.waikato.ac.nz/10.1186/1479-5868-11-35

Nigg, C. R. (2003). Technology's influence on physical activity and exercise science: the present and the future. *Psychology of Sport and Exercise, 4*(1), 57–65. doi:10.1016/S1469-0292(02)00017-1

Nooijen, C. F. J., Post, M. W. M., Spijkerman, D. C. M., Bergen, M. P., Stam, H. J., & van den Berg-Emons, R. J. G. (2013). Exercise self-efficacy in persons with spinal cord injury: Psychometric properties of the Dutch translation of the Exercise Self-Efficacy Scale. *Journal of Rehabilitation Medicine, 45*(4), 347–350. doi:10.2340/16501977-1112

Noroozi, A., Ghofranipour, F., Heydarnia, A. R., Nabipour, I., Tahmasebi, R., & Tavafian, S. S. (2011). The Iranian version of the exercise self-efficacy scale (ESES) Factor structure, internal consistency and construct validity. *Health Education Journal, 70*(1), 21–31. doi:10.1177/0017896910374547 doi:10.1016/j.ijnurstu.2009.01.016

Oakley Browne, M. A., Wells, J. E., & Scotts, K. M. (Eds). (2006). *Te Rau Hinengaro: The New Zealand Mental Health Survey*. Wellington: Ministry of Health.

Perri, M. G., Anton, S. D., Durning, P. E., Ketterson, T. U., Sydeman, S. J., Berlant, N. E., … Martin, A. D. (2002). Adherence to exercise prescriptions: Effects of prescribing moderate versus higher levels of intensity and frequency. *Health Psychology*, *21*(5), 452–458. doi:10.1037/0278-6133.21.5.452

Prochaska, J. O., & Velicer, W. F. (1997). The Transtheoretical Model of health behavior change. *American Journal of Health Promotion*, *12*(1), 38–48. doi:10.4278/0890-1171-12.1.38

Ryan, R. M., Frederick, C. M., Lepes, D., Rubio, N., & Sheldon, K. M. (1997). Intrinsic motivation and exercise adherence. *International Journal of Sport Psychology*, (28), 335–354.

Sallis, J. F., Haskell, W. L., Fortmann, S. P., Vranizan, K. M., Taylor, C. B., & Solomon, D. S. (1986). Predictors of adoption and maintenance of physical activity in a community sample. *Preventive Medicine*, *15*(4), 331–341. doi:10.1016/0091-7435(86)90001-0

Schwarzer, R., Luszczynska, A., Ziegelmann, J. P., Scholz, U., & Lippke, S. (2008). Social-cognitive predictors of physical exercise adherence: Three longitudinal studies in rehabilitation. *Health Psychology*, *27*(1), 54–63. doi:10.1037/0278-6133.27.1(Suppl.).S54

Sherwood, N. E., & Jeffery, R. W. (2000). The behavioral determinants of exercise: Implications for physical activity interventions. *Annual Review of Nutrition*, *20*, 21–44.

Shin, Y., Jang, H., & Pender, N. J. (2001). Psychometric evaluation of the exercise self-efficacy scale among Korean adults with chronic diseases. *Research in Nursing & Health, 24*(1), 68–76. doi:10.1002/1098-240X(200102)24:1<68::AID-NUR1008>3.0.CO;2-C

Steele, R., Mummery, K. W., & Dwyer, T. (2007). Development and process evaluation of an Internet-based physical activity behaviour change program. *Patient Education and Counseling*, *67*(1–2), 127–136. doi:10.1016/j.pec.2007.02.013

Taliaferro, L. A., Rienzo, B. A., Pigg, M. R., Miller, D. M. & Dodd, V. J. (2009). Associations between physical activity and reduced rates of hopelessness, depression and suicidal behavior among college students. *Journal of American College Health*, *57*(4), 427-436.

Tyson, P., Wilson, K., Crone, D., Brailsford, R. & Laws, K. (2010). Physical activity and mental health in a student population. *Journal of Mental Health, 19*(6), 492-499.

Wallace, J. P., Raglin, J. S., & Jastremski, C. A. (1995). Twelve month adherence of adults who joined a fitness program with a spouse vs without a spouse. *The Journal of Sports Medicine and Physical Fitness*, *35*(3), 206–213.

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). doi:10.2196/jmir.1376

Weinstein, N. D. (2003). Exploring the links between risk perceptions and preventive health behavior. In J. Suls & K. A. Wallston (Eds.), *Social Psychological Foundations of Health and Illness* (pp. 22–53). Blackwell Publishing Ltd. Retrieved from http://onlinelibrary.wiley.com/doi/10.1002/9780470753552.ch2/summary

Wiles, N. J., Haase, A. M., Lawlor, D. A., Ness, A & Lewis, G. (2011). Physical activity and depression in adolescents: Cross-sectional findings from the ALSPAC cohort. *Social Psychiatry and Psychiatric Epidemiology and Mental Health Services, 47*(7), 1023-1033. doi: 10.1007/s00127-011-0422-4

Williams, P. T. (2001). Physical fitness and activity as separate heart disease risk factors: A meta-analysis. *Medicine and Science in Sports and Exercise*, *33*(5), 754–761.

Williams, S. L., & French, D. P. (2011). What are the most effective intervention techniques for changing physical activity self-efficacy and physical activity behaviour--and are they the same? *Health Education Research*, *26*(2), 308–322. doi:10.1093/her/cyr005

Williams, D. M., Lewis, B. A., Dunsiger, S., Whiteley, J. A., Papandonatos, G. D., Napolitano, M. A., … Marcus, B. H. (2008). Comparing psychosocial predictors of physical activity adoption and maintenance. *Annals of Behavioral Medicine*, *36*(2), 186–194. doi:10.1007/s12160-008-9054-7

Wilson, K., & Brookfield, D. (2009). Effect of goal setting on motivation and adherence in a six-week exercise program. *International Journal of Sport and Exercise Psychology*, *7*(1), 89–100. doi:10.1080/1612197X.2009.9671894

World Health Organisation. (2004). *The global burden of disease: 2004 update.* Retrieved June 29, 2015, from http://www.who.int/healthinfo/global_burden_disease/2004_report_update/en/

World Health Organisation. (2008). *Physical inactivity: Physical inactivity - Data by country*. Retrieved June 23, 2014, from http://apps.who.int/gho/data/node.main.A893

World Health Organisation. (2010). *Global recommendations on physical activity for health.* Retrieved June 23, 2014, from http://www.who.int/dietphysicalactivity/publications/9789241599979/en/

World Health Organisation. (2012). *Depression: Fact sheet 369.* Retrieved July 24, 2014, from http://www.who.int/mediacentre/factsheets/fs369/en/

World Health Organisation. (2014a). *Physical Inactivity: A Global Public Health Problem.* Retrieved June 23, 2014, from http://www.who.int/dietphysicalactivity/factsheet_inactivity/en/

World Health Organisation. (2014b). *Obesity and overweight*. Retrieved June 20, 2014, from http://www.who.int/mediacentre/factsheets/fs311/en/

World Health Organisation. (2014c*). What is Moderate-intensity and Vigorous-intensity Physical Activity?* Retrieved March 20, 2014, from http://www.who.int/dietphysicalactivity/physical_activity_intensity/en/

Vandelanotte, C., Spathonis, K. M., Eakin, E. G., & Owen, N. (2007). Website-delivered physical activity interventions: A review of the literature.

American Journal of Preventive Medicine, *33*(1), 54–64. doi:10.1016/j.amepre.2007.02.041

Yoon, S., Buckworth, J., Focht, B., & Ko, B. (2013). Feelings of energy, exercise-related self-efficacy, and voluntary exercise participation. *Journal of Sport & Exercise Psychology*, *35*(6), 612–624.

Young, H. K., & Cardinal, B. J. (2009). Effects of a transtheoretical model-based stage-matched intervention to promote physical activity among Korean adults. *International Journal of Clinical Health & Psychology, 9*(2), 259–273.

Appendices

Appendix A: Modified Version of Bandura's (2006) 18 item Exercise Self-Efficacy Scale

Exercise Self Efficacy Scale: #____

Participant Name: ______________________________ Participant Number: ___

A number of situations are described below that can make it hard to stick to an exercise routine.

Please rate on the scale how certain you are that you can get yourself to perform your exercise routine regularly (three or more times a week).

Rate your degree of confidence by selecting a number from 0 - 10 using the scale given below.

0	1	2	3	4	5	6	7	8	9	10
Cannot do at all					Moderately can do					Highly certain can do

	Confidence (0 - 10)
When I am feeling tired	
When I am feeling under pressure from work	
During bad weather	
After recovering from an injury that caused me to stop exercising	
During or after experiencing personal problems	
When I am feeling depressed	
When I am feeling anxious	
After recovering from an illness that caused me to stop exercising	
When I feel physical discomfort when I exercise	
After a vacation	
When I have too much work to do at home	
When visitors are present	
When there are other interesting things to do	
If I don't reach my exercise goals	
Without support from my family or friends	
During a vacation	
When I have other time commitments	
After experiencing family problems	

Appendix B: Exercise Operationalisation and Intensity Information Sheet

Exercise Activity and Intensity Criteria

To be counted as exercise:

The activity must be performed continuously for a minimum of 10 minutes.

The purpose of the activity needs to be exercise; riding a bike or walking to the store or work can be counted, as this can be seen as time set aside specifically for exercise.
Things like moving around the office or house shouldn't be counted, as the purpose of it isn't really exercise and it generally wouldn't be something you do continuously for a minimum of 10 minutes.
Household tasks such as gardening, cleaning etc can be counted if they last for at least 10 minutes and meet the required intensity criteria.

How do I judge my level of intensity?

A good rule of thumb to ascertain your exercise intensity is the 'talk test';

1. Light intensity: Can sing a few lines of a song without difficulty and hold a conversation

2. Moderate intensity: Can't sing lines to a song without pausing to catch your breath, but can hold a conversation

3. Vigorous intensity: Can't sing lines to a song or hold a conversation without pausing to catch your breath.

Moderate Intensity

- Elevated heart rate
- Breathing faster and feeling warmer
- Able to speak to others, but not sing

Activity examples:

1. Walking at a moderate to brisk pace of 5 – 7 kph on a level surface, e.g;

   a) Walking to class, work, or the store
   b) Walking for pleasure
   c) Walking the dog
   d) Walking as a break from work

2. Bicycling at 8 – 12 kph over level terrain, or at a moderate pace on a stationary bicycle.
3. Yoga
4. Gymnastics
5. Jumping on a trampoline
6. Using a stair climber of elliptical machine at a moderate pace
7. Dancing (ballroom, square, folk, ballet, etc).

Light Intensity

- Slightly elevated heart rate
- Not much change in breathing
- Should be able to comfortably hold a conversation

Activity examples:

1. A leisurely walk
2 Light housework

Vigorous Intensity

- Significantly elevated heart rate
- Breathing hard and fast, sweating
- Only able to speak a few words at a time

Activity examples:

1. Race walking and aerobic walking - 8 kph or higher.
2. Jogging or running
3. Walking and climbing briskly up a hill
4. Bicycling at more than 16 kph
5. Martial arts (Judo, Tae Kwon Do, Kickboxing, Jiu-Jitsu etc)
6. Most active sports (Rugby, Tennis, Soccer)

Appendix C: Baseline Exercise Recording Form

Exercise Record Form | Baseline

Date started: ___/___/_____

Name: ______________________ Participant Number: ___

Please use this form to record your daily exercise duration and intensity.
Write in the total duration of exercise for that day in minutes.
Please tick the box that best describes your exercise session intensity.
Refer to the 'intensity criteria' information sheet if unsure which intensity to choose.
At the end of the week please copy this data into the survey form you are sent via email.

Day 1 **Please tick one**

Duration: _______ minutes. **Intensity:** Light ☐ Moderate ☐ Vigorous ☐

Day 2

Duration: _______ minutes. **Intensity:** Light ☐ Moderate ☐ Vigorous ☐

Day 3

Duration: _______ minutes. **Intensity:** Light ☐ Moderate ☐ Vigorous ☐

Day 4

Duration: _______ minutes. **Intensity:** Light ☐ Moderate ☐ Vigorous ☐

Day 5

Duration: _______ minutes. **Intensity:** Light ☐ Moderate ☐ Vigorous ☐

Day 6

Duration: _______ minutes. **Intensity:** Light ☐ Moderate ☐ Vigorous ☐

Day 7

Duration: _______ minutes. **Intensity:** Light ☐ Moderate ☐ Vigorous ☐

Appendix D: Intervention Exercise Recording Form

Exercise Record Form

Date started: ___/___/_____ Stage ___

Name: ______________________ Participant Number: ___

Please use this form to record your daily exercise duration and intensity.
Write in the total duration of exercise for that day in minutes.
Please tick the box that best describes your exercise session intensity.
Refer to the 'intensity criteria' information sheet if unsure which intensity to choose.

At the end of the week please copy this data into the survey form you are sent via email.

Day 1 **Please tick one**

Duration: ______ minutes. **Intensity:** Light ☐ Moderate ☐ Vigorous ☐

Day 2

Duration: ______ minutes. **Intensity:** Light ☐ Moderate ☐ Vigorous ☐

Day 3

Duration: ______ minutes. **Intensity:** Light ☐ Moderate ☐ Vigorous ☐

Day 4

Duration: ______ minutes. **Intensity:** Light ☐ Moderate ☐ Vigorous ☐

Day 5

Duration: ______ minutes. **Intensity:** Light ☐ Moderate ☐ Vigorous ☐

Day 6

Duration: ______ minutes. **Intensity:** Light ☐ Moderate ☐ Vigorous ☐

Day 7

Duration: ______ minutes. **Intensity:** Light ☐ Moderate ☐ Vigorous ☐

Appendix E: Intervention Data Collection Survey

Edit this form

Exercise Activity Survey: Stage 1

Please fill out this survey with the intensity and time you spent exercising for each day within a seven day period for stage one of the exercise program.
The days you choose need to be seven consecutive days between when you were given your targets, and when you submit this survey.
The seven day period you choose is up to you, this is to allow for some flexibility due to extenuating circumstances such as sickness, injury, or vacations.

*Required

Who are you?

What is your participant number? *

Select your participant number, if you can't remember it should be in your email communications

[▼]

What is your full name? *

[ ]

Day One

At what intensity did you exercise? (Day 1) *

- Didn't Exercise
- Light
- Moderate
- Vigorous

How long did you exercise for? (Day 1)

Minimum of 10 minutes

Hr ▼ : Min ▼ : Sec ▼

Day Two

At what intensity did you exercise? (Day 2) *

- Didn't Exercise
- Light
- Moderate
- Vigorous

Appendix E: Continued

How long did you exercise for? (Day 2)

Hr ▼ : Min ▼ : Sec ▼

Day Three

At what intensity did you exercise? (Day 3) *

- ◯ Didn't Exercise
- ◯ Light
- ◯ Moderate
- ◯ Vigorous

How long did you exercise for? (Day 3)

Hr ▼ : Min ▼ : Sec ▼

Day Four

At what intensity did you exercise? (Day 4) *

- ◯ Didn't Exercise
- ◯ Light
- ◯ Moderate
- ◯ Vigorous

How long did you exercise for? (Day 4)

Hr ▼ : Min ▼ : Sec ▼

Day Five

At what intensity did you exercise? (Day 5) *

- ◯ Didn't Exercise
- ◯ Light
- ◯ Moderate
- ◯ Vigorous

How long did you exercise for? (Day 5)

Hr ▼ : Min ▼ : Sec ▼

Day Six

At what intensity did you exercise? (Day 6) *

Appendix E: Continued

- Didn't Exercise
- Light
- Moderate
- Vigorous

How long did you exercise for? (Day 6)

Hr ▼ : Min ▼ : Sec ▼

Day Seven

At what intensity did you exercise? (Day 7) *

- Didn't Exercise
- Light
- Moderate
- Vigorous

How long did you exercise for? (Day 7)

Hr ▼ : Min ▼ : Sec ▼

Stage One Exercise Targets

Did you manage to complete your stage 1 exercise targets? *

- Yes! I did!
- Didn't quite make it this time.

Stage One Homework Tasks

Did you complete your stage 1 tasks?

Tick the box for each task that you completed.

- Scheduling task
- Social task

Submit

100%: You made it.

Never submit passwords through Google Forms.

Appendix F: Recruitment Poster

Appendix G: Consent Form for Participation in the Study

Consent Form

Ψ School of Psychology

THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato

PARTICIPANT'S COPY

Research Project:

Name of Researcher:

Name of Supervisor (if applicable):

I have received an information sheet about this research project or the researcher has explained the study to me. I have had the chance to ask any questions and discuss my participation with other people. Any questions have been answered to my satisfaction.

I agree to participate in this research project and I understand that I may withdraw at any time. If I have any concerns about this project, I may contact the convenor of the Research and Ethics Committee phone: ext. e-mail

Participant's Name:____________________ Signature:_______________ Date:_______

Consent Form

Ψ School of Psychology

THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato

RESEARCHER'S COPY

Research Project: Pilot study of a technology based intervention to increase adherence to a physical exercise program

Name of Researcher:

Name of Supervisor (if applicable):

I have received an information sheet about this research project or the researcher has explained the study to me. I have had the chance to ask any questions and discuss my participation with other people. Any questions have been answered to my satisfaction.

I agree to participate in this research project and I understand that I may withdraw at any time. If I have any concerns about this project, I may contact the convenor of the Research and Ethics Committee.

Participant's Name: ____________________ Signature:_____________ Date:_______

Appendix H: Baseline Data Collection Survey

1/14/2015 Baseline Exercise Survey: Week 1

Edit this form

Baseline Exercise Survey: Week 1

Please fill out this survey with the intensity and time you spent exercising for the past seven days.

*Required

Who are you?

What is your participant number? *

Select your participant number, if you can't remember it should be in your email communications

▼

What is your full name? *

Day One

At what intensity did you exercise? (Day 1) *

- Didn't Exercise
- Light
- Moderate
- Vigorous

How long did you exercise for? (Day 1)

Minimum of 10 minutes

Hr ▼ : Min ▼ : Sec ▼

Day Two

At what intensity did you exercise? (Day 2) *

- Didn't Exercise
- Light
- Moderate
- Vigorous

How long did you exercise for? (Day 2)

Hr ▼ : Min ▼ : Sec ▼

https://docs.google.com/forms/d/17cc5YSXCaVpph1vF7RePkVtViF_ORETrWhVlTbYIF9c/viewform 1/3

Appendix H: Continued

Day Three

At what intensity did you exercise? (Day 3) *

- Didn't Exercise
- Light
- Moderate
- Vigorous

How long did you exercise for? (Day 3)

Hr ▼ : Min ▼ : Sec ▼

Day Four

At what intensity did you exercise? (Day 4) *

- Didn't Exercise
- Light
- Moderate
- Vigorous

How long did you exercise for? (Day 4)

Hr ▼ : Min ▼ : Sec ▼

Day Five

At what intensity did you exercise? (Day 5) *

- Didn't Exercise
- Light
- Moderate
- Vigorous

How long did you exercise for? (Day 5)

Hr ▼ : Min ▼ : Sec ▼

Day Six

At what intensity did you exercise? (Day 6) *

- Didn't Exercise
- Light
- Moderate

Appendix H: Continued

○ Vigorous

How long did you exercise for? (Day 6)

Hr ▼ : Min ▼ : Sec ▼

Day Seven

At what intensity did you exercise? (Day 7) *

○ Didn't Exercise
○ Light
○ Moderate
○ Vigorous

How long did you exercise for? (Day 7)

Hr ▼ : Min ▼ : Sec ▼

Submit

Never submit passwords through Google Forms.

100%: You made it.

Appendix I: Example of Stage Feedback and Target Information Email

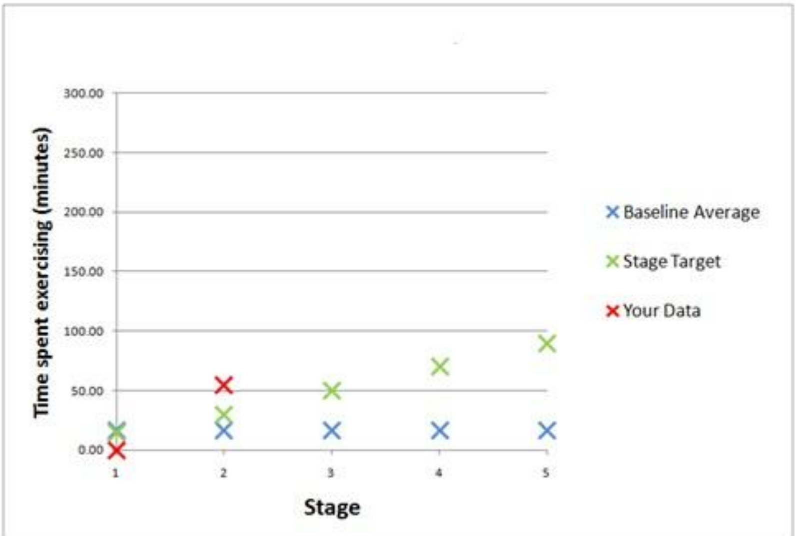
Participant number: [redacted]

Name: [redacted]

You completed stage 2, good job!
How did the goal setting work out for you? Setting short term achievable goals, such as adding another block to your walk, is a great way to stay motivated. Just remember to make sure that the goal can be achieved within the exercise session itself.

Although goal setting is not one of the goals for this stage, it is quite helpful so feel free to keep using it.

This graph gives useful feedback on whether you need to increase or decrease your activity. Remember you don't want to do too much too soon! If you find you're exceeding your weekly targets by too much, it might be a good idea to dial it down a little.



Appendix I: Continued

Stage Three Target and Tasks

Stage 3 target

50 minutes of moderate exercise.

You can break this up any way you like; just do whatever works for your schedule and ability. If you can schedule in a 30 and a 20 minute session, that's great. But you can also do multiple 15 or 10 minute sessions if that works for you.

Stage 3 tasks

Scheduling:

Hopefully by now this is becoming a habit. Schedule in your exercise days; put them in your calendar, write them on some paper and stick it to your fridge, set up reminders on your phone!
Any of the above will do, just make sure you actively schedule in when you're going to exercise, and what you're going to do!

Social

Let your friends and family know how you're going on the path to a healthier lifestyle; post on Facebook/Twitter, or tell someone close to you about your progress so far.
Success deserves recognition!

Good luck!

Appendix J: Post Program Information Sheet

I've finished the 5 stage program, what now?!

1. The most important thing you can do is schedule your exercise sessions! Make solid plans that include what you're going to do, and when you're going to do it. Behavioural intentions don't really lead to actual behaviour, but studies have shown that scheduling bridges this gap and makes your intentions become actions.

2. Proximal goal setting; set small goals that are inherent to the activity itself. If you're power-walking around the block for your daily exercise, set yourself slightly longer distances each time. It feels really good to be able to see yourself improving, and meeting your goals. Make sure your goals are realistic though.

3. Start out at a lower intensity, and don't take on too much too soon. Exercise is supposed to be fun, not painful. A major reason people don't stick to exercise routines is that they are often very unpleasant. This is generally because when you start out, you're very unfit, so exercising hurts! As your fitness increases you'll be able to do more without it being unpleasant and painful, but this doesn't happen all at once.
   Try and stick to moderate intensity exercise, don't over exert yourself.

4. Find social reinforcement; exercise with friends, post on Facebook when you reach your targets. Success deserves recognition, so make sure that those around you are supporting your healthy exercise behaviour.

5. Set yourself realistic targets. Now that you're finished with the 5 stage program, you have control over your own exercise targets.
   Remember to make sure they are realistic and achievable. You don't need to be increasing them every week either, if you find a routine that works for you, stick at it for awhile.

Appendix K: Post Program Exercise Recording Sheet

My Exercise Record

Date started: ___/___/_____ Name: ____________________________

THINGS TO DO EACH WEEK:
1 - SET YOUR TARGET FOR THE WEEK
2 - SCHEDULE YOUR EXERCISE SESSIONS TO MEET THAT TARGET
3 - TELL PEOPLE WHEN YOU SUCCESSFULLY MEET YOUR WEEKLY TARGETS
4 - SET SMALL ACHIEVEABLE GOALS FOR EACH SESSION
5 - DON'T INCREASE YOUR TARGET BY MORE THAN 20 MINUTES EACH WEEK
6 - DON'T INCREASE THE INTENSITY OF YOUR WORKOUT TOO FAST
7 - HAVE FUN, EXERCISE SHOULDN'T BE A CHORE!

Week 1 **Target:** _______ minutes.	Target met? Scheduling done? Had fun?	Yes Yes Yes	No No No
Week 2 **Target:** _______ minutes.	Target met? Scheduling done? Had fun?	Yes Yes Yes	No No No
Week 3 **Target:** _______ minutes.	Target met? Scheduling done? Had fun?	Yes Yes Yes	No No No
Week 4 **Target:** _______ minutes.	Target met? Scheduling done? Had fun?	Yes Yes Yes	No No No
Week 5 **Target:** _______ minutes.	Target met? Scheduling done? Had fun?	Yes Yes Yes	No No No
Week 6 **Target:** _______ minutes.	Target met? Scheduling done? Had fun?	Yes Yes Yes	No No No
Week 7 **Target:** _______ minutes.	Target met? Scheduling done? Had fun?	Yes Yes Yes	No No No
Week 8 **Target:** _______ minutes.	Target met? Scheduling done? Had fun?	Yes Yes Yes	No No No