Affective, Motivational and Behavioural Outcomes from an Exercise Intervention Comparing
Self-Selected versus Imposed Intensity

Jade D. Fleming

A thesis submitted for the degree of Masters in Physical Education at the University of Otago,
Dunedin, New Zealand
(2012)
Abstract

Understanding the factors that will lead individuals to increase and maintain their levels of physical activity is a key area of investigation within exercise psychology. Research has suggested that the affective responses that individuals experience during exercise may have a role in predicting future exercise behaviour (Kiviniemi, Voss-Humke & Seifert, 2007; Williams, Dunsiger, Ciccolo, Lewis, Albrecht & Marcus, 2008). Thus, it is important to ensure individuals experience positive exercise-induced affective responses. Both exercise intensity and the method of exercise prescription are factors that have been shown to influence exercise-induced affective responses. For example, self-selected intensities have been shown to result in more positive and less variable affective responses than exercise imposed at the same intensity (e.g., Rose & Parfitt, 2007). However, the extent to which a self-selected versus imposed intensity method of prescription influences exercise motivation and behaviour has not been examined in a longitudinal investigation. The purpose of the current research was to compare the affective responses to exercise, levels of self-determined motivation and physical activity behaviour that results from a six-week intervention of self-selected versus imposed intensity exercise.

A single-subject multiple baseline case design was used to identify individual differences in exercise preference and affective responses and gain in-depth information on the cognitive appraisal process and behavioural outcomes without losing external validity. Six females aged 39-49 years participated in a six week intervention consisting of 30 min of aerobic exercise three times a week. Three participants exercised at a self-selected intensity and three at an imposed intensity based on the relative intensity they self-selected at baseline. Affect, self-determined motivation, self-efficacy and physical activity behaviour were measured weekly throughout the intervention and six weeks post-intervention.

The results showed that, as expected, the intensities chosen between participants were variable. Participants in the imposed condition selected intensities that were below their Ventilatory Threshold (VT) at baseline. Participants in the self-selected group selected a mixture of intensities (one below, one at, and one above VT). As expected, two of the three participants in the imposed condition had less positive affective responses during the intervention, while in the self-selected condition affect remained positive throughout the intervention despite higher intensities being selected. Participants in both conditions increased their physical activity behaviour to the same extent from baseline to follow up. Perceived
choice decreased in two of the imposed intensity participants, showing the successful manipulation of choice. Two participants in each condition had increased intrinsic and introjected regulation as well as perceived volition and a more internal locus of causality across the six week intervention. The study has highlighted the impact that loss of control over exercise intensity can have on affective responses even when the intensity is imposed at a previously self-selected level. This loss of control did not appear to impact physical activity behaviour as participants in both conditions increased from their baseline levels. Exercise professionals must recognise that individuals differ in their preferred exercise intensity and through allowing individuals to self-select their exercise intensity can provide the autonomy support necessary to result in positive affective responses.
Acknowledgements

Firstly I would like to thank my supervisor Dr Elaine Hargreaves for your ongoing support, epic feedback and encouragement over the past two years. Thanks for sticking with me and having the faith that I was lacking at times (or at least putting on a good act!). Thanks also to my secondary supervisor Dr Jim Cotter for lending your exercise physiology expertise and for all your support particularly with the research proposal process.

To my office mates over the past two years Fi and Lisa, thanks for all the good times in the office it has been awesome spending time with both of you. Thanks Fi for getting me through that first year I don’t think it ever even would have eventuated without your support, and for your ongoing help and wise words from afar this year. Thanks also to the other postgrads that have helped me out as well as provided encouragement and entertainment, especially Kate and Mon.

Thanks to the tech team, especially Lisa for all your help with organisation in the lab throughout my testing and always being so helpful, enthusiastic and understanding.

A huge thank you to the awesome ladies who participated in my study, it was really great to get to know you all and I cannot thank you enough for giving up your time to help me out and being so reliable and enthusiastic throughout.

Last but not least I would like to thank my friends and family for all your support (especially Mum, Dad, Samara, Nicky and Shane) particularly in the last year. You have all been there for me in different ways and have gone out of your way to make this happen for me. I am so grateful for your ongoing encouragement, support and belief in me.
# Table of Contents

**Chapter I: Introduction** .................................................................................................................. 1

**Chapter II: Review of Literature** ........................................................................................................ 6

  - Intensity-Affect Relationship ........................................................................................................ 6
  - Support for Self-Selected Exercise Intensity ................................................................................. 10
  - Self-Selection and Self-Determination ......................................................................................... 12
  - The Affect-Adherence Relationship ............................................................................................. 15
  - Conclusion .................................................................................................................................... 18

**Chapter III: Methods** ......................................................................................................................... 19

  - Research Design ........................................................................................................................ 19
  - Participants ................................................................................................................................... 21
  - Measures ..................................................................................................................................... 22
  - Procedure ................................................................................................................................... 26
  - Analysis ........................................................................................................................................ 31

**Chapter IV: Results** ............................................................................................................................. 33

  - Participant IC1 .......................................................................................................................... 33
    - Intensity ................................................................................................................................. 33
    - Affect ..................................................................................................................................... 35
    - Physical Activity Behaviour ................................................................................................. 37
    - Motivation ............................................................................................................................. 38
  - Participant IC2 .......................................................................................................................... 41
    - Intensity ................................................................................................................................. 42
    - Affect ..................................................................................................................................... 44
    - Physical Activity Behaviour ................................................................................................. 46
    - Motivation ............................................................................................................................. 47
  - Participant IC3 .......................................................................................................................... 50
    - Intensity ................................................................................................................................. 50
    - Affect ..................................................................................................................................... 52
    - Physical Activity Behaviour ................................................................................................. 54
    - Motivation ............................................................................................................................. 55
Appendix B ............................................................................................................................................. 124
Appendix C ............................................................................................................................................. 125
Appendix D ............................................................................................................................................. 126
Appendix E ............................................................................................................................................. 127
Appendix F ............................................................................................................................................. 129
Appendix G ............................................................................................................................................. 131
Appendix H ............................................................................................................................................. 133
Appendix I ............................................................................................................................................. 135
Appendix J ............................................................................................................................................. 136
Appendix K ............................................................................................................................................. 137
Appendix L ............................................................................................................................................. 139
Appendix M ............................................................................................................................................. 141
List of Figures

Figure 1.
The Self-Determined Motivation Continuum (Deci & Ryan, 1985)…………………………..13

Figure 2.
Williams’ (2008) model of exercise, affect & Adherence..............................................16

Figure 3.
Imposed intensity profile (% HR max) in 5-minute interval..............................................33

Figure 4.
PANAS (0-50) scores at baseline, the intervention and at follow up..............................37

Figure 5.
Accelerometer data at baseline, across the intervention and at follow up.......................37

Figure 6.
BREQ-2 (0-4) scores at baseline, across the intervention and at follow up........................39

Figure 7.
BPNS (0-5) scores at baseline, across the intervention and at follow up..........................40

Figure 8.
Imposed intensity profile (% HR max) in 5-minute intervals...........................................42

Figure 9.
PANAS (0-50) scores at baseline, across the intervention and at follow up .......................45
Figure 10.
Accelerometer data at baseline across the intervention and at follow up..............................46

Figure 11.
BREQ-2 (0-4) scores at baseline, across the intervention and at follow up..............................48

Figure 12.
BPNS (0-5) scores across baseline, the intervention and follow up.................................49

Figure 13.
Imposed intensity profile (% HR max) in 5-minute intervals................................................50

Figure 14.
PANAS (0-50) scores at baseline, across the intervention and at follow up..........................53

Figure 15.
Accelerometer data at baseline, across the intervention and at follow up..........................54

Figure 16.
BREQ-2 (0-4) scores at baseline, across the intervention and at follow up..........................55

Figure 17.
BPNS (0-5) scores at baseline, across the intervention and at follow up............................57

Figure 18.
% HRmax (data averaged from the 3 sessions each week) recorded across the exercise sessions.................................................................61

Figure 19.
PANAS (0-50) scores across the baseline, intervention and follow up..........................65

Figure 20.

Accelerometer data at baseline, across the intervention and at follow up..........................66

Figure 21.

BREQ-2 (0-4) scores at baseline, across the intervention and at follow up..........................68

Figure 22.

BPNS (0-5) scores across the baseline, intervention and follow-up.................................69

Figure 23.

% HRmax (data averaged from the 3 sessions each week) recorded across the exercise
sessions each week........................................................................................................70

Figure 24.

PANAS (0-50) score for positive and negative affect at baseline, across the intervention and
follow-up..........................................................................................................................74

Figure 25.

Accelerometer data at baseline, across the intervention and at follow up..........................75

Figure 26.

BREQ-2 (0-4) scores at baseline, across the intervention and at follow up..........................76

Figure 27.

BPNS (0-5) scores at baseline, across the intervention and at follow up..........................77

Figure 28.
% HRmax (data averaged from the 3 sessions each week) recorded across the exercise sessions each week........................................................................................................................................79

Figure 29.

PANAS (0-50) scores at baseline, across the intervention and follow up.................................83

Figure 30.

Accelerometer data at baseline, across the intervention and at follow up.................................83

Figure 31.

BREQ-2 (0-4) scores at baseline, across the intervention and at follow up..............................85

Figure 32.

BPNS (0-5) scores at baseline, across the intervention and at follow up.................................86
List of Tables

Table 1.
Mean (and standard deviation) %HRmax, RPE and % HR at VT across the intervention......34

Table 2.
Weekly mean (and standard deviation) FS and FAS scores pre, during and post-exercise
across the intervention........................................................................................................35

Table 3.
Self-reported minutes per week of moderate, hard and very hard physical activity in the
baseline, intervention and 6-week post intervention periods..............................................38

Table 4.
Mean (and standard deviation) %HRmax, RPE and % HR at VT across the intervention......43

Table 5.
Weekly mean (and standard deviation) FS and FAS scores pre, during and post exercise
across the intervention........................................................................................................44

Table 6.
Self-reported minutes per week of moderate, hard and very hard physical activity in the
baseline, intervention and 6-week follow up periods.........................................................47

Table 7.
Mean (and standard deviations) %HRmax, RPE and % HR at VT, across the intervention.....51
Table 8.
Weekly mean (and standard deviation) FS and FAS scores pre during and post exercise across the intervention.................................................................52

Table 9.
Self-reported minutes per week of moderate, hard and very hard physical activity in the baseline, intervention and 6-week follow up periods.........................................................54

Table 10.
Means (and standard deviations) %HRmax, RPE and % HR at VT..................................................62

Table 11.
Weekly mean (and standard deviation) FS and FAS scores pre during and post exercise across the intervention.........................................................................................64

Table 12.
Self-reported minutes per week of moderate, hard and very hard physical activity in the baseline, intervention and 6-week follow up periods.........................................................64

Table 13.
Means (and standard deviations) %HRmax, RPE and % HR at VT..................................................66

Table 14.
Mean (and standard deviation) FS scores pre, during and post exercise across the intervention.....................................................................................................................71
Table 15.
Self-reported minutes per week of moderate, hard and very hard physical activity in the baseline, intervention and 6-week follow up periods..........................................................75

Table 16.
Weekly means (and standard deviations) %HRmax, RPE and % HR at VT.................................80

Table 17
Weekly mean (and standard deviation) FS scores pre during and post exercise across the intervention.................................................................................................................81

Table 18
Self-reported minutes per week of moderate, hard and very hard physical activity in the baseline, intervention and 6-week follow up periods..........................................................84
Introduction

Physical inactivity is estimated to cause 3.2 million deaths globally each year as an independent risk factor for chronic disease (WHO, 2011). Despite this mortality rate attributed to physical inactivity and the acceptance of physical activity as a key component to public health, physical activity levels remain low (e.g., Haskell et al., 2007; Warburton, Nicol & Bredin, 2006). In New Zealand just one half of adults achieve recommended physical activity levels, and there has been very little change to this statistic over the past eight years (SPARC, 2009). According to the American College of Sports Medicine (ACSM, 2009) guidelines, individuals should accumulate 150 minutes of moderate intensity exercise per week, around 30 minutes of exercise on at least 5 days of the week or 20-60 minutes of vigorous intensity physical activity on three days of the week. These physical activity guidelines have been put in place with the aim of improving health and cardiorespiratory fitness in the general population.

The health benefits of being involved in physical activity are numerous and include both physiological and psychological benefits. Physical activity has been found to contribute to the prevention of chronic disease such as diabetes, cardiovascular disease and obesity (Warburton, Nicol & Bredin, 2006). The psychological benefits of physical activity include decreased stress, anxiety and depression (Warburton et al., 2006). Despite the extensive research supporting the benefits of physical activity and the implementation of public health campaigns aimed at increasing physical activity, people remain inactive and of those who begin to be more physically active, 60% are likely to drop out within the first six months (Pate et al., 1995).

Exercise psychology researchers are charged with the task of understanding the psychological factors that will encourage individuals to adopt, and maintain regular physical activity so that the health benefits of activity can be realised. It has been proposed that the affective responses that individuals experience during their exercise sessions can play a key role in predicting their future exercise behaviour (Kiviniemi et al., 2007; Williams et al., 2008). Affect refers to an intrapersonal valenced response to a situation that ranges from positive to negative or pleasant to unpleasant (Ekkekakis, 2003). Affect has been described as the core, most elementary response to a stimulus and is the strongest aspect of an emotional reaction (Weiner, Russell & Lerman, 1979). In line with hedonic theory (Young, 1952), it is proposed that individuals will choose to repeat behaviours that result in pleasant affective
responses and choose to avoid those that result in less pleasant affective responses. Therefore, to encourage continued exercise participation, individuals should experience positive affective responses from their exercise attempts.

The intensity at which individuals exercise, as well as the methods used to prescribe exercise, are factors that have been shown to influence exercise-induced affective responses (Ekkekakis, Parfitt & Petruzzello, 2011). It was long assumed that exercise at a moderate intensity (55-69% HRmax) would result in more positive affective responses than exercise at higher intensities (e.g., Berger & Owen, 1988; Berger, 1994; Kirkcaldy & Shephard, 1990; Morgan, 1997). However, attempts to prescribe an intensity which results in positive affective responses across individuals have shown that there is great variation in affective responses to exercise at a moderate intensity (Van Landuyt, Ekkekakis, Hall & Petruzzello, 2000). This supports the claim of Rose and Parfitt (2007) that prescribing an intensity that will result in universally positive affective responses across individuals may not be possible.

The Dual Mode Model (DMM) (Ekkekakis, 2003) was developed to provide some explanations for these inter-individual differences in affect and bring conceptual clarity and a theoretical basis for research into the exercise intensity-affective response relationship. In developing the model, Ekkekakis (2003) identified that traditional methods of defining exercise intensity were confounding the relationship between exercise intensity and affective responses. Traditionally, exercise intensity had been defined according to percentages of maximum values such as VO₂ max and heart rate maximum and often taken from estimates (e.g. percentage of age predicted heart rate maximum). However, as Bixby, Spalding and Hatfield (2001) found, individuals vary in their metabolic response to intensity prescribed at a set percentage of maximum. This means that the physiological responses to exercise of the same relative intensity can differ greatly from individual to individual. This will confound the comparison of affective responses to different exercise intensities because individuals will vary in their metabolic response to the different intensities. As a consequence, Ekkekakis (2003) proposed that to ensure individuals are experiencing the same metabolic profile, exercise intensity should be measured using a fixed metabolic profile, namely the anaerobic threshold. The anaerobic threshold is the point above which the effects of anaerobic metabolism start to accumulate rather than being cleared at the rate of production (Svedahl & MacIntosh, 2003). Anaerobic Threshold (AT) is typically measured as either the Lactate Threshold (LT) or Ventilatory Threshold (VT).
The DMM (Ekkekakis, 2003) explains that the metabolic demands of exercise (defined according to VT) determine the affective responses that result from exercise. It proposes that there are two mechanisms by which affective responses are produced. 1) A cognitive appraisal process that will include a range of psychological concepts, for example, self-efficacy, goals and anxiety. 2) Interoceptive cues that are signals received from receptors within the body that are triggered by the physiological response to exercise. For example, thermoreceptors pick up on increased body temperature, baroreceptors sense changes in the blood pressure and receptors in the heart and lungs are stimulated by changes in heart rate and breathing rate. The cognitive appraisal process contributes to the inter-individual variability seen at intensities at and below VT, while interoceptive cues result in the majority of individuals experiencing more negative affective responses at intensities above VT (Ekkekakis, 2003).

In order to reduce the individual differences in affective responses that are identified in the DMM (Ekkekakis, 2003) research exploring the notion of self-selecting exercise intensity has come to a fore. Research focussing on self-selected versus imposed intensities has suggested that an individual’s cognitive processes would guide their intensity regulation in a way that resulted in more positive and stable affective responses than when intensity was imposed (Lind, Ekkekakis & Vazou, 2008; Parfitt, Rose & Burgess, 2006; Parfitt, Rose & Markland, 2000; Rose & Parfitt, 2007, 2012; Vazou-Ekkekakis & Ekkekakis, 2009). Recent ACSM guidelines (2011) have also supported this notion in recognising that the prescribed exercise intensity may be successfully refined by the individual exerciser through self-regulation using scales such as the Feeling Scale (Hardy & Rejeski, 1989) which measure affective valence.

A model linking exercise intensity self-selection, affect and adherence was developed by Williams (2008) who predicted that an exercise stimulus will induce a series of cognitive and interoceptive factors which will determine an individual’s affective response. This positive or negative affective response will influence the exerciser’s anticipated affective response to further exercise bouts, with anticipation of negative affective responses leading to non-participation and anticipation of positive affective responses leading to continued exercise behaviour.

In addition to the theoretical and empirical support for the relationship between affect and exercise adherence, recent findings suggest that self-selection of exercise intensity may
support self-determined motivation through increased perceived autonomy and competence (Parfitt et al., 2006; Rose & Parfitt, 2007, 2012). Self-Determination Theory (SDT, Deci & Ryan, 1985) proposes that the fulfilment of the basic psychological needs of autonomy (feeling of being in control and that one’s actions are of one’s own free will), competence (feeling confident in one’s own ability to succeed in a given situation) and relatedness (feeling a connection to others) will result in self-determined motivation. A recent review article found that self-determined motivation for exercise was positively correlated to long term exercise adherence (Teixeira, Carraca, Markland, Silva & Ryan, 2012). This indicated that to increase the likelihood of adherence to physical activity, not only does the exercise intensity need to result in positive affective responses, but the exercise must support the basic psychological needs in order to increase self-determined motivation.

The premise behind this thesis is that a programme of exercise based on the self-selection of exercise intensity will result in positive affective responses to exercise which will support self-determination which will in turn, result in increased physical activity behaviour and motivation. Self-selection of intensity is likely to result in self-determination due to the support it provides for the basic needs of perceived competence and autonomy. Individuals are unlikely to self-select an intensity that they do not feel capable of, which will support the need for perceived competence, while a sense of control is provided by being free to choose their exercise intensity. In contrast, imposing the exercise intensity may result in less positive affective responses and not support self-determination and therefore will result in decreased physical activity behaviour and motivation. Motivation is more likely to be non-self-determined due to the decrease in perceived competence that may be caused by exercise being imposed at an intensity that the individual is not confident with, while perceived autonomy may not be fulfilled due to the lack of control and choice in intensity.

As yet no study has investigated these relationships in a longitudinal exercise intervention, or with the implementation of a post-intervention follow-up period. Therefore, the purpose of this research was to investigate the impact of self-selection of exercise intensity versus imposed exercise intensity on (1) affective responses to exercise (2) basic needs and self-determined motivation and (3) physical activity behaviour. Based on theory and the results of previous studies it was hypothesised that (a) affective responses to exercise would be more positive and less variable across sessions in the self-selected condition compared to the imposed condition, (b) affective responses during exercise would become more positive over the course of the intervention in the self-selected condition, (c) self-
determined motivation and levels of basic needs satisfaction would be higher in the self-selected condition and (d) physical activity behaviour (amount of physical activity participated in per week) post-intervention would be higher in the self-selected condition than the imposed condition.
Review of Literature

The review of literature will cover the three main research areas which have informed the current study. Firstly, research into the relationship between exercise intensity and affective responses will be discussed. The focus will be on research underpinned by the Dual Mode Model (Ekkekakis, 2003) and that which has investigated the influence of exercise intensity self-selection on affect. Secondly, the review will address the research which has investigated the impact of intensity self-selection on self-determined motivation, focusing on the possible motivational outcomes of this form of intensity regulation. Lastly, the review looks at the relationship between affect and adherence in order to present the final link in the rationale for this research study.

Intensity-Affect Relationship

Early research (prior to 2000) investigated the relationship between exercise intensity and a range of emotions and moods (e.g., anger, joy, depression, anxiety, vigour) (see review by Ekkekakis & Petruzzello, 1999). This research was criticised for a number of reasons. For example, the psychological measures used were not specific enough to the focus of the investigation. Furthermore, multiple psychological scales were used however, there were no means of integrating the information from these scales (Ekkekakis, 2003). There was also focus on measuring negative emotions (e.g. anxiety and depression) which created a floor effect in groups where pre-intervention/exercise levels were low (Ekkekakis, 2003). Furthermore, the early research often confused changes in perceived activation/arousal during exercise with changes in emotion (Ekkekakis, 2003). As a result of these measurement issues no real conclusions on the relationship between intensity and affect could be drawn from this research.

Ekkekakis and Petruzzello (2000) suggested that with the current stage of knowledge development regarding the relationship between affect and exercise intensity, researchers should measure basic affective valence rather than distinct emotions or moods due to this line of research being concerned with the overall subjective experience (e.g. how pleasant or unpleasant it felt) rather than the impact exercise has on specific emotions. In line with their suggestions, Ekkekakis and Petruzzello (2002) acknowledged that a dimensional model was
required that focussed on basic affect and had a strong theoretical basis. The Circumplex Model of Affect (Russell, 1978, 1980) was identified as a model that fit these criteria. The Circumplex Model is characterised by its focus on two dimensions of affect: affective valence (pleasure/displeasure) and perceived activation (arousal) (Ekkekakis & Petruzzello, 2002). In adopting this approach it was acknowledged that the specificity that measuring moods and emotion provides was lost, however this sacrifice was necessary in order to gain a wider breadth of understanding regarding the exercise-affect relationship. The majority of recent research investigating affective responses to exercise has adopted this measurement approach and have specifically used the Feeling Scale (FS, Hardy & Rejeski, 1989) and Felt Arousal Scale (Svebak & Murgatroyd, 1985) as the measurement tools (Ekkekakis et al., 2011). Throughout this thesis the term ‘affect’ will be used to describe affective valence (pleasure/displeasure) while ‘arousal’ will describe perceived activation.

Exercise intensity is a key mediator in the affective response to exercise (Ekkekakis, 2003). This has led researchers to investigate what intensity can be prescribed to ensure individuals experience a positive affective response. Early research presumed that moderate intensity exercise was the optimal exercise prescription that would result in positive affective responses for all individuals (Morgan, 1997). This was likely a result of the ACSM (1990) guidelines that were produced at the time, suggesting moderate intensity exercise (40-60% \( \dot{V}O_{2\text{max}} \) or 50-85% HRmax) should be prescribed for individuals to experience health benefits and would be most likely promote exercise adherence. However, a seminal study by Van Landuyt et al., (2000) showed that this was not necessarily the case. Out of their participants who exercised at a moderate intensity 41% experienced a decrease in the positivity of affective responses while 44% experienced an increase across a 30 minute period of moderate intensity exercise. This study spurred researchers to change the methods they used to examine the exercise intensity-affect relationship and to understand why individual differences exist in exercise-induced affective responses. Researchers acknowledged that in order to gain a greater understanding of the intensity-affect relationship, intensity needed to be measured through the metabolically equivalent ventilatory or lactate threshold (Ekkekakis, 2003). They also acknowledged that in order to understand the intensity-affect relationship the mechanisms by which affective responses are produced during exercise needed to be clarified.

The DMM (Ekkekakis, 2003) explains that affective responses are generated from a combination of the cognitive appraisal process and interoceptive cues. At exercise intensities below VT most individuals experience affective responses that are generally pleasant,
although there is a degree of variability. While the DMM does not specifically explain why these responses occur; Rose and Parfitt (2007) proposed that they would be the result of the cognitive appraisal process. During exercise at VT, it is proposed that some individuals will experience positive affective responses and some will experience less positive affective responses. This is because the individual’s cognitive appraisal process is determining the affective responses and some individuals will appraise the intensity positively and others negatively. Additionally, at this intensity there is increasing input from interoceptive cues which will influence the affective responses. Finally, at intensities above VT, affect is the least variable. Most individuals will experience unpleasant affective responses because they are being dominated by the interoceptive cues. At this intensity, the interoceptive cues signify to the individual that there is a threat to the body’s homeostasis and the negative affective response that results is the individual’s cue to stop exercising to return the body to homeostasis. Perceived activation has not been found to have the variability between individuals that affect does and has been found to typically increase as exercise intensity increases and begin to decrease again at the cessation of exercise (Hall, Ekkekakis & Petruzzello, 2002; Shephard & Parfitt, 2008).

Research which has tested DMM propositions using an incremental exercise protocol have shown support for the propositions that as intensity increases affect decreases (e.g., Ekkekakis, Hall & Petruzzello, 2004; Ekkekakis, Lind & Vazou, 2010; Hall et al., 2002; Welch, Hulley, Ferguson & Beauchamp, 2007). This research has also confirmed that the point of AT is the key turning point at which affective valence begins to decline. Further support for the DMM has been shown in studies with more externally valid exercise protocols that have compared 15-30 mins of exercise at varying intensities prescribed using VT or LT (Ekkekakis, Hall & Petruzzello, 2008; Parfitt, Rose & Burgess, 2006; Rose & Parfitt, 2007). Results have shown that exercise performed at an intensity above VT results in a uniform decline in affective valence, and significantly less positive affective responses than exercise at intensities below and at VT.

Researchers have also adopted idiographic forms of analysis in their studies in order to examine individual differences in affective responses to exercise. Results of these studies have confirmed that exercise carried out above and below VT results in lower inter-individual variability in affective responses while intensities at VT result in higher variability (Rose & Parfitt, 2007, 2010). These individual differences in affective responses that occur below and at VT are proposed to occur due to the cognitive appraisal process that generates the affective responses at this intensity. Quantitative research has investigated the role of
self-efficacy (McAuley, Talbot & Martinez, 1999; McAuley, Blissmer, Katula & Duncan, 1999) and anticipation of the end of exercise (Eston, Stansfield, Westoby & Parfitt, 2012) on affective responses. High levels of self-efficacy have been found to be associated with more positive affective responses to exercise both when the perception of self-efficacy was manipulated by the researcher (McAuley et al., 1999) and when pre-exercise levels of self-efficacy were naturally high (McAuley, Blissmer, Katula & Duncan, 1999). Anticipation of the end of exercise has also been found to result in more positive affective responses to exercise with Eston et al., (2012) finding that when participants were aware of the end approaching their affective responses were much higher than when they were not.

Qualitative research has been particularly effective in gaining insight into the cognitive appraisal process by allowing researchers to understand the thought processes that are underpinning affective responses at the point during exercise when they are being experienced. Rose and Parfitt (2007) investigated the factors involved in the cognitive appraisal process and found that positive affective responses were produced when the participants felt comfortably challenged, in control, felt the benefits of exercise, that they were coping with the intensity and that they are able to switch their attentional focus away from the exercise. These findings were supported and extended by Rose and Parfitt (2010) using the more valid method of protocol analysis which involved verbal reports within the exercise sessions as opposed to a recall after exercise. They also found that pre-exercise affective state, and how the physiological symptoms were being interpreted influenced affective responses. The insight into the cognitive appraisal process that we have gained from these studies highlights the complexities of prescribing exercise that will result in positive affective responses due to the highly individualised nature of the cognitive appraisal process. Furthermore, it reinforces the unsuitable nature of a ‘one size fits all’ approach to exercise prescription.

Although prescribing a set exercise intensity may be classed as safe, tolerable or beneficial for fitness from a physiological point of view, it cannot be relied upon to result in positive affective responses and may actually result in a wide range of affective responses from extreme displeasure to pleasure. Consequently, researchers have adopted methodologies that allow individuals to self-regulate their own exercise intensity with the hypothesis that this will result in more positive and less variable affective responses (e.g. Lind et al., 2008; Parfitt et al., 2000; Parfitt et al., 2006; Rose & Parfitt, 2007; Rose & Parfitt, 2012; Vazou-Ekkeakis & Ekkekakis, 2009). The rationale is that during self-selected intensity exercise the cognitive appraisal process should lead individuals to select
and monitor their exercise intensity to maintain a positive affective response (Rose & Parfitt, 2007).

**Support for Self-Selected Exercise Intensity**

Self-selection of exercise intensity means that the individual is free to select and alter the intensity that they would prefer to exercise at over the period of exercise. Recent research has made a case for the use of self-selection of exercise intensity to maximise the affective response to exercise (Lind et al., 2008; Parfitt et al., 2000; Parfitt et al., 2006; Rose & Parfitt, 2007; Rose & Parfitt, 2012; Vazou-Ekkekakis & Ekkekakis, 2009). Parfitt et al. (2000) examined the effect of a prescribed (65% $\dot{V}O_2_{max}$) versus self-selected exercise intensity on affect and enjoyment in 26 aerobically fit individuals. Results showed that participants chose to exercise harder (71% $\dot{V}O_2_{max}$) than in the prescribed condition, but affective responses were similar between the two conditions. Using a methodology consistent with the DMM, Parfitt et al. (2006) compared 20 min of exercise at intensities above and below VT and at a self-selected intensity in 12 sedentary males. Affective responses were significantly more positive in the self-selected condition than the above VT condition. Although affect was the same between the self-selected and below VT condition affective responses were less variable in the self-selected condition and the intensity that the participants selected was higher than the below VT condition, at an average of 54.1% $\dot{V}O_2$ max. In a similar study with inactive, middle aged women, Rose and Parfitt (2007) also found that affective responses were more positive in the below VT and self-selected conditions compared with at VT and above VT. The intensity chosen in the self-selected condition was similar to the at VT condition at 67% $\dot{V}O_2$ max. Individual differences in affective responses were greatest in the below VT and at VT conditions with less variation in the self-selected and above VT conditions.

Taking a different approach, Lind et al. (2008) investigated affective responses to self-selected exercise and exercise prescribed at intensity 10% higher than self-selected, in 25 middle-aged sedentary women. Results showed that during the self-selected exercise condition there were no significant decreases in affective valence, but affect valence declined in the prescribed condition. This suggested that when asked to exercise slightly above a preferred level, affective responses were negatively affected. In a follow up to Lind et al. (2008), Vazou-Ekkekakis and Ekkekakis investigated affective responses to a self-selected and prescribed condition of the same intensity in 19 female university students. The findings
showed that although there was no significant effect on the broad dimension of affect (pleasure-displeasure) there was a significantly higher score in the interest/enjoyment and perceived choice subcales of the Intrinsic Motivation Inventory in the self-selected condition where the average intensity chosen was 67% HR max.

In summary, studies that have investigated the use of self-selected exercise intensity compared to prescribed intensities support the idea that individuals self-select an exercise intensity that results in positive affective responses. Self-selecting exercise intensity appears to result in affective responses that are as positive, if not more, than affective responses to exercise below and around VT. Additionally, exercise at a self-selected intensity results in decreased (although not entirely eliminated) variability in affective responses. Therefore, from an exercise prescription perspective encouraging individuals to self-select their exercise intensity may be a key aspect of maximising positive affective responses to exercise and motivating continued participation in exercise.

An important aspect of encouraging self-selected methods in exercise prescription is knowing that the intensity that is chosen will be sufficient to elicit health and fitness benefits. In studies involving active participants (e.g., Glass & Chvala, 2001; Parfitt et al., 2000; Spelman, Pate, Macera & Ward, 1993) and inactive participants (Ekkekakis & Lind, 2006; Parfitt et al., 2006; Rose & Parfitt, 2007) the intensity of the exercise chosen has been found to meet the ACSM (2009) recommendations for improvement of cardiorespiratory fitness (50-70% VO2 max). Furthermore, overweight participants have selected an intensity within the range recommended by ACSM (2009) for weight management (55-69% HR max). Researchers have also investigated the intensity level that individuals self-select in relation to the DMM. These studies have shown that when asked to self-select their exercise intensity individuals typically choose to exercise at an intensity that is close to their VT (Lind, Joens-Matre & Ekkekakis, 2005; Lind et al., 2008; Parfitt et al., 2006; Rose & Parfitt, 2007).

Each of the aforementioned studies provides evidence that self-selection of exercise intensity results in intensity levels that will provide health and fitness benefits according to ACSM (2009) recommendations. However, it is important to note that there is individual variability in selection of intensity, with some individuals preferring to exercise at lower relative intensities and others at higher. Ekkekakis, Hall and Petruzzello (2005) found that exercise intensity preference was linked to individual traits which they identified as “preference for exercise” (p. 356) and “tolerance of exercise intensity” (p.356). The preference for higher exercise intensities has been found to be related with more regular exercise participation by Ekkekakis, Thome, Petruzzello and Hall (2008) who found a
correlation between exercise preference/tolerance and frequency of exercise participation, and Rose and Parfitt (2012) who found that sedentary women preferred to exercise at a much lower %HR$_{peak}$ than active women. Awareness of the way in which different studies asked participants to self-select their intensity (e.g. select your preferred intensity, select an intensity that you would exercise at for leisure, select an intensity that you feel comfortable exercising at) is also important as this may influence the intensity at which the participants choose to exercise.

In summary, self-selection of exercise intensity is supported by research evidence as an effective way to prescribe exercise in terms if the positive affective responses gained and the ability of self-selected exercise intensity to meet ACSM (2009) requirements for health and fitness in both active and sedentary populations. However, previous research has been based on single exercise bouts. Longitudinal studies are required to investigate the way in which individuals self-select their exercise intensity over time and the impact that it has on their affective responses.

**Self-Selection and Self-Determination**

It has been proposed that the self-selection of exercise intensity will have a positive influence on motivation (e.g., Lind et al., 2008; Parfitt et al., 2000; Rose & Parfitt, 2012; Vazou-Ekkekakis & Ekkekakis, 2009). According to the Self-Determination Theory (Deci & Ryan, 1985) motivation levels lie on a continuum ranging from self-determined/autonomous motivation to non-self-determined/controlled motivation (see figure 1). The least self-determined form is amotivation, where no motivation is present, next is external regulation where the individual is motivated by external sources such as reward or avoidance of punishment. Introjected regulation is partially internalised and is generally associated with participation due to pressure or guilt, whereas identified regulation is more internalised and associated with participation due to the identification of positive, valued outcomes from involvement in the activity. Integrated regulation refers to motivation that is internalised due to being viewed as part of an individual sense of self or beliefs. Intrinsic motivation is the most positive form of motivation and is completely internalised, meaning that the individual’s participation is driven by interest and/or enjoyment.
Research has shown that individuals whose motivation is highly self-determined will be more successful in maintaining physical activity behaviour (e.g. Edmunds, Ntoumanis & Duda, 2005; Rose, Parfitt & Williams, 2005; Ryan, Frederick, Lepes, Rubio & Sheldon, 1997; Silva et al., 2008). Self-selection of exercise intensity may result in increased levels of self-determined motivation due to the autonomy support that it provides. The concept of autonomy is a combination of locus of causality, volition and perceived choice. Locus of causality refers to the individual perceiving that their behaviour is initiated and regulated by either personal (internal locus) or environmental (external locus) forces (Deci & Ryan, 1987). Volition is an individual’s perception of whether they are free or pressured with respect to their participation in an activity (Deci & Ryan, 1987). Perceived choice is an individual’s perception that they have flexibility in making decisions, the opportunity to choose from different options and the capacity to freely alter or regulate behaviour during a given activity (Deci & Ryan, 1987). Typically, autonomy has been measured as perceived choice rather than the combination of perceived choice, volition and locus of causality.

Research that had measured perceived choice found that perceptions of autonomy are higher following self-selected intensities compared with prescribed intensities (Lind et al., 2008; Parfitt et al., 2000; Rose & Parfitt, 2012). Furthermore, Vazou-Ekkekakis and Ekkekakis (2009) measured perceived choice, volition and locus of causality and found that imposing a previously self-selected intensity caused decreases in all three subscales. Qualitative results have also shown that in a self-selected exercise condition participants reported feeling a sense of control over the exercise session and that this increased their enjoyment and made their affective responses more positive (Rose & Parfitt, 2007).

Lind and colleagues (2008) proposed that loss of perceived autonomy may have been a factor in the decrease in pleasure their participants experienced when exercise was prescribed at an intensity higher than the preferred level. To investigate the role of autonomy and self-selected exercise intensities, Vazou-Ekkekakis and Ekkekakis (2009) had 19 sedentary females aged 19-28 years complete two 30 min treadmill sessions, the first at a
self-selected intensity and the second at a pace controlled by the researchers which was matched to the same pace the participants had self-selected in their first session. Their results showed that perceived choice, perceived locus of causality and perceived volition scores were significantly lower following the imposed condition compared to the self-selected condition. Although there were no significant differences in Feeling Scale responses between the conditions, the imposed condition resulted in decreased interest/enjoyment, which the authors attributed to the loss of perceived autonomy.

Rose and Parfitt (2012) also investigated the motivational responses to exercise at a self-selected versus prescribed (close to VT) exercise intensity in 17 sedentary and 15 active women. Feeling competent and in control during exercise were both attributed to more positive affective responses. The quantitative results showed that both active and sedentary women experienced higher levels of perceived autonomy in the self-selected condition. It may also be argued that self-selection of exercise intensity supports the need for a sense of competence, as it is unlikely that an individual would select an intensity that they did not feel competent to complete. Furthermore, it ensures that the exerciser is not prescribed an intensity at which they do not feel they are able to exercise. Qualitative data from Rose and Parfitt (2012) showed that increased perceptions of competence and control were key factors in the cognitive processes that were attributed to more positive affective responses.

Similarly, Parfitt et al. (2006) found that 11 out of 12 participants who preferred the self-selected condition cited feeling competent, with a participant stating “it allowed me to exercise within my own capabilities and I could extend myself should I wish to” (Parfitt et al., 2006, p. 50). Parfitt et al. (2006) found that sedentary men who completed the self-selected condition first experienced lower levels of perceived competence and self-efficacy than those who completed the prescribed session first. This result highlights the need for familiarisation sessions and guidance for sedentary individuals who are learning to self-select their exercise intensity to ensure that they feel competent and confident in selecting and maintaining an appropriate intensity of exercise. Furthermore, the results of Rose and Parfitt (2007) suggested that compared to active women, sedentary women may require a longer familiarisation session in order to become more adept at self regulation and be able to self-select exercise at an intensity that will result in positive affective responses. This may be due to the fact that sedentary individuals have less confidence in selecting an intensity that will suit them and less awareness of what they are physically capable of than active individuals. Without this familiarisation period there may be a danger that they select an
intensity that is not safe for them to exercise at which may result in negative outcomes, both physically and psychologically.

The results of these studies highlight the influence that positive affective outcomes can have on increasing self-determined motivation. Although these studies lack the longitudinal follow up to measure future exercise behaviour, the increases in self-determined motivation identified following exercise at a self-selected intensity would suggest a positive link between intensity self-selection and exercise adherence.

The Affect-Adherence Relationship

An integrated model to explain the relationships between exercise intensity, affective responses and exercise adherence was presented by Williams (2008). Hedonic theory is an influential force in the affect-adherence relationship and is based around the idea that it is within human nature to make choices that increase pleasure and avoid choices that decrease pleasure or cause displeasure (Higgins, 1997). Hedonic theory can be traced back to Bentham’s (1789) hedonic calculus and Freud’s (1920) pleasure principle. Despite many years of psychological research involving hedonic theory a single model encompassing the ideas of hedonic theory has not been presented and within the field of exercise and health promotion hedonic theory has rarely been applied. However, models have been applied within the exercise promotion field that have attempted to explain the exercise-affect-adherence relationship and these are underpinned by the notion of hedonic theory.

Williams’ (2008) model integrates the ideas of the DMM and hedonic theory (see Figure 2). Williams’ (2008) model summarises the suggestions of previous research in predicting that the exercise stimulus will induce a series of cognitive and interoceptive factors which will result in either a positive or negative affective response to the exercise. This positive or negative affective response will then influence the exerciser’s anticipated affective response to further exercise bouts, with anticipation of negative affective responses leading to non-participation and anticipation of positive affective responses leading to continued exercise behaviour.
Each of the connections in Williams’ (2008) model have been tested in previous research. As already discussed, research testing the proposals of the DMM has investigated the combination of cognitive factors and interoceptive cues at different exercise intensities resulting in a positive or negative affective response (Ekkekakis, Hall & Petruzzello, 2008; Parfitt, Rose & Burgess, 2006; Rose & Parfitt, 2007, 2010, 2012). The relationships amongst exercise intensity, cognitive factors and affective response have received specific attention in research exploring the cognitive appraisal process (e.g., Rose & Parfitt, 2007, 2010).

The affect-adherence relationship has also been investigated in the exercise context (e.g., Kiviniemi, Voss-Humke & Seifert, 2007; Schneider, Dunn, & Cooper, 2009; Williams, Dunsiger, Ciccolo, Lewis, Albrecht & Marcus, 2008; Williams, Dunsiger, Jennings & Marcus, 2012). Williams et al., (2008) investigated the relationship between affective responses during exercise and future physical activity participation in 37 sedentary predominantly female (78.4%) adults with a mean age of 43.92 years, using a longitudinal design. Affective responses were measured at the minute during a graded sub-maximal exercise test where the participants first reached a moderate intensity (above 64% age predicted HR max in line with ACSM, 2005 guidelines) and the FS and RPE recorded at that point was used to predict future physical activity behaviour. The participants were then encouraged to participate in moderate intensity exercise for at least 30 minutes a day on most days of the week. Physical activity behaviour was measured 6 and 12 months later to determine how much physical activity the participants were engaging in of their own accord. The results showed that the participants who experienced more positive affective responses to the initial submaximal exercise test reported more minutes of physical activity participation both 6 and 12 months later, with a positive shift of one point on the FS correlating to 38 minutes of physical activity a week at 6 months and 41 minutes of physical activity a week at 12 months. Similarly, Williams et al. (2012) investigated the relationship between the affective responses experienced during a 10 minute bout of moderate intensity exercise 6 months in to a physical activity promotion program and physical activity.
behaviour 6 months later. In their study of 146 low active adults aged 18-65 years Williams et al. (2012) found that a positive one point shift in affective valence during exercise was related to a 15-29 minute increase in physical activity levels at the 12 month point.

Schneider, Dunn and Cooper (2009) examined the relationship between affective responses to exercise and levels of daily moderate-to-vigorous physical activity (MVPA) in 124 adolescents. The participants completed a graded exercise test followed by two 30 min exercise sessions one below and one above VT. In the week following each session the participants wore accelerometers to monitor their physical activity participation. The results showed that affective responses were more positive below VT and that positive affective responses to the exercise session led to increased physical activity participation in the following week. Participants who experienced positive affective responses averaged 54.25 min of MVPA per week compared with those who experienced no change (46.94 min) or a decrease in affective valence (39.83 min).

Taking a different stance, Kiviniemi, Voss-Humke and Seifert, (2007) examined the influence of affective associations with exercise on future exercise behaviour choices. Affective associations are feelings that an individual has towards health behaviours as a result of a previous experience and can influence motivation and future behavioural choices (e.g. exercise adherence) (Kiviniemi et al., 2007). Kiviniemi et al. (2007) studied the physical activity behaviour and affective associations with physical activity of 433 male (180) and female (249) adult participants (average age 33.4 yrs). The results showed that more positive affective associations with physical activity was a significant predictor of physical activity behaviour, further supporting the Williams (2008) model linking affective responses to exercise adherence.

Although Williams’ (2008) model predicted that the positive affective responses associated with self-selected exercise intensity would lead to exercise adherence, no longitudinal studies with follow up have been implemented in order to measure exercise behaviour following an exercise programme based on self-selected intensity. Therefore, the purpose of the current research was to investigate the impact of self-selection of exercise intensity versus imposed exercise intensity on affective responses to exercise, basic needs and self-determined motivation and physical activity behaviour.
Summary

The use of self-selection of exercise intensity is developing support within research with the realisation that it is impossible to find one ‘gold standard’ of exercise intensity that would result in positive affective responses from every exerciser (Ekkekakis & Lind, 2006; Lind et al., 2008; Parfitt, Rose & Markland, 2000; Rose & Parfitt, 2007). Self-selected exercise intensities have been found to result in more positive and less variable affective responses as well as more adaptive motivational responses compared with prescribed intensities. Furthermore, the chosen level of exercise being performed meets ACSM guidelines for health and fitness benefits (e.g., Glass & Chvala, 2001; Parfitt et al., 2000; Spelman et al., 1993). However, previous research has only investigated the relationship between exercise intensity and affective responses during single bouts of exercise and therefore whether and how this relationship changes over time with repeated bouts of exercise is unknown. Researchers have also proposed that the positive affective responses experienced from self-selected exercise intensities will result in higher motivation levels and physical activity behaviour, while the less positive affective responses experienced as a result of an imposed intensity may lead to lower levels of motivation and exercise behaviour (e.g., Ekkekakis & Lind, 2006; Williams, 2008). However, a direct test of this proposal has not been undertaken. Together this provides the rationale for an intervention study that compares the influence of prescribed versus self-selected exercise intensity on future exercise behaviour.

The purpose of this research was to investigate the impact of self-selection of exercise intensity versus imposed exercise intensity on (1) affective responses to exercise (2) basic needs and self-determined motivation, and (3) physical activity behaviour. Based on theory (namely the Dual Mode Model and the Self-Determination Theory) and the results of previous studies it was hypothesised that (a) affective responses to exercise would be more positive and less variable across sessions in the self-selected condition than in the imposed condition, (b) affective responses would become more positive over the course of the intervention, (c) self-determined motivation and levels of fulfilment of basic needs would be higher in the self-selected condition and (d) physical activity behaviour post-intervention would be greater in the self-selected condition than the imposed condition.
Methods

Research Design

Much of the research in the field of exercise psychology particularly, in the study of affective responses has been carried out with a nomothetic research design meaning that the analysis of results is based on group averages of a relatively large sample size. Nomothetic research designs aim to highlight the general features of human nature which may then be applied in broad terms to a large group of individuals (Hayes, 2000). A major limitation with this type of research is that when data are averaged out, individual responses are typically obscured. To overcome this limitation, the use of an idiographic research approach (a description of the individual) has been advocated in the study of affective responses to exercise (Ekkekakis et al., 2011; Rose & Parfitt, 2007; Van Landuyt et al., 2000). The difference between using a nomothetic versus an idiographic design was shown by Van Landuyt et al. (2000) who found that following a moderate intensity exercise session, analysis of the group data showed that affective responses remained stable throughout the exercise session. However, when individual results were examined, they showed that there was great diversity in the responses, with almost half the group experiencing a gradual increase in affective valence across the session, and the other half a gradual decline. These results and other research showing the individual differences that exist in affective responses to exercise (e.g., Ekkekakis, Lind, Hall & Petruzzello, 2007; Parfitt et al., 2006; Rose & Parfitt, 2007, 2010) provide support for the use of research approaches that capture the individual’s unique affective experience of exercise, and also the differences in self-selected exercise intensities individuals choose for exercise. This has been recognised to be particularly important when the results of research may ultimately be used to inform public health physical activity guidelines (Van Landuyt et al., 2000).

A single-subject research design was implemented in the research. This design allowed for the in-depth analysis of the effect that the intervention of both the self-selected intensity and
prescribed intensity conditions had on each individual in terms of their affective responses to exercise, motivation and exercise behaviour. The single-subject research design aims to establish the existence of cause and effect relationships through demonstrating that the intervention set by the researcher caused a change in the participants’ responses, when all individuals react in the same way when the intervention is applied (Gravetter & Forzano, 2009). Through focusing on a small number of participants the data gathered are sensitive to individual differences and include detailed information relating specifically to each participant.

The use of a single-subject research design has often been viewed as lacking in validity due to not having an experimental control and therefore being unable to determine that the intervention was the catalyst for the change reported (Kratochwill & Levin, 1992). However, there are many ways in which a single-subject study may be designed and evaluated in order for the researcher to be able to draw valid conclusions from the study (Kratochwill, Mott & Dodson, 1984). Following Kratochwill et al.’s (1984) recommendations, this research project incorporated the following procedures in order to control threats to internal validity. 1) The participants were measured continuously across the pre-intervention, intervention and follow-up phases of the study; 2) if there was an intervention effect it would be demonstrated across several participants, and; 3) the intervention was carried out with a written procedure to ensure consistency in the treatment of participants. These procedures are described below.

The measurement of the participants across the pre-intervention involved measures of cardiovascular fitness, affect, self-determined motivation, self-efficacy and physical activity behaviour. During the six week intervention, the measurement of affect, self-determined motivation, self-efficacy and exercise behaviour were continued. At the completion of the intervention, cardiovascular fitness levels were re-tested. Six weeks post-intervention, the follow-up measures of affect, self-determined motivation and exercise behaviour were taken. These measures were taken in each of the three phases to ensure that the effect of the intervention could be identified. Changes in the variables measured from pre-intervention to the intervention and then
post-intervention would clearly indicate the impact of the intervention on the measured variables. Any intervention effect would be demonstrated across six participants (three in each condition). The validity of any intervention effect would be strengthened by the use of a multiple baseline approach which involved the sequential introduction of participants to the intervention (Gast, 2010). If a change in the measured variables for each participant occurred once the intervention had been introduced, then a conclusion was drawn that the intervention (as opposed to other extraneous factors), caused the change (Kazdin, 1982). The power of this research design is that external validity is increased by the fact that change occurs only when the intervention is introduced. This research approach is one of the most common in single subject research, and is often preferred to other approaches, such as the withdrawal approach as it does not require the treatment (in this case physical activity) to be ceased in order to measure the impact of the treatment (Barlow, 2008). In order to ensure that the intervention procedure was consistent in the treatment of each participant an intervention was written up outlining the procedure (e.g., order and timing of questioning and timing and use of scales and questionnaires) and this was followed during each session (see Appendix A).

Participants

Six participants were recruited for the study in order to allow for comparison between participants in each condition as well as across the two conditions. Recruiting six participants also meant that even if up to two dropped out it would still be possible to gain these comparisons. Although recruiting a greater number of participants would have provided more insight into the research question the amount of data would have become unmanageable for a study of this nature. The recruitment process was carried out by advertisements in the local newspaper, through word of mouth and through emails sent around staff and postgraduate students at the School of Physical Education, asking them to forward the information to anyone who they thought would meet the eligibility criteria and may have been interested in participating. The following eligibility criteria were applied: Participants were to be, 1) inactive (i.e., have not participated in more than 150
minutes of moderate intensity physical activity a week in the past six months), 2) aged between 25 and 50, 3) female, and 4) free of any medical condition or injury that would make it unsafe for them to begin exercise – this was ascertained through the use of the widely recognised Physical Activity Readiness Questionnaire (PAR-Q, Canadian Society for Exercise Physiology, 2002) (Appendix B). The rationale for recruiting female participants was that statistics (Hillary Commission, 2001) show that females in New Zealand are less active than males, therefore results that are directly applicable to women becoming more active would be of great value. The age group of 25-50 was selected as it has been reported by Sport and Recreation New Zealand (2009) that this is the most inactive age group in the New Zealand population. Six participants were recruited for the study as this number allowed for the greatest depth and breadth of data collection possible, while maintaining a manageable amount of data for a project of this size.

Measures

Feeling Scale. Affective responses before, during and immediately after exercise were measured using the 11-point Feeling Scale (FS; Hardy & Rejeski, 1989) (Appendix C) which measures positive and negative valence on a scale ranging from -5 (very bad) to +5 (very good). Significant correlations between other self-report measures of pleasure and the FS support the validity of the FS (Hardy & Rejeski, 1989).

Felt Arousal Scale. The Felt Arousal Scale (FAS; Svebak & Murgatroyd, 1985) (Appendix C) was also measured during exercise to determine the activation dimension of affect through a 6-point scale that ranges from low arousal (1) to high arousal (6). Correlations between FAS and other similar self-report measures of arousal have shown significant correlation which indicates that the FAS is a valid measure of perceived activation (Van Landuyt et al., 2000).

Positive And Negative Affective Schedule. Affect was also measured at the end of each week through the Positive and Negative Affective Schedule (PANAS; Watson, Clark & Tellegen, 1988) (Appendix D) which is a scale consisting of 20 words that relate to a variety of
moods and emotions for example, ‘interested’, ‘ashamed’, ‘alert’ and ‘nervous’. Participants were asked to rate on a scale of 1 (very slightly, or not at all) to 5 (extremely), to what extent they felt this way in the previous week. Crawford and Henry (2004) found that there were significant correlations between the PANAS and other scales measuring similar constructs and that demographic variables (representative of general UK population) had little influence on PANAS scores, thus supporting the validity of the PANAS in measuring positive and negative affect.

**Behavioural Regulation in Exercise Questionnaire-2.** Levels of self-determined motivation were measured through the Behavioural Regulation in Exercise Questionnaire -2 (BREQ-2; Markland & Tobin, 2004) (Appendix E) It involved a series of statements that relate to why the participant was involved in exercise, for example, “I exercise because other people say I should”, “It’s important to me to exercise regularly” and “I get pleasure and satisfaction from participating in exercise”. These statements were answered with a 4-point likert scale that ranged from “never true for me” to “very true for me”. Factorial validity for the BREQ-2 was supported by the results of Markland and Tobin (2004) who carried out a confirmatory factor analysis which indicated that the BREQ-2 model was a good fit.

**Basic Psychological Needs Satisfaction.** Basic psychological needs satisfaction (BPNS) was measured through the combination of the competence scale of the Psychological Need Satisfaction in Exercise Scale (PNSES; Wilson, Rogers, Rogers & Wild, 2006) (Appendix F) and a modified autonomy scale developed from Reeve’s (2002) guidelines in order to measure perceived choice, volition and locus of control rather than just autonomy. Perceived relatedness was not measured in this research project because this variable was not being manipulated. Each of the 17 statements (e.g., “I feel like I am capable of doing even the most challenging exercise”, “I feel free to choose which exercise I participate in” and “when I exercise I feel I am doing what I want to be doing”) were answered through a likert scale ranging from 1 (strongly agree) to 5 (strongly disagree). Wilson et al., (2009) found that the internal consistency of the PNSES
measures was acceptable via Cronbach’s alpha coefficient while Vazou-Ekkekakis and Ekkekakis (2009) found that the internal consistency of Reeve’s (2002) autonomy measures was acceptable via Cronbach’s alpha coefficient.

**Interview questions.** Semi-structured interview questions were asked during the last exercise session of each week (Appendix G). These questions were used to explore the cognitive processes that resulted in the affective responses that were reported during exercise. Further interview questions were asked at the 6-week follow-up to gather information on how the participants felt about the intervention, the way the exercise was prescribed and how they perceived the intervention had influenced their motivation/physical activity behaviour (Appendix G).

**Seven-Day Physical Activity Recall.** The seven day physical activity recall (PAR; Sallis, Haskell, Wood, Fortmann, Rogers, Blair, & Paffenbarger, 1985) (Appendix H) is a subjective measure of exercise behaviour that involves the recall of all physical activity that has been completed in the last week. The PAR was carried out in written form with the participants filling in a questionnaire which asked a series of questions relating to activities they participated in during the past week in order to assist the participant in recalling any/all physical activity completed. The physical activity recall was broken down into minutes of physical activity on each day of the week and how many minutes of that activity was at a moderate, hard or very hard intensity.

**Accelerometer.** A GT3X Actigraph accelerometer was used to provide an objective measure of activity behaviour to supplement the information provided by the participants in their seven day physical activity recalls. The accelerometer measured physical activity behaviour through recording energy expenditure, steps taken, activity intensity level and MET’s. The cut points for moderate and vigorous/very vigorous intensity exercise were taken from Freedson, Melanson and Sirard (1998) who identified moderate intensity for adults as 1952-5724 counts
per minute and vigorous/very vigorous as over 5725 counts per minute. A ‘count’ is a measure of acceleration which determines activity, therefore the more counts measured within a 60 second period the greater the acceleration/more vigorous the activity being performed (Actigraph, 2011). The accelerometer was worn by the participant during waking hours, attached to a point closest to their centre of mass either by the elastic belt supplied with the accelerometer, or to the participants own belt. Participants were briefed on the correct way to wear the accelerometer and the importance of wearing the accelerometer in this position and as close to the body as possible. Each participant wore the accelerometer for the baseline week, then every second week in the intervention period and then for one week in the follow-up period.

**Self-Efficacy.** Self-Efficacy for Exercise (SES) (Appendix I) was measured through a scale created from guidelines in Bandura’s (2006) handbook. Participants were asked a series of questions at five minute intervals during the exercise session. The questions asked were 1) How would you rate your confidence in completing the session? 2) How would you rate your confidence in exercising at this intensity? 3) How would you rate your confidence in exercising when you are feeling at a (insert FS value) on the FS? 4) How would you rate your confidence in selecting your exercise intensity (only applies to self-selected condition during the intervention). The participants were asked to reply on a scale of 0-100% how confident they felt, from 0% (not confident at all) to 100% (completely confident).

**Ratings of Perceived Exertion (RPE).** RPE was measured through the use of the 6-20 item Borg scale (Borg, 1970) (Appendix J). This 15-point scale ranges from 6 (no exertion at all) to 20 (maximal exertion). Instructions were given on how to use the RPE in accordance with Borg’s (1998) recommendations. Participants were told that the scale was to be used to rate their exertion on how strenuous the exercise feels and were given examples of indicators that the exercise was strenuous (e.g., fatigued muscles and breathlessness).
**Procedure**

In the initial contact the participants made with the researcher, their eligibility to participate was checked. All suitable individuals were then invited to a meeting with the researcher where the study was described. The participants were told that the study was an exploration of individuals’ responses to exercise over time. The information sheets (Appendix K) were discussed with the potential participants to ensure that they understood what they would be asked to do in terms of time commitment and amount of physical activity each week. They were given an information sheet and consent form (Appendix L) to sign if they decided that they would like to take part in the study. Following this, the participants’ eligibility to participate in the study was verified through the following procedure: 1) completion of the PAR (reworded to apply to average weekly activity over the past 6 months) to ensure that the participants were inactive and had not participated in more than 150 minutes of physical activity a week in the past six months 2) completion of the American Health Association/American College of Sports Medicine screening form (Appendix M) and the PAR-Q to check that potential participants fell in to the A1 category (lowest category for cardiovascular risk factors) and were free of any medical conditions or injuries that may have made it unsafe for them to participate. Once eligibility was confirmed and informed consent was provided, the participants filled out the BREQ-2, the BPNS and the PANAS. The participants were given accelerometers to wear for the week before beginning their familiarisation sessions.

The participants were randomly assigned to either the self-selected or prescribed exercise intensity condition. Due to the multiple baseline design of the study the participants began the study in a staggered start with two participants (one from each condition) starting the study each fortnight. The first two participants began the study for the week using the accelerometer. At the end of that week, once they began the familiarisation sessions, the second two participants began their week using the accelerometers, followed by the final two participants.
**Familiarisation Sessions.** The familiarisation session consisted of three 30 min exercise sessions at self-selected intensity which were carried out the week before the participants began the intervention. Three 30 minute sessions were chosen to fit with ACSM (2009) recommendations for sedentary individuals beginning exercise. The purpose of these sessions was to familiarise the participants with exercising on the treadmill and using the FS, FAS, RPE and SES that were employed during the intervention. These familiarisation sessions were also necessary to provide the self-selected exercise intensity data, to be able to prescribe exercise to the participants in the prescribed intensity condition. However, this function of the familiarisation sessions was not made known to the participants.

At the beginning of each session the participants were fitted with the (Polar Electro™) heart rate monitor and asked to rate their pre-exercise levels on the FS and FAS. Heart rate was recorded for the duration of the exercise and uploaded to a computer after each session. Every four and a half minutes the participant was presented with the FS, FAS and RPE scales in that order and was asked to choose a number on each scale that described how they were feeling at that time. The scales were presented at four and a half minutes in order to give the participant 30 seconds to consider their choice and answer before the five minute mark. A five minute time period between each use of the scales was allowed in order to give the participants time to exercise and settle into their own thoughts rather than be concentrating on the researcher the whole time and the next set of questions and is in line with the time periods used in previous studies (e.g. Parfitt et al., 2000; Parfitt et al., 2006; Rose & Parfitt, 2007). A five-minute warm down period followed the 30-minute exercise session. At the end of the warm down period, and another five minutes after the warm down period, the participant was asked to complete the FS and FAS again. Five minute measurement periods were used for the FS and FAS in order to measure change affective valence throughout the entire 30 minute exercise session, directly after the exercise and once recovered.

During the third and final familiarisation session the participants were asked a set of short questions after they had given their SES, FS and FAS responses to find out what aspects of
the exercise caused them to feel the way they did on the FS at that time and what thoughts were going through their head at that point in the exercise. The participants were also asked why they changed their exercise intensity and how they felt once they had changed it, whenever they altered the intensity. At the completion of the third exercise session the BREQ-2, PANAS, PAR and BPNS were filled out (this process took 5-10 minutes).

**Graded exercise test.** A graded exercise test following the Balke-Ware protocol (ACSM, 2009) was carried out after the familiarisation sessions (prior to the intervention beginning) and at the end of the six week intervention, to gain a measure of VO\textsubscript{2} max, locate their ventilatory threshold and determine changes in the participants’ fitness and ventilatory threshold across the intervention. Ventilatory threshold was used to define the exercise intensities selected and prescribed during the intervention. At the beginning of this exercise test session, the participant was fitted with the Polar heart rate monitor and a measure of resting heart rate was taken. Following this the procedure of the test was explained. The participants were then fitted with the face mask, and stepped on to the treadmill to begin the test. The exercise test began with participants walking at a pace that they were comfortable with. They then walked at this pace on the (Quinton) Treadmill for three minutes. The speed was then increased by 1-1.5 km/h where the participants remained at walking speed. Every minute thereafter the intensity was increased by changes in gradient (by 1-2%). The gradient was altered based on the expected fitness level and age of each individual, in order to ensure that the test was completed within 10-15 minutes. The test continued until the participant reached volitional exhaustion and could not continue. The criteria used to ensure that the effort in the test was maximal, was that two of the following were observed: 1) a plateau in oxygen consumption (changes of less than 2ml kg\textsuperscript{-1} min\textsuperscript{-1} with one increase in intensity), 2) respiratory exchange ratio of ≥1.1 and 3, and 3) reaching or exceeding the age related maximum heart rate (220 – age). VO\textsubscript{2} max was identified as the highest VO\textsubscript{2} value attained while ventilatory threshold was determined through the V-slope method (Schneider, Phillips, & Stoffolano, 1993). The V-slope method involved plotting VCO\textsubscript{2} against VO\textsubscript{2} and identifying the
point where a disproportionate increase in VCO₂ occurred. Two researchers independently identified this point and if there was any disagreement regarding the point of VT a third researcher analysed the graphs and a discussion took place to ensure a consensus on where VT occurred.

**Intervention exercise sessions.** Participants in both the self-selected and prescribed conditions carried out three exercise sessions per week and with the exception of how intensity was manipulated they each followed the same protocol. A six week exercise intervention was employed in this research in order to guide participants through the initial phase of exercise adoption (1-4 weeks) and enter them in to the improvement phase (5-24 weeks) for cardiovascular fitness (ACSM, 2009). During the six week intervention period the participants were informed that they were able to participate in physical activity outside of the intervention if they wanted to. Each exercise session was carried out in the same laboratory location with only the researcher and the participant present. Participants came in at the same time of day, and on the same days each week. The researcher avoided unnecessary communication with the participants during their exercise session, and the radio was playing in order to reduce boredom. At the beginning of each session, the participants were fitted with the heart rate monitor and asked to rate their pre-exercise levels on the FS and FAS. Heart rate was recorded for the duration of the exercise and uploaded to a computer after each session. Every four and a half minutes the participant was presented with the FS, FAS and RPE scale in that order, and was asked to choose a number on each scale that described how they were feeling at that time. A five minute warm down period followed the 30 minute exercise session. At the end of the warm down period, and another five minutes after the warm down period, the participant was asked to complete the FS and FAS again.

During the third and final session each week the participants were asked a set of short probing questions after they had given their SES, FS and FAS responses. This was to gain insight in to what it was about the exercise that caused them to select the number on the FS at that time and where their attention was directed at that point in the exercise. The participants in the self-selected condition were also asked why they changed their exercise intensity and how they felt once they
had changed it, whenever they altered the intensity. At the completion of the third exercise session
the BREQ-2, PANAS, PAR and BPNS based on the week just passed were filled out (this process
took 5-10 minutes).

**Self-selected exercise intensity session.** Participants in the self-selected exercise
intensity condition were told: “you will be exercising for 30 minutes in the exercise session and you
may choose whatever intensity that you feel comfortable exercising at and can change the intensity
at any time”.

**Imposed intensity exercise session.** Participants in the imposed exercise intensity condition,
exercised on a treadmill at an intensity imposed by the researcher. The imposed intensity was
specific to the participant as it was set from the exercise intensity data gathered during the
familiarisation sessions. This means that the exercise was carried out at the intensity the participant
chose themselves in the familiarisation sessions. The pattern of intensity was selected by
identifying the two most similar intensity profiles from the participant’s three familiarisation
sessions and then averaging the heart rates for every five minutes of the 30 min exercise session.
This individual intensity profile was used by the researcher to monitor the speed on the treadmill to
match the intensity profile as closely as possible (± 5 bpm) throughout. The intensity was based on
heart rate, so that as the participant’s fitness increased over the six weeks, they were exercising at a
faster speed on the treadmill in order to reach the same heart rates.

There was a post-intervention meeting with each participant at the completion of the
intervention (at the beginning of the week after the completed the intervention) where the VO2 max
test was taken again.

**Follow up sessions.** Participants were followed up six weeks after the intervention was
finished. The follow up was placed six weeks after the intervention in order to compare motivation
and physical activity levels twelve months after the exercise sessions began. The first six months
following exercise adoption is the time where individuals are most likely to lose motivation and
stop being physically active (Pate et al., 1995). The short follow up period of six week allowed for
the exploration of motivation levels within the initial phase of exercise adoption in order to give us
an insight into what influences the continuation or discontinuation of physical activity following an
intervention. At this six week point, participants again wore an accelerometer for the entire week
and completed the BREQ-2, BPNS, PAR and PANAS. After the week wearing the accelerometer
participants carried out two exercise sessions at a self-selected intensity, under the same
instructions as the familiarisation sessions. Following these two sessions the participants were
interviewed again and asked questions (see appendix G) to find out how they felt the intervention
had influenced their physical activity behaviour and why, as well as how they felt about the method
of exercise prescription that they experienced during the intervention (self-selected versus
imposed).

Analysis

The results were analysed through the traditional method of analysing Single Subject
Case Designs (SSCD) - visual analysis of graphed data (Kazdin, 1982). Kazdin (1982) describes
the visual analysis of graphed data as “reaching a judgement about the reliability or consistency of
intervention effects by visually examining graphed data” (p. 232). In the current research data was
also analysed through visual analysis of tables due to the data being more effectively displayed for
visual analysis in this way. The changes in the quantitative data from baseline, across the
intervention and in the follow-up were then described in detail for each participant, allowing for
comparison of the influence that the intervention had on each participant. This analysis of the
quantitative data allowed for the changes in each participant from baseline to intervention and then
to follow up to be easily identified and then integrated with relevant qualitative data in order to
further explain changes. The qualitative data was analysed through analysis techniques of
explanation building and thematic analysis (Yin, 2003). Explanation building was carried out
through the construction of a case report for each participant consisting of the quantitative data as
well as the qualitative data from baseline, during and post-intervention. The explanation building in
the case report consisted of the researcher linking the information from the interviews to explain the reasons behind the affective responses, motivation levels and behavioural outcomes that were identified in the quantitative results. The case analysis takes into account the variations and commonalities between the participants, allowing for the results of the individual to be recognised, and for common results to be highlighted (Yin, 2003). When combined with the quantitative data, the case reports and case analysis served to explain, to an extent, the thought processes behind the qualitative data for each participant. Participants are described by the acronym IC (imposed condition) and SSC (self-selected condition) they are also numbered to distinguish between participants within each condition (e.g. IC1, IC2, IC3 and SSC1, SSC2, SSC3).
Results

Participant IC1

Participant IC1 was a 44 year old woman, she was 1.75m in height and weighed 89.9kg, giving her a BMI of 29.3 kg/m$^2$, her baseline $\dot{V}O_2$max was 28.86 ml/min/kg and her $\dot{V}O_2$ at VT was 22.07 ml/min/kg. She was relatively physically inactive before beginning the study and self reported zero minutes of physical activity per week and recorded 22 minutes of moderate intensity exercise on the accelerometer over the week.

Intensity

% HRmax. In the baseline session she chose to exercise at an average of 70% HRmax, this intensity was then imposed on her over the six week intervention. In the 6 week follow up session where she was able to self-select her intensity, again she selected an average of 76% HRmax, a 6% increase from the intervention intensity.

![Figure 3. Imposed intensity profile (% HR max) in 5-minute interval.](image)

The heart rate profile obtained during the baseline sessions was then imposed as the intensity during the intervention exercise sessions. The heart rate profile of participant IC1 shows that she chose to increase her intensity up to the 20 minute point and then decrease until completion of the session (see Figure 3).
RPE. In line with the consistent intensity that was imposed across the intervention there was very little variability in her RPE (see Table 1). Her RPE remained at, or very close to, the average baseline session level of 13. In the two follow up sessions the RPE remained close to baseline and intervention levels at 14.

Table 1

*Mean (and standard deviation) %HRmax, RPE and % HR at VT across the intervention.*

<table>
<thead>
<tr>
<th>Week</th>
<th>%HRmax</th>
<th>RPE</th>
<th>%HR at VT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>70</td>
<td>13</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>(2.65)</td>
<td>(1.10)</td>
<td>(3.05)</td>
</tr>
<tr>
<td>1</td>
<td>69</td>
<td>13.5</td>
<td>79</td>
</tr>
<tr>
<td></td>
<td>(2.85)</td>
<td>(1.23)</td>
<td>(3.28)</td>
</tr>
<tr>
<td>2</td>
<td>69</td>
<td>14</td>
<td>79</td>
</tr>
<tr>
<td></td>
<td>(2.66)</td>
<td>(0.92)</td>
<td>(3.06)</td>
</tr>
<tr>
<td>3</td>
<td>69</td>
<td>13.5</td>
<td>79</td>
</tr>
<tr>
<td></td>
<td>(3.99)</td>
<td>(0.99)</td>
<td>(4.6)</td>
</tr>
<tr>
<td>4</td>
<td>69</td>
<td>13</td>
<td>79</td>
</tr>
<tr>
<td></td>
<td>(4.51)</td>
<td>(1.10)</td>
<td>(5.18)</td>
</tr>
<tr>
<td>5</td>
<td>70</td>
<td>13</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>(3.41)</td>
<td>(1.06)</td>
<td>(3.93)</td>
</tr>
<tr>
<td>6</td>
<td>70</td>
<td>12</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>(5.1)</td>
<td>(0.80)</td>
<td>(5.84)</td>
</tr>
<tr>
<td>Follow-up</td>
<td>76</td>
<td>14</td>
<td>87</td>
</tr>
<tr>
<td></td>
<td>(3.65)</td>
<td>(0.39)</td>
<td>(4.2)</td>
</tr>
</tbody>
</table>

% HR at VT. She exercised at 80% of the HR recorded at VT across the intervention. In the follow-up session she chose to exercise closer to her VT at 87% of her HR at VT (see Table 1).

Cardiovascular fitness. The results from the pre and post-intervention $\dot{V}O_2$max tests show an increase in $\dot{V}O_2$max of 5.72% and an increase in $\dot{V}O_2$ at VT of 13.41%.
Affect

Table 2

Weekly mean (and standard deviation) FS and FAS scores pre, during and post-exercise across the intervention.

<table>
<thead>
<tr>
<th>Week</th>
<th>Pre</th>
<th>During</th>
<th>Post</th>
<th>Pre</th>
<th>During</th>
<th>Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>2</td>
<td>4.6</td>
<td>2.7</td>
<td>4.7</td>
<td>4.6</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td>(1.0)</td>
<td>(0.7)</td>
<td>(0.8)</td>
<td>(1.5)</td>
<td>(1.5)</td>
<td>(0.9)</td>
</tr>
<tr>
<td>1</td>
<td>2.0</td>
<td>1.8</td>
<td>2.2</td>
<td>4.0</td>
<td>5.1</td>
<td>3.9</td>
</tr>
<tr>
<td></td>
<td>(0.0)</td>
<td>(0.4)</td>
<td>(0.4)</td>
<td>(0.0)</td>
<td>(0.7)</td>
<td>(0.8)</td>
</tr>
<tr>
<td>2</td>
<td>1.7</td>
<td>1.7</td>
<td>1.8</td>
<td>3.3</td>
<td>4.9</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td>(1.5)</td>
<td>(1.1)</td>
<td>(1.0)</td>
<td>(0.6)</td>
<td>(0.7)</td>
<td>(1.0)</td>
</tr>
<tr>
<td>3</td>
<td>3.0</td>
<td>2.6</td>
<td>3.0</td>
<td>4.0</td>
<td>4.6</td>
<td>2.7</td>
</tr>
<tr>
<td></td>
<td>(0.0)</td>
<td>(0.5)</td>
<td>(0.0)</td>
<td>(0.0)</td>
<td>(0.7)</td>
<td>(0.8)</td>
</tr>
<tr>
<td>4</td>
<td>1.3</td>
<td>2.2</td>
<td>3.0</td>
<td>4.3</td>
<td>4.7</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td>(1.2)</td>
<td>(0.7)</td>
<td>(0.0)</td>
<td>(0.6)</td>
<td>(0.6)</td>
<td>(0.6)</td>
</tr>
<tr>
<td>5</td>
<td>1.7</td>
<td>2.2</td>
<td>2.3</td>
<td>4.0</td>
<td>4.7</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td>(1.5)</td>
<td>(0.9)</td>
<td>(1.0)</td>
<td>(0.0)</td>
<td>(0.8)</td>
<td>(0.5)</td>
</tr>
<tr>
<td>6</td>
<td>1.3</td>
<td>2.1</td>
<td>2.3</td>
<td>5.0</td>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td>(1.5)</td>
<td>(1.0)</td>
<td>(0.5)</td>
<td>(0.0)</td>
<td>(0.8)</td>
<td>(0.8)</td>
</tr>
<tr>
<td>Follow-up</td>
<td>3.0</td>
<td>3.0</td>
<td>3.0</td>
<td>3.5</td>
<td>4.8</td>
<td>3.5</td>
</tr>
<tr>
<td></td>
<td>(0.0)</td>
<td>(0.0)</td>
<td>(0.0)</td>
<td>(0.7)</td>
<td>(0.4)</td>
<td>(0.6)</td>
</tr>
</tbody>
</table>

**FS.** Participant IC1 experienced a consistent improvement in affective response during each exercise session, particularly between weeks two and three. She recorded similar FS scores from pre to during-exercise in all weeks, apart from the baseline and weeks 4-6 where there was an increase from pre to during exercise. Pre and post-exercise affective responses were similar in weeks one and two however, in weeks 4-6 there was an increase from pre to post-exercise affective responses (see Table 2). The FS scores in the follow-up sessions (intensity was self-selected) also resulted in more positive affective responses than during baseline and intervention exercise sessions, despite the intensity being higher.

**Explanations for FS values given.** The participant was asked to explain why she had experienced these affective responses. During the first 15 minutes of the exercise session
her FS generally stayed the same as baseline because she did not feel any different than when she came in or did not feel that the exercise had a positive or negative influence on her. Although, she often mentioned the physiological symptoms she was experiencing, for example, “my legs are a little sore but it doesn’t make me feel bad because it shows that I am exercising and I think I should feel a little sore”. In the final 15 minutes of the exercise when her FS generally increased above baseline, she explained “I feel better because I have stopped thinking about work”, “feeling happy because I am nearly finished” and “feeling happy with myself that I have done it even though I didn’t really feel like exercising today”.

**FAS.** The FAS scores for participant IC1 show an increase in arousal during exercise, followed by a decrease post-exercise to pre-exercise levels. Her arousal scores show little change across the intervention or in the follow up sessions.

**Reasons given for FAS scores.** The participant had relatively high FAS levels pre-exercise, which dropped post-exercise. She came to the sessions on her lunch break from work and explained that she was often “stressed about everything I have to get done at work today” or “annoyed about work this morning” which caused her to “feel a bit wound up”. This would explain the relatively high FAS scores.

**PANAS.** Psychological well-being was measured at the end of each week. Participant IC1 displayed a decrease in negative affect from baseline to the first week of the intervention, where it then plateaued from weeks one to five. Negative affect increased in week six before decreasing to below the baseline level at follow up. Her negative affect level remained in the lower range (scale ranges from 0-50) from baseline through the intervention and in follow up. Positive affect increased from baseline to week three but decreased in weeks four and five to its lowest point. At follow up positive affect was at a point slightly above baseline. The PANAS scores showed that the exercise intervention seemed to result in a decrease in negative affect, but also a decrease in positive affect (see figure 4). However, at
follow up psychological well-being had improved from baseline due to a decrease in negative affect and an increase in positive affect.

![PANAS scores graph](image)

Figure 4. PANAS (0-50) scores at baseline, across the intervention and at follow up.

**Physical Activity Behaviour**

**Accelerometry.** At baseline participant IC1 was achieving 22 min of moderate intensity exercise per week. During the intervention her physical activity participation increased and by week six she achieved 233 min per week (see Figure 5). At follow-up, she recorded only 44 min of moderate intensity exercise in the week. All exercise minutes taken from the accelerometer were at a moderate intensity, with no vigorous minutes recorded.

![Accelerometer data graph](image)

Figure 5. Accelerometer data at baseline, across the intervention and at follow-up.
7-day PAR. In the physical activity recall the participant reported that she did no formal exercise at baseline. During the intervention she reported achieving an average of 135 min per week which was an additional 45 min over the 90 min required for the intervention. Of these 135 min per week, she reported an average of 45 min of moderate intensity, 80 min of hard and 10 min of very hard exercise per week. At the follow-up she reported a weekly average of 120 min of exercise, an increase of 120 min from baseline and a decrease of 15 min from the intervention. Of these 120 mins she reported 90 min at moderate intensity and 30 min at a hard intensity. Clearly the participant’s perception of the physical activity she was doing did not match the accelerometry data. However, from the combination of these results it appears that intervention was successful in increasing the participant’s physical activity behaviour. In the six weeks following the intervention, objectively monitored physical activity dropped to below recommended physical activity levels but she still perceived she had accumulated close to two hours of exercise per week (see Table 3).

Table 3

*Self-reported minutes per week of moderate, hard and very hard physical activity in the baseline, intervention and 6-week post intervention periods.*

<table>
<thead>
<tr>
<th>Week</th>
<th>Total</th>
<th>Moderate</th>
<th>Hard</th>
<th>Very Hard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Intervention</td>
<td>135</td>
<td>45</td>
<td>80</td>
<td>10</td>
</tr>
<tr>
<td>Follow up</td>
<td>120</td>
<td>90</td>
<td>30</td>
<td>0</td>
</tr>
</tbody>
</table>

Motivation

SE. The measure of self-efficacy was asked about the participant’s confidence in completing the exercise session, confidence in exercising at a particular intensity, confidence in exercising when she felt at a (insert feeling scale score) on the FS and confidence in selecting her own intensity (only asked in baseline and follow up sessions). Participant IC1
was very confident throughout all of the exercise sessions with 90-100% self-efficacy during all measurement times.

**BREQ-2.** The possible scores for the BREQ-2 range from 0-4. Participant IC1’s levels of non self-determined forms of motivation are fairly low across the intervention (see Figure 6). Amotivation increased from a baseline level of 0 to 0.75 by week three then plateaued at 1 for the remainder of the intervention. In the follow up amotivation had increased again to 2. Introjected regulation increased from baseline of 0.3 to 1 across the intervention and increased again at follow-up to 1.3. With respect to the self-determined forms of motivation, identified regulation varied across the intervention but remained within 0.5 of the baseline of 2. At follow up identified regulation had decreased. Intrinsic motivation increased from baseline level of 0 to levels ranging from 1.25-2 across the intervention and remained at the moderate level of 1.75 at follow-up. These results were not in line with the hypothesis that motivation would become less self-determined across the intervention in the imposed group.

![BREQ-2 Score Chart](image)

Figure 6. BREQ-2 (0-4) scores at baseline, across the intervention and at follow up.

**Explanations for changes in motivation.** After the follow up session participant IC1 was asked to explain her motivation for exercise and how the intervention had influenced it. She explained that she “wants to keep going with it” because she “knows there are benefits of being active” which she has seen through her decreased blood pressure. This reasoning
illustrates that her motivation may be underpinned by identified regulation and fits with the BREQ-2 results that showed her levels of identified regulation were higher than other forms.

**BPNS.** The possible scores in the BPNS range from 1-5. Perceived competence increased from baseline of 3 to 4 in week 2 then decreased across the remaining weeks to 3.3 (see Figure 7). At follow up her perceived competence had increased again and was above the baseline level at 3.7. These results show that the intervention resulted in an increase in perceived competence from the baseline level.

Perceived choice decreased from 4.2 (baseline and week 1) to 3.4 (week 2) then increased again in week 3 to a level just below baseline, where it remained for the rest of the intervention and at follow up. Overall the intervention resulted in a minor decrease in perceived choice. Her perceived volition increased from 2.3 at baseline to 3.7 in the first week of the intervention and it then alternated between 3.7 and 4.0 each week in the intervention and remained at 4.0 at follow up. This showed that during the intervention she felt she was freely making the choice to participate in exercise more so than she did at baseline. Perceived locus of causality became slightly more internal from 3.3 at baseline to 3.7-4.0 during the intervention. Perceived causality remained at 3.7 at follow up. This suggests that during the intervention she made the decision to exercise rather than feeling some external pressure was influencing the decision.

![Figure 7. BPNS (0-5) scores at baseline, across the intervention and at follow up.](image-url)
Explanations for BPNS results. After the follow up session participant IC1 was asked to explain her motivation for exercise and how the intervention had influenced it. When she was asked about how she felt about not having control over the exercise intensity, she explained that she knew she wasn’t “going to be pushed to the point of not being able to continue” because sometimes she would think she was “going really hard, but then it would get turned down a wee bit”. This may have contributed to her increase in perceived competence as she felt that she was capable of exercising at the intensity that was imposed and would never have to ask for it to be stopped. She also explained that if she had the choice she would rather select her own intensity until she was “exercising a lot more consistently” because she would like to feel confident in her ability to “do the whole session at whatever pace is chosen”. Once she had greater perceived competence in her exercise ability and was exercising more regularly she then felt that it “might be good to have someone choose” for her again so that she did not just plateau and not push herself.

Participant IC2

Participant I2 was a 41 year old woman, she was 1.65m in height and weighed 82.1kg, giving her a BMI of 30.2 kg/m² her baseline $\dot{V}O_2$max was 25.67 ml/min/kg and her $\dot{V}O_2$ at VT was 22.07 (ml/kg/min). She was relatively inactive before beginning the study, self-reporting 30 minutes of moderate and 30 minutes of vigorous intensity exercise per week at baseline and recording 88 minutes of moderate intensity exercise on the accelerometer.

Intensity

% $HR_{max}$. In the baseline sessions she chose to exercise at an average of 84% $HR_{max}$, this intensity was then imposed on her over the 6 week intervention. In the 6 week
follow up session where she was able to self-select her intensity again, she selected an average of 88% HRmax, a 4% increase from the intervention intensity.

![Graph showing heart rate profile](image)

**Figure 8.** Imposed intensity profile (% HR max) in 5-minute intervals.

The heart rate profile obtained from the baseline sessions was then imposed as the intensity during the intervention exercise sessions. The heart rate profile of participant I2 showed that she chose to increase her intensity up to half way in the session then decreased it by 3% HRmax to the 20 min mark, followed by a plateau across the final 10 minutes of exercise (see Figure 8).

**RPE.** Despite the intensity remaining the same in each session, RPE increased during the intervention from the baseline of 11 to 13 in week one, 14 in weeks two and three and then increased again to 15 for the remainder of the intervention (see Table 4). In the follow-up session the RPE remained at 15 despite her choosing a higher intensity again. This shows that when she self-selected her intensity (baseline) she perceived her exertion as being lower than when the same intensity was imposed (during intervention).

**%HR at VT.** She exercised at 90% of her HR at VT throughout the intervention. In the follow-up session she chose to exercise closer to her VT at 94% of her HR at VT.
Table 4

*Mean (and standard deviation) %HRmax, RPE and % HR at VT across the intervention.*

<table>
<thead>
<tr>
<th>Week</th>
<th>%HRmax</th>
<th>RPE</th>
<th>%HR at VT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>84</td>
<td>11</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td>(10.01)</td>
<td>(1.50)</td>
<td>(10.67)</td>
</tr>
<tr>
<td>1</td>
<td>84</td>
<td>13</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td>(6.26)</td>
<td>(1.91)</td>
<td>(6.67)</td>
</tr>
<tr>
<td>2</td>
<td>84</td>
<td>14</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td>(7.09)</td>
<td>(1.71)</td>
<td>(7.55)</td>
</tr>
<tr>
<td>3</td>
<td>84</td>
<td>14</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td>(7.11)</td>
<td>(1.75)</td>
<td>(7.58)</td>
</tr>
<tr>
<td>4</td>
<td>83</td>
<td>15</td>
<td>88</td>
</tr>
<tr>
<td></td>
<td>(8.92)</td>
<td>(1.34)</td>
<td>(9.5)</td>
</tr>
<tr>
<td>5</td>
<td>83</td>
<td>15</td>
<td>88</td>
</tr>
<tr>
<td></td>
<td>(7.97)</td>
<td>(1.49)</td>
<td>(8.49)</td>
</tr>
<tr>
<td>6</td>
<td>84</td>
<td>15</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td>(7.22)</td>
<td>(1.22)</td>
<td>(7.69)</td>
</tr>
<tr>
<td>Follow-up</td>
<td>88</td>
<td>15</td>
<td>94</td>
</tr>
<tr>
<td></td>
<td>(10.42)</td>
<td>(2.01)</td>
<td>(11.1)</td>
</tr>
</tbody>
</table>

**Cardiovascular fitness.** The results from the pre and post-intervention $\dot{V}O_2$max tests showed an increase in $\dot{V}O_2$max of 15.97% and an increase in $\dot{V}O_2$ at VT of 16.48%.

**Affect**

**FS.** During exercise her FS decreased each week of the intervention, from an average of 2.6 at baseline to between 0.4-0.9 in weeks 3-6. In each exercise session FS became less positive from pre to during-exercise, but increased from during to post-exercise to a level higher than the pre-exercise level (see Table 5). The FS scores at follow-up were similar to during the intervention and much lower than at baseline, despite her self-selected intensity being higher than what was imposed during the intervention. The results were in line with
the hypothesis that participants in the imposed group would experience less positive affective responses over the course of the intervention.

Table 5

Weekly mean (and standard deviation) FS and FAS scores pre, during and post exercise across the intervention.

<table>
<thead>
<tr>
<th></th>
<th>FS Pre</th>
<th>FS During</th>
<th>FS Post</th>
<th>FAS Pre</th>
<th>FAS During</th>
<th>FAS Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>2.7 (0.6)</td>
<td>2.6 (0.9)</td>
<td>3.7 (0.5)</td>
<td>2.7 (0.6)</td>
<td>3.4 (0.5)</td>
<td>2.5 (0.5)</td>
</tr>
<tr>
<td>1</td>
<td>2.0 (1.0)</td>
<td>1.7 (1.1)</td>
<td>3.5 (0.5)</td>
<td>3.0 (0.0)</td>
<td>3.2 (0.4)</td>
<td>4.4 (0.0)</td>
</tr>
<tr>
<td>2</td>
<td>2.0 (1.0)</td>
<td>1.6 (1.0)</td>
<td>3.3 (0.5)</td>
<td>3.7 (0.6)</td>
<td>3.3 (0.4)</td>
<td>3.0 (0.0)</td>
</tr>
<tr>
<td>3</td>
<td>2.0 (1.0)</td>
<td>0.8 (1.0)</td>
<td>2.8 (0.5)</td>
<td>3.3 (0.6)</td>
<td>3.4 (0.5)</td>
<td>3.0 (0.0)</td>
</tr>
<tr>
<td>4</td>
<td>2.3 (0.6)</td>
<td>0.7 (1.1)</td>
<td>2.7 (0.5)</td>
<td>3.0 (0.0)</td>
<td>3.9 (0.5)</td>
<td>3.2 (0.4)</td>
</tr>
<tr>
<td>5</td>
<td>1.7 (1.0)</td>
<td>0.4 (1.2)</td>
<td>2.2 (0.5)</td>
<td>3.3 (0.6)</td>
<td>3.9 (0.4)</td>
<td>3.3 (0.5)</td>
</tr>
<tr>
<td>6</td>
<td>2.3 (0.6)</td>
<td>0.9 (0.9)</td>
<td>2.7 (0.5)</td>
<td>3.0 (0.0)</td>
<td>3.8 (0.4)</td>
<td>3.0 (0.5)</td>
</tr>
<tr>
<td>Follow up</td>
<td>2.5 (0.7)</td>
<td>0.5 (1.3)</td>
<td>3.0 (0.0)</td>
<td>4.0 (1.4)</td>
<td>3.8 (0.5)</td>
<td>2.5 (0.6)</td>
</tr>
</tbody>
</table>

Explanation for FS values given. Participant IC2 attributed her less positive affective responses during exercise to psychological factors such as anticipation that the exercise was “going to hurt a bit”, that she was “not feeling as energetic as I have been” and that she was “feeling challenged already” even though she knew she still had a long way to go in the session. Less positive affective responses were also attributed to physiological cues such as “feeling quite uncomfortable in the legs and breathing”. Her more positive affective responses were explained by psychological factors such as positive perceptions of her ability and believing she could do it, and distracting herself from the exercise and physiological symptoms by “concentrating really hard on not looking at the time” and thinking about
things outside of the exercise such as “planning what is for dinner”. She also explained she was feeling good because of being “surprised by how easy I am finding it” and “happy because I have run consistently for almost 5 minutes and that is the first time I have achieved that” as well as “feeling a bit calmer and less frantic” and anticipating of the end of the exercise session, for example, “I feel good because I was determined to make it to the end”.

**FAS.** The FAS scores for participant I2 indicated a slight increase in arousal during exercise followed by a slight decrease post-exercise. Her arousal scores showed little change across the intervention or in the follow up sessions (see Table 5).

**PANAS.** Psychological well-being scores fluctuated around baseline levels across the intervention (see Figure 9). At follow-up her negative affect score was just one lower than at baseline at 15. Her negative affect level remained in the lower range (below 25) from baseline through the intervention and at follow-up. Her positive affect was 30 at baseline and, similarly to negative affect, fluctuated around baseline levels. At follow-up, positive affect was at a point well above baseline and higher than any positive affect scores during the intervention at 37.

![Figure 9. PANAS (0-50) scores at baseline, across the intervention and at follow up.](image)

**Physical Activity Behaviour**

**Accelerometry.** At baseline she was achieving 88 min of moderate intensity exercise per week. During the intervention her physical activity participation increased and by week
six she achieved 108 min per week. At follow-up she only recorded 37 min of moderate intensity exercise in the week. All exercise minutes taken from the accelerometer were at moderate intensity, there were no vigorous intensity minutes recorded (see Figure 10).

Figure 10. Accelerometer data at baseline across the intervention and at follow up.

7-day PAR. In the physical activity recall, participant IC2 perceived she did 60 min per week of exercise at baseline. During the intervention she reported she was achieving on average 215 min per week which was an additional 125 min over the 90 min required for the intervention. Of those 215 min per week she reported an average of 87 min of moderate intensity, 113 min of hard and 15 min of very hard exercise per week. At follow-up she reported a weekly average of 180 min of exercise, an increase of 120 minutes from baseline and a decrease of 35 min from the intervention. Of these 180 min she reported 160 min at a hard intensity and 20 min at a very hard intensity. Similarly to participant IC1, the exercise that she reported did not match the accelerometry data, with the accelerometry results showing that she did less physical activity at follow-up than baseline, compared to the increase of 120 min per week that was self-reported (see Table 6).
Table 6

*Self-reported minutes per week of moderate, hard and very hard physical activity in the baseline, intervention and 6-week follow up periods.*

<table>
<thead>
<tr>
<th>IC2</th>
<th>Total</th>
<th>Moderate</th>
<th>Hard</th>
<th>Very Hard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>60</td>
<td>30</td>
<td>30</td>
<td>0</td>
</tr>
<tr>
<td>Intervention</td>
<td>215</td>
<td>87</td>
<td>113</td>
<td>15</td>
</tr>
<tr>
<td>Follow-up</td>
<td>180</td>
<td>0</td>
<td>160</td>
<td>20</td>
</tr>
</tbody>
</table>

**Motivation**

**SE.** Participant IC2 began with self-efficacy at 100% for her confidence in completing the session, continuing to exercise when she felt the way she did on the FS and confidence in selecting intensity at baseline. Her confidence in exercising at the intensity she had chosen for herself averaged 91% across the baseline sessions. In the intervention her confidence to exercise at the intensity that was imposed on her decreased to 87%. In the follow-up sessions self-efficacy was at a slightly lower level, again decreasing to 85% despite being able to select the intensity for herself again.

**BREQ -2.** Participant IC2’s levels of non-self-determined motivation were very low throughout the intervention with amotivation levels between 0 and 0.5 and external regulation fluctuating between 1.0 and 1.5. Similarly to participant IC1, introjected regulation increased from baseline (0.3) to follow up (1.67). With respect to the self-determined forms of motivation, identified regulation remained constant at around 2.25 throughout the intervention, while intrinsic motivation increased from baseline (1.75) across the intervention to reach 2.75 by week six. At follow-up, intrinsic motivation was 3.0, the highest level recorded. Increases were seen in both introjected regulation and intrinsic motivation as a result of the intervention (see Figure 11).
Figure 11. BREQ-2 (0-4) scores at baseline, across the intervention and at follow up.

**Explanations for physical activity behaviour.** Participant IC2 explained that she continued to be active following the intervention because when she thought about not exercising she “felt guilty about getting to this point and just letting it go”. This combined well with the increase seen in her levels of introjected regulation from the BREQ-2 questionnaire. She also felt that having been involved in the intervention she had “got in the habit of exercise and developed a time frame for it”.

**BPNS.** Participant IC2’s perceived competence increased from a baseline of 2.3 to between 3.7 and 4.0 across the intervention. At follow-up her perceived competence had increased again from 4.0 in the final week of the intervention to 4.3 (see Figure 12).

Perceived choice decreased from her baseline level of 5.0 to 4.0 in week one of the intervention and remained there for the entirety of the intervention (see Figure 12). Although perceived choice remained high, the decrease that occurred when the intervention began, perhaps illustrates the imposed nature of the exercise intensity in the intervention. At follow-up perceived choice increased to 4.6, but was still lower than baseline levels. Perceived volition did not change greatly across the intervention, fluctuating between 3.3 and 4.0 during the intervention (see Figure 12). At follow-up, perceived volition remained at the baseline level of 4.0. This suggested that the intervention did not influence how free she felt she was in her choice to participate in exercise. Perceived locus of causality became slightly
more internal from 3.3 at baseline to 3.7 in every week of the intervention aside from week three where she increased again to 4.0 (see Figure 12). Perceived locus of causality remained at 3.7 at follow-up.

Figure 12: BPNS (0-5) scores across baseline, the intervention and follow up.

**Explanation of BPNS results.** Participant IC2 explained that she was comfortable with having the intensity imposed on her which may explain why there was little change in the autonomy subscales of choice, volition and causality across the intervention. She explained that she felt comfortable because she “wouldn’t be pushed past a point where she couldn’t cope”. Despite this comfort with the imposed intensity during the intervention she also mentioned that in the future she would prefer to select the intensity for herself. Her explanation for this was that she felt as though her mood can influence how she feels during exercise and if she “was feeling really crap” she knew she “could walk for the whole time and that was ok” when she was self-selecting the intensity.

**Participant IC3**

Participant I3 was a 48 year old woman, she was 1.55m in height and weighed 64.4kg, giving her a BMI of 26.8 kg/m² her baseline \(\dot{V}O_2\)max was 28.79 ml/min/kg and \(\dot{V}O_2\) at VT was 21.81 ml/min/kg. She was relatively inactive before beginning the study, self reporting 0
min of physical activity per week and recording 22 min of moderate intensity exercise on the accelerometer over the week.

**Intensity**

% HRmax. In the baseline session she chose to exercise at an average of 66% HRmax. In the 6 week follow up session where she was able to self-select her intensity again she selected an average of 63% HRmax, a 3% decrease from the intervention intensity.

![Figure 13. Imposed intensity profile (% HR max) in 5-minute intervals.](image)

The heart rate profile that was obtained from the baseline sessions was imposed as the intensity sessions during the intervention. The heart rate profile of participant IC3 shows that she chose to increase her intensity gradually across the exercise session, up until the final 10 minutes where there was a greater increase in intensity from 64 to 71% HR max (see Figure 13).

**RPE.** In line with the consistent intensity that was imposed across the intervention there was very little variability in her RPE across the intervention (see Table 7). It remained at, the baseline session level of 9.0. In the follow up session, the RPE was slightly above the baseline and intervention level at 10.5 despite her selecting a lower intensity.

% HR at VT. She exercised at 82% of the HR recorded at VT. In the follow up session she chose to exercise further from her VT at 79% of her HR at VT (see Table 7).
Table 7

Mean (and standard deviations) %HRmax, RPE and % HR at VT, across the intervention.

<table>
<thead>
<tr>
<th>Week</th>
<th>%HRmax</th>
<th>RPE</th>
<th>%HR at VT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>66 (5.36)</td>
<td>9 (0.69)</td>
<td>82 (7.10)</td>
</tr>
<tr>
<td>1</td>
<td>66 (4.91)</td>
<td>9 (0.54)</td>
<td>82 (6.12)</td>
</tr>
<tr>
<td>2</td>
<td>66 (4.87)</td>
<td>9.5 (0.70)</td>
<td>82 (6.08)</td>
</tr>
<tr>
<td>3</td>
<td>67 (4.54)</td>
<td>9 (0.90)</td>
<td>84 (5.67)</td>
</tr>
<tr>
<td>4</td>
<td>67 (3.43)</td>
<td>9 (0.87)</td>
<td>84 (4.28)</td>
</tr>
<tr>
<td>5</td>
<td>66 (4.85)</td>
<td>9 (0.62)</td>
<td>82 (6.05)</td>
</tr>
<tr>
<td>6</td>
<td>66 (5.53)</td>
<td>9 (0.87)</td>
<td>82 (6.90)</td>
</tr>
<tr>
<td>Follow-Up</td>
<td>63 (4.93)</td>
<td>10.5 (1.22)</td>
<td>79 (6.15)</td>
</tr>
</tbody>
</table>

**Cardiovascular fitness.** The results from the pre and post-intervention \( \dot{V}O_2 \text{max} \) tests show an increase in cardiovascular fitness with an increase of 34.48% in \( \dot{V}O_2 \) at VT and an increase in \( \dot{V}O_2 \text{max} \) of 11.72% from pre to post intervention. The increase in \( \dot{V}O_2 \) at VT may be inflated because due to being very nervous on the treadmill and about the test, she terminated the test before she reached two out of three of the criteria required for the max test.

**Affect**

**FS.** Participant IC3 experienced fairly similar affective responses during each exercise session (3.6-3.9) with the exception of weeks five and six which were slightly less
positive. Affective responses became more positive pre to during-exercise and increased or remained at during exercise levels post exercise during the baseline, intervention and follow-up weeks.

Table 8

Weekly mean (and standard deviation) FS and FAS scores pre during and post exercise across the intervention.

<table>
<thead>
<tr>
<th>Week</th>
<th>FS Pre</th>
<th>During</th>
<th>Post</th>
<th>FAS Pre</th>
<th>During</th>
<th>Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>3.0 (0.0)</td>
<td>3.7 (0.6)</td>
<td>4.3 (0.5)</td>
<td>2.7 (0.6)</td>
<td>3.4 (0.6)</td>
<td>4.0 (0.0)</td>
</tr>
<tr>
<td>1</td>
<td>3.3 (0.6)</td>
<td>3.9 (0.5)</td>
<td>4.3 (0.5)</td>
<td>2.7 (0.6)</td>
<td>3.8 (0.5)</td>
<td>4.0 (0.5)</td>
</tr>
<tr>
<td>2</td>
<td>2.7 (0.6)</td>
<td>3.4 (0.5)</td>
<td>3.5 (0.5)</td>
<td>2.3 (0.6)</td>
<td>3.2 (0.6)</td>
<td>3.5 (0.5)</td>
</tr>
<tr>
<td>3</td>
<td>3.0 (0.0)</td>
<td>3.3 (0.5)</td>
<td>3.2 (0.4)</td>
<td>3.0 (0.0)</td>
<td>3.4 (0.5)</td>
<td>3.2 (0.4)</td>
</tr>
<tr>
<td>4</td>
<td>3.0 (0.0)</td>
<td>3.6 (0.5)</td>
<td>3.3 (0.5)</td>
<td>2.7 (0.6)</td>
<td>3.3 (0.7)</td>
<td>3.5 (0.5)</td>
</tr>
<tr>
<td>5</td>
<td>2.7 (0.6)</td>
<td>2.8 (0.5)</td>
<td>3.2 (0.4)</td>
<td>2.0 (0.0)</td>
<td>2.7 (0.7)</td>
<td>3.3 (0.5)</td>
</tr>
<tr>
<td>6</td>
<td>3.0 (0.0)</td>
<td>3.1 (0.2)</td>
<td>3.3 (0.5)</td>
<td>2.7 (0.6)</td>
<td>3.1 (0.4)</td>
<td>3.5 (0.5)</td>
</tr>
<tr>
<td>Follow-up</td>
<td>3.0 (0.0)</td>
<td>3.3 (0.5)</td>
<td>3.0 (0.0)</td>
<td>2.5 (0.7)</td>
<td>3.3 (0.8)</td>
<td>4.0 (0.6)</td>
</tr>
</tbody>
</table>

Explanations for affective responses. We asked the participant to explain why she had experienced these affective responses. She explained that her less positive affective responses were due to her feeling like she was “just plodding along which makes me feel a bit flat really”. More positive affective responses were felt when she perceived the intensity as being more difficult, for example, “the increase [in intensity] made me feel better” and “I feel good working a bit harder”. More positive responses were also attributed to increased self-efficacy, “I am feeling like I can do the exercise” and positive perceptions of her ability, for example, “I am enjoying the challenge of feeling better and feeling like I am finding it easier at each session”.
**FAS.** The FAS scores for participant IC3 showed an increase in arousal from pre to during-exercise followed by a further increase in arousal post-exercise. Her arousal scores showed little change across the intervention or in the follow-up sessions (see Table 8).

**PANAS.** Negative affect decreased from baseline (18) to week one of the intervention (12) and remained close to this level (10-13) across the intervention. In the follow-up, negative affect had increased slightly to 13 but was still below the baseline level. Her negative affect level remained in the lower range (below 25) from baseline through the intervention and in follow up (see Figure 14). Her positive affect was 23 at baseline and increased to 36 in week four, before decreasing to 32 in weeks five and six. At follow up, positive affect had decreased from the end of the intervention to 28 but was still above the baseline of 23. The intervention seemed to result in an overall decrease in negative affect and an increase in positive affect, suggesting that the intervention had a positive influence on her psychological well-being.

![Figure 14. PANAS (0-50) scores at baseline, across the intervention and at follow-up.](image)

**Physical Activity Behaviour**

**Accelerometry.** At baseline she was achieving 22 min of moderate intensity exercise per week. During the intervention her physical activity participation increased and
by week six she was achieving 114 min per week. At follow-up, she recorded 84 min of moderate intensity exercise in the week (see Figure 15).

![Graph showing exercise minutes per week](image)

Figure 15. Accelerometer data at baseline, across the intervention and at follow up.

**7-day PAR.** In the physical activity recall, participant IC3 perceived that she did no formal exercise at baseline. During the intervention she reported 198 min of exercise, an additional 108 min over the 90 min required for the intervention. Of these 198 min per week she reported an average of 103 mins of moderate intensity and 95 mins of hard intensity (see Table 9). At follow-up she reported a weekly average of 0 minutes of exercise which was a return to the baseline level. She explained that once the intervention ended she did not continue to exercise over the six week follow-up period, due to time constraints. The zero minutes recorded at follow-up differed from the 84 minutes that the accelerometer recorded, and it may be that this is because she did not perceive the activity that she was participating in as being ‘physical activity’ and therefore did not report it.

Table 9

*Self-reported minutes per week of moderate, hard and very hard physical activity in the baseline, intervention and 6-week follow-up periods.*

<table>
<thead>
<tr>
<th>Week</th>
<th>Total</th>
<th>Moderate</th>
<th>Hard</th>
<th>Very Hard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Intervention</td>
<td>198</td>
<td>103</td>
<td>95</td>
<td>0</td>
</tr>
<tr>
<td>Follow-up</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Motivation

**SE.** Participant I3 began with self-efficacy levels in the 90’s and during the intervention her SE was at 100% every week. In the follow-up sessions SE remained at 100%.

**BREQ-2.** All of the non-self-determined forms of motivation were at low levels across the intervention (see Figure 16). Amotivation ranged from 0-0.5, external regulation ranged from 0-0.75 and introjected regulation ranged from 0-1 across the intervention. In contrast, the self-determined forms of motivation were at higher levels, identified regulation ranged between 2.75 and 3.25 and intrinsic motivation ranged between 3.25-3.75. At follow up, intrinsic motivation remained high at 3.50. These results were not those expected for the imposed condition, similarly, the fact that this participant had high levels of self-determined motivation and low levels of non-self-determined motivation at baseline was also unexpected.

Figure 16. BREQ-2 (0-4) scores at baseline, across the intervention and at follow-up.

**Explanations for motivation results.** After the follow up session participant IC3 was asked to explain her motivation for exercise and how the intervention had influenced it. She explained that during the intervention she participated in additional exercise because she was experiencing the benefits of exercise such as “having more energy at the end of the
day”. This relates to her identified regulation level in the BREQ-2 which was high at baseline and did not change across the intervention. She found the exercise that she carried out during the intervention to be motivating because of the “the discipline of the set appointments and the set pace on the treadmill” which she enjoyed. These results suggest that simply imposing an exercise intensity at which she had to exercise did not influence the enjoyment and value she gets from exercise. During the 6-week follow-up when she did not have the commitment of the intervention sessions her physical activity levels decreased which she put down to a lack of time.

**BPNS.** Participant IC3’s perceived competence sat close to 2.5 from baseline to week three and then increased to 3.3 from week four to six (see Figure 17). At follow up her perceived competence had decreased from the final weeks of the intervention but was above the baseline at 2.8, likely due to the lack of physical activity that she had carried out in the six week follow-up.

Participants IC3’s perceived choice decreased from 3.4 at baseline to 3 for weeks one and two of the intervention however it increased to 3.6 and then plateaued at 3.8 for weeks four, five and six despite intensity being imposed (see Figure 17). At follow-up, perceived choice remained at 3.8, an increase from the baseline. Perceived volition was 4.3 at the baseline and ranged from 3.7 to 4.3 during the intervention (see Figure 17). In the follow-up, perceived volition remained at the baseline level of 4.3. There was little change in participant IC3’s perceived locus of causality, with the intervention levels ranging from 3-4 over the 6 weeks, close to the baseline level of 3.7 (see Figure 17). At follow up perceived causality remained at the baseline level.

**Explanation for BPNS results.** Participant I3 explained that she felt that it was good for her to have the intensity chosen for her because “when you choose for yourself you can be a bit lazy”. This information can help to explain why there were no great decreases in her
sense of choice, volition or causality despite the intensity being imposed on her and will again explain why self-determined motivation remained high.

![BPNS (0-5) scores at baseline, across the intervention and at follow-up.](image)

**Figure 17. BPNS (0-5) scores at baseline, across the intervention and at follow-up.**

### Imposed Condition Results Summary

#### Intensity

The intensities that were selected in the baseline sessions ranged from 66-84% HRmax. These chosen intensities were 79-90% below the HR recorded at VT. As a result of the intervention participants increased in cardiovascular fitness ranging from 5.7-34.5% \( \dot{V}O_2 \text{max} \). At follow-up when the participants were able to self-select their intensity again, participants IC1 and IC2 selected intensities 6% and 4% higher in terms of HR max than what had been imposed on them during the intervention. Participant IC3 selected an intensity 3% lower in % HR max.

#### Affect

**FS.** When during-exercise FS values were compared across the intervention, results show that participant IC1’s FS decreased from baseline and then remained stable across the intervention, while participant IC2 continued to decrease across the intervention. Participant
I3 showed little change in FS. At follow up, participant IC1’s FS decreased from her intervention level of 2.6 (feeling good) to between 0.0 and 2.0 (neutral to between fairly good and good) while participants IC2 and IC3 remained at their intervention levels of 1.8 to 3.9 (between fairly good and very good). It would appear that a six week period of imposed intensity exercise may result in negative changes in during exercise FS from the baseline level. However, affect did not appear to become less positive across the six weeks of the intervention.

**PANAS.** The PANAS scale showed that negative affect decreased overall from pre-intervention to follow up in all participants. However, positive affect decreased below pre-intervention levels during the intervention in participants IC1 and IC2 while IC3’s level of positive affect never went below baseline. At follow-up, all participants in the imposed group reported positive affect scores above their baseline levels. Therefore, it appears that the six week intervention led to a decrease in negative affect during the intervention but psychological well-being had improved again six weeks post-intervention.

**Motivation**

In the baseline sessions participant IC3 reported self-efficacy levels in the 90’s (%) for all four self-efficacy dimensions, while participants IC1 and IC2 reported 91% for confidence in self-selecting intensity and 90% for confidence in exercising at this intensity, respectively. This showed that they had some doubt about their ability in the familiarisation week. Once the intervention began participants IC1 and IC3’s self-efficacy increased to 100% and remained at 100% at follow-up, while participant IC2’s self-efficacy for exercising at the imposed intensity ranged between 80 and 96% from intervention to follow-up, while the other dimensions remained at 100% . The results show that all participants felt confident about their exercise ability during the intervention.
All participants increased in perceived competence from baseline, over the intervention and at follow-up. Perceptions of choice decreased across the intervention in participants IC1 and IC2, while participant IC3 had an initial decrease but then increased in perceived choice. At follow-up, participant IC2’s perceived choice increased from intervention while the other two had no change. Participants IC2 and IC3’s perceived volition remained very close to their high baseline levels across the intervention and at follow-up while participant IC1 increased from baseline then plateaued across the intervention and at the follow-up. Perceived locus of causality became more internal in participants IC1 and IC2 while IC3 did not change from baseline. Therefore, as expected perceived choice decreased during the imposed intervention and supports that the imposed intensity intervention was successful. However, there was little change in perceived volition and perceived locus of causality. This suggests that despite having their exercise intensity imposed, autonomy was still high because participants made their own decision to participate and did not feel pressured.

During the intervention non-self-determined motivation increased. Amotivation increased in participant IC1 and all participants had increased introjected regulation. At follow-up all three participants had increased in introjected regulation from their baseline. In terms of self-determined motivation participants IC1 and IC2 increased in intrinsic motivation from baseline to intervention and at follow up while participant IC3’s decreased slightly.

**Physical Activity Behaviour**

Participants IC1 and IC2 self-reported an increase in physical activity of 120 mins from baseline to six weeks post-intervention. However, these self reports were not supported by the accelerometer data which showed an increase of only 22 mins in participant IC1 and a decrease of 55 mins in participant IC2. Participant IC3 reported an increase in physical
activity during the intervention, but at the six week follow-up felt she had returned to her baseline of zero minutes. However, data from her accelerometer at follow-up showed that although her physical activity level had decreased from the intervention, it remained higher than baseline. None of the participants in the imposed condition were meeting the physical activity guidelines of 150 min of moderate intensity exercise per week at follow-up, according to either the self-report or objective measures of physical activity.

**Self-Selected Condition Results**

**Participant SSC1**

Participant SSC1 was a 39 year old woman, she was 1.75m in height and weighed 94.3kg, giving her a BMI of 30.8 kg/m² her VO₂ max at baseline was 25.96 ml/min/kg and VO₂ at VT was 17.73 ml/min/kg. She was physically inactive before beginning the study, self reporting zero minutes of physical activity per week and recording zero minutes of moderate intensity exercise on the accelerometer at baseline.

**Intensity**

% HRmax. Participant SSC1 chose to exercise at 79% HRmax in the baseline sessions. Over the first four weeks of the intervention she selected an average intensity that was lower than baseline with 76% HRmax in week one and 75% HRmax in weeks two, three and four. In weeks five and six the intensity increased to 80% HRmax. In the follow-up she increased her intensity again to 82% HRmax (see Table 10). During each week of the intervention her % HR max during each session fluctuated across the 30 minute duration (see Figure 18).
Figure 18. % HRmax (data averaged from the three sessions each week) recorded across the exercise sessions each week.

**RPE.** Despite the average %HR max being similar in weeks one to four, RPE varied between 12 and 15. In weeks five and six she reported RPE values of 10 and 13 although the intensities were the same and were higher than in weeks one to four. In the follow up, she chose a higher intensity which resulted in a higher RPE score (14) being reported. This suggested that over the course of the intervention the participant began to perceive the intensity that she was choosing as being less ‘hard’ even though it had not changed substantially. When she increased the intensity in the follow-up she then perceived the intensity as being more difficult again.
Table 10

*Means (and standard deviations) %HRmax, RPE and % HR at VT*

<table>
<thead>
<tr>
<th>Weeks</th>
<th>%HRmax</th>
<th>RPE</th>
<th>%HR at VT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>79</td>
<td>13</td>
<td>116</td>
</tr>
<tr>
<td></td>
<td>(11.9)</td>
<td>(2.30)</td>
<td>(12.87)</td>
</tr>
<tr>
<td>1</td>
<td>76</td>
<td>13.5</td>
<td>112</td>
</tr>
<tr>
<td></td>
<td>(12.98)</td>
<td>(2.10)</td>
<td>(13.98)</td>
</tr>
<tr>
<td>2</td>
<td>75</td>
<td>14</td>
<td>110</td>
</tr>
<tr>
<td></td>
<td>(13.29)</td>
<td>(3.05)</td>
<td>(14.32)</td>
</tr>
<tr>
<td>3</td>
<td>75</td>
<td>12</td>
<td>110</td>
</tr>
<tr>
<td></td>
<td>(9.48)</td>
<td>(3.68)</td>
<td>(10.21)</td>
</tr>
<tr>
<td>4</td>
<td>75</td>
<td>13</td>
<td>110</td>
</tr>
<tr>
<td></td>
<td>(8.93)</td>
<td>(3.54)</td>
<td>(9.62)</td>
</tr>
<tr>
<td>5</td>
<td>80</td>
<td>10</td>
<td>118</td>
</tr>
<tr>
<td></td>
<td>(9.23)</td>
<td>(4.16)</td>
<td>(9.94)</td>
</tr>
<tr>
<td>6</td>
<td>80</td>
<td>13</td>
<td>118</td>
</tr>
<tr>
<td></td>
<td>(9.86)</td>
<td>(3.07)</td>
<td>(10.05)</td>
</tr>
<tr>
<td>Follow-up</td>
<td>82</td>
<td>14</td>
<td>121</td>
</tr>
<tr>
<td></td>
<td>(4.63)</td>
<td>(0.58)</td>
<td>(4.99)</td>
</tr>
</tbody>
</table>

*%HR at VT.* At baseline the participant chose to exercise at 116% of her HR at VT. During the first four weeks of the intervention she exercised between 110 and 112% and in the final two weeks exercised at 118%. In the follow-up session she chose to exercise at 121% of her HR at VT.

**Explanations of intensity choices.** During each session the intensity she chose varied over time. She chose to increase and decrease the intensity for periods of the time within the session rather than just maintaining a steady intensity over the session. She explained that she used this interval training style because she was aiming to “increase the running and decrease the recovery” and was “setting goals for how long to run for”. When reflecting on her intensity regulation at the end of the intervention, she explained that she
found some decisions about how to self-regulate her intensity difficult such as deciding “whether to select a higher intensity and run for shorter bursts or select a lower intensity and run for a longer period of time”.

During exercise participants were asked to explain why they regulated their intensity the way they had. Participant SSC1 explained that when she increased the intensity during exercise it was because she had “recovered enough and couldn’t justify staying at the lower intensity”, and felt she needed to be challenged by the intensity. She interpreted ‘challenge’ as feeling like she was breathing harder and feeling warmer. When she decreased the intensity it was “because I am breathless, I can feel my face is red hot and I am sure my heart is going really fast – that is why I am having to slow down, because it is too uncomfortable to keep going”.

**Cardiovascular fitness.** The results from the pre and post-intervention $\dot{V}O_2$ max tests show an increase in $\dot{V}O_2$ max of 19.01% and an increase in $\dot{V}O_2$ at VT of 12.30%.

**Affect**

**FS.** FS scores during exercise ranged between 1.7 and 2.1 in weeks one to five. In week six and follow-up FS was at 3. Her FS levels became more positive from pre to during-exercise and from during to post (see Table 11). During each individual exercise session, FS did not change much across time.
Table 11

Weekly mean (and standard deviation) FS and FAS scores pre during and post exercise across the intervention.

<table>
<thead>
<tr>
<th>Week</th>
<th>Pre</th>
<th>During</th>
<th>Post</th>
<th>Pre</th>
<th>During</th>
<th>Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>1.0</td>
<td>2.4</td>
<td>3.8</td>
<td>2.3</td>
<td>3.1</td>
<td>4.2</td>
</tr>
<tr>
<td></td>
<td>(1.0)</td>
<td>(0.7)</td>
<td>(0.4)</td>
<td>(0.6)</td>
<td>(0.5)</td>
<td>(0.4)</td>
</tr>
<tr>
<td>1</td>
<td>1.0</td>
<td>1.9</td>
<td>3.2</td>
<td>1.7</td>
<td>2.1</td>
<td>3.8</td>
</tr>
<tr>
<td></td>
<td>(1.0)</td>
<td>(0.5)</td>
<td>(0.5)</td>
<td>(0.7)</td>
<td>(0.5)</td>
<td>(0.5)</td>
</tr>
<tr>
<td>2</td>
<td>1.7</td>
<td>2.0</td>
<td>3.3</td>
<td>2.3</td>
<td>2.1</td>
<td>3.7</td>
</tr>
<tr>
<td></td>
<td>(0.6)</td>
<td>(0.3)</td>
<td>(0.5)</td>
<td>(0.6)</td>
<td>(0.2)</td>
<td>(0.5)</td>
</tr>
<tr>
<td>3</td>
<td>1.3</td>
<td>1.7</td>
<td>2.7</td>
<td>1.7</td>
<td>2.1</td>
<td>3.3</td>
</tr>
<tr>
<td></td>
<td>(0.6)</td>
<td>(0.5)</td>
<td>(1.0)</td>
<td>(0.6)</td>
<td>(0.5)</td>
<td>(0.5)</td>
</tr>
<tr>
<td>4</td>
<td>1.3</td>
<td>2.2</td>
<td>3.3</td>
<td>2.3</td>
<td>2.7</td>
<td>3.8</td>
</tr>
<tr>
<td></td>
<td>(0.6)</td>
<td>(0.4)</td>
<td>(0.5)</td>
<td>(0.6)</td>
<td>(0.6)</td>
<td>(0.4)</td>
</tr>
<tr>
<td>5</td>
<td>2.0</td>
<td>2.1</td>
<td>3.0</td>
<td>2.3</td>
<td>2.6</td>
<td>3.7</td>
</tr>
<tr>
<td></td>
<td>(0.0)</td>
<td>(0.3)</td>
<td>(0.0)</td>
<td>(0.6)</td>
<td>(0.5)</td>
<td>(0.5)</td>
</tr>
<tr>
<td>6</td>
<td>1.7</td>
<td>3.0</td>
<td>3.8</td>
<td>3.0</td>
<td>3.0</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td>(0.6)</td>
<td>(0.0)</td>
<td>(0.4)</td>
<td>(0.0)</td>
<td>(0.0)</td>
<td>(0.0)</td>
</tr>
<tr>
<td>Follow-up</td>
<td>3.0</td>
<td>3.0</td>
<td>4.0</td>
<td>3.0</td>
<td>3.0</td>
<td>4.3</td>
</tr>
<tr>
<td></td>
<td>(0.0)</td>
<td>(0.0)</td>
<td>(0.0)</td>
<td>(0.0)</td>
<td>(0.0)</td>
<td>(0.5)</td>
</tr>
</tbody>
</table>

**Explanations for FS values.** When asked why she was feeling a particular way, she explained that less positive FS scores were due to physiological factors such as feeling “breathless”, “sore and getting the stitch”. She also described “feeling tired and not very alert”, “not feeling very energetic or bouncy” and “feeling disappointed that I am too sore to run for that last minute and reach my goal” which illustrated more psychological reasons for the affective response. More positive affective responses were explained by a lack of physiological symptoms; for example, “I haven’t got any bad feelings, no stitch or anything” and also explained by psychological factors such as feeling like she “had a lot more energy”, “feeling better now knowing that I have achieved something” and “feeling elated that I have run for 20 minutes straight”.
FAS. FAS increased from pre to during exercise and during to post-exercise, with similar values for pre, during and post across the intervention (see Table 11).

PANAS. Negative affect scores varied across the intervention. Weeks one, two and four were all above the baseline of 16, while weeks three, five and six were below (see Figure 19). Negative affect at follow up was just below the baseline at 15. Levels of negative affect across all three periods were well within the lower range (below 25). During the intervention, positive affect scores increased from baseline of 34 to range from 35 to 39. At follow up her positive affect score was 39. These results suggest that the intervention improved her psychological well-being.

Figure 19. PANAS (0-50) scores across the baseline, intervention and follow up.

Physical Activity Behaviour

Accelerometry. At baseline, she was achieving zero min of exercise per week. During the intervention her physical activity levels increased and by week six she was achieving 180 min of moderate intensity exercise. At follow-up she was achieving 31 min of moderate intensity exercise in the week (see Figure 20). All exercise mins taken from the accelerometer were at moderate intensity, there were no vigorous intensity mins recorded.
Figure 20. Accelerometer data at baseline, across the intervention and at follow-up.

7-day PAR. In the physical activity recall, the participant perceived she did no formal exercise at baseline. During the intervention she reported achieving 90 min of exercise per week, no additional minutes from what was required for the intervention. She recalled all of those as being of a hard intensity. In the follow-up she reported a weekly average of 60 min of exercise at a hard intensity, an increase of 60 min from the baseline and a decrease of 30 min from the intervention (see Table 12).

Table 12

<table>
<thead>
<tr>
<th>Week</th>
<th>Total</th>
<th>Moderate</th>
<th>Hard</th>
<th>Very Hard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Intervention</td>
<td>90</td>
<td>0</td>
<td>90</td>
<td>0</td>
</tr>
<tr>
<td>Follow-up</td>
<td>60</td>
<td>0</td>
<td>60</td>
<td>0</td>
</tr>
</tbody>
</table>

Self-reported minutes per week of moderate, hard and very hard physical activity in the baseline, intervention and 6-week follow-up periods.

The physical activity behaviour results showed that the intervention resulted in the participant increasing her physical activity behaviour from her baseline level, but she still was not meeting the physical activity guidelines of 150 minutes of moderate intensity exercise each week.
Motivation

SE. In the baseline sessions participant SSC1 felt 99% confident in completing the session and selecting what intensity to exercise at while her confidence in exercising at the intensity she had selected (78%) and exercising while she was feeling the way she was on the FS (80%) were lower. Once the intervention began her SE for completing the session, exercising while she was feeling the way she was on the FS and selecting what intensity to exercise at increased to 100%. However, confidence in exercising at the intensity she had selected decreased during the intervention from the baseline level of 78% to between 43% and 61% in weeks one to three, and 27-42% in weeks four to six. At follow-up SE was at 100% for all questions.

BREQ-2. Participant SSC1’s levels of two of the non-self-determined forms of motivation decreased during the intervention. Amotivation was 1.8 at baseline and decreased across the intervention to reach 1.0 by week four and remained there for the rest of the intervention. At follow-up her amotivation level increased back up to 1.5 which was still slightly lower than at baseline. Her level of external regulation was 1.5 at baseline, decreased during the intervention remaining at 1.0 during all six weeks, and at follow-up increased up to 2.5. Unlike the other forms of non-self-determined motivation, introjected regulation levels increased across the intervention from 2.7 at baseline to 3.7 at week four, before decreasing to 3.0 in weeks five and six. At follow-up introjected regulation remained at 3.0, a slight increase from the baseline (see Figure 21). Self-determined forms of motivation did not change substantially across the intervention. Identified regulation was consistent from baseline and across the intervention at 3.0 before decreasing to 2.5 at follow-up. Her level of intrinsic motivation was 3.0 at baseline and remained between 2.25 and 3.0 in the intervention and was back at 3.0 at follow-up.
Explanations for motivational outcomes. Participant SSC1 was motivated to continue exercising following the intervention and stated that she had “increased her physical activity level dramatically” because she believed that the commitment she made to the intervention motivated her to participate in the sessions which enabled her to “come along and get a base level of fitness up, which has made it easier to maintain”. She also stated in the final session of the intervention that she wanted to keep exercising but didn’t know if she would without having the commitment to attend the study sessions. This linked to her increased introjected regulation scores during the intervention, as it appeared that the participant felt pressured to exercise due to the commitment she had made to the sessions and not wanting to let the researcher down.

BPNS. Perceived competence was at 2.0 at baseline then increased to its highest point of 4.8 in week two then decreased to 3.7 in week three. From weeks three to six perceived competence was fairly consistent with a range of 3.3-3.7. At follow-up her perceived competence was at 3.3.

Perceived choice was 1.0 at baseline, increasing during the intervention to range between 2.7 and 3.7. At follow up, perceived choice was 3.3. Perceived volition was 2.0 at the baseline and increased across the intervention with levels ranging from 3.3 to 4.0 and
remained at 4.0 at follow-up. Perceived locus of causality became less internal across the intervention from a baseline of 4.7 to 4.0 at week six and at follow-up (see Figure 22).

Figure 22. BPNS (0-5) scores across the baseline, intervention and follow-up.

**Explanation of BPNS results.** Although the perceived competence scores did not show a large increase across the intervention, the participant’s comments suggested that she experienced an increase in perceived competence. She explained that she was “personally very happy” with the fitness gains that she felt she had made. Her increased perceived competence was shown through statements such as, “I can now run for almost half an hour and at the start I couldn’t even run for two minutes”. She believed she may benefit from having someone regulate the intensity for her so that she would be “pushed a bit harder” but went on to say that she would have to be careful that “she wasn’t pushed over the edge” because being pushed that hard would feel unpleasant and might put her off exercising. These comments suggest that the participant valued the sense of perceived choice that she gained from having control over her intensity during the intervention but would also be happy to give up control as long as she was sure that the imposed intensity would not make her too uncomfortable as she felt this would threaten her future exercise participation.
Participant SSC2

Participant SSC2 was a 40 year old woman, she was 1.75m in height and weighed 60kg, giving her a BMI of 20.0 kg/m² her baseline \( \dot{V}O_2 \) max was 33.49 ml/min/kg and her \( \dot{V}O_2 \) at VT was 25.92 ml/min/kg. She was relatively inactive before beginning the study, self reporting 60 min of moderate intensity physical activity per week and recording 65 min of moderate intensity exercise on the accelerometer over the baseline week.

Intensity

\% HRmax. Participant SS2 chose to exercise at an average of 84% HR max at baseline. Over the first five weeks of the intervention the intensity that she selected was lower than the baseline ranging from 78-81% HRmax. In week six the intensity increased to 85% HRmax and increased again in the follow-up to 86% HRmax (see Table 13 for means and standard deviations).

![Graph showing % HRmax across weeks](image)

Figure 23. % HRmax (data averaged from the three sessions each week) recorded across the exercise sessions each week.

Although she chose to exercise at different intensities each week, the pattern of how she regulated her intensity across each session was the same. She chose to steadily increase her
intensity over the session up until around 25 minutes, where she would tend to decrease the intensity over the last 5 minutes (see Figure 23).

**RPE.** The RPE reported did not decrease in line with the decrease in intensity in the intervention and varied between 10 and 12. At follow-up, despite the higher intensity her RPE was still 12 (see Table 13).

**%HR at VT.** She exercised at 100% of her HR at VT in the baseline period. During the first five weeks of the intervention the intensity ranged between 94 and 97% of HR at VT. Intensity then increased in the final week of the intervention to 102% and increased again in the follow up to 103% (see Table 13).

**Table 13 Means (and standard deviations) %HRmax, RPE and % HR at VT**

<table>
<thead>
<tr>
<th>Week</th>
<th>%HRmax</th>
<th>RPE</th>
<th>%HR at VT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>84</td>
<td>10</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>(10.79)</td>
<td>(2.32)</td>
<td>(12.94)</td>
</tr>
<tr>
<td>1</td>
<td>80</td>
<td>12</td>
<td>96</td>
</tr>
<tr>
<td></td>
<td>(12.88)</td>
<td>(2.35)</td>
<td>(15.45)</td>
</tr>
<tr>
<td>2</td>
<td>81</td>
<td>11</td>
<td>97</td>
</tr>
<tr>
<td></td>
<td>(14.88)</td>
<td>(3.52)</td>
<td>(17.86)</td>
</tr>
<tr>
<td>3</td>
<td>78</td>
<td>10</td>
<td>94</td>
</tr>
<tr>
<td></td>
<td>(15.14)</td>
<td>(2.61)</td>
<td>(18.17)</td>
</tr>
<tr>
<td>4</td>
<td>80</td>
<td>11</td>
<td>96</td>
</tr>
<tr>
<td></td>
<td>(14.82)</td>
<td>(3.31)</td>
<td>(17.78)</td>
</tr>
<tr>
<td>5</td>
<td>81</td>
<td>12</td>
<td>97</td>
</tr>
<tr>
<td></td>
<td>(15.2)</td>
<td>(3.36)</td>
<td>(18.24)</td>
</tr>
<tr>
<td>6</td>
<td>85</td>
<td>12</td>
<td>102</td>
</tr>
<tr>
<td></td>
<td>(15.97)</td>
<td>(3.78)</td>
<td>(19.17)</td>
</tr>
<tr>
<td>Follow-up</td>
<td>86</td>
<td>12</td>
<td>103</td>
</tr>
<tr>
<td></td>
<td>(16.71)</td>
<td>(3.67)</td>
<td>(20.00)</td>
</tr>
</tbody>
</table>
**Explanations for intensity choices.** Participant SSC2 explained that she chose her intensity based on needing it to be challenging. For example, “I have increased the intensity in order to increase the challenge”, “I feel better having pushed myself and got to the end” and “I feel exhilarated from having pushed myself”. She explained decreases in her intensity as being due to physiological symptoms for example “I had to slow down to rest my legs” and “I couldn’t sustain that pace because I am too puffed”.

**Cardiovascular fitness.** The results from the pre and post-intervention VO₂ max tests showed an increase in VO₂ max of 7.71% and an increase in VO₂ at VT of 8.22%. The smaller change in cardiovascular fitness in this participant is likely due to the fact that she had a higher fitness level coming in to the study.

**Affect**

**FS.** Participant SSC2 experienced little change in affective responses. FS scores during exercise at baseline and at follow-up were positive ranging from 3.1 to 3.5. In general her FS scores increased from pre to during-exercise. FS was pretty similar during to post-exercise in all but the baseline week where there was an increase from 3.1 to 4.5 (see Table 14).

**FAS.** The FAS scores for participant SSC2 showed an increase in arousal from pre to during-exercise and a decrease in arousal from during to post-exercise in all but the baseline week where there was a slight increase from during to post-exercise (see Table 14).
Table 14

Mean (and standard deviation) FS scores pre, during and post exercise across the intervention.

<table>
<thead>
<tr>
<th></th>
<th>FS</th>
<th></th>
<th></th>
<th>FAS</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>During</td>
<td>Post</td>
<td>Pre</td>
<td>During</td>
<td>Post</td>
</tr>
<tr>
<td>Baseline</td>
<td>2.3</td>
<td>3.1</td>
<td>4.5</td>
<td>2.0</td>
<td>3.4</td>
<td>3.8</td>
</tr>
<tr>
<td></td>
<td>(2.1)</td>
<td>(0.8)</td>
<td>(1.0)</td>
<td>(1.0)</td>
<td>(0.8)</td>
<td>(0.5)</td>
</tr>
<tr>
<td>1</td>
<td>3.0</td>
<td>3.2</td>
<td>3.8</td>
<td>2.0</td>
<td>3.8</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td>(0.0)</td>
<td>(0.4)</td>
<td>(0.8)</td>
<td>(0.0)</td>
<td>(1.0)</td>
<td>(0.6)</td>
</tr>
<tr>
<td>2</td>
<td>3.0</td>
<td>3.3</td>
<td>3.0</td>
<td>2.0</td>
<td>3.8</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td>(0.0)</td>
<td>(0.5)</td>
<td>(0.5)</td>
<td>(0.0)</td>
<td>(1.2)</td>
<td>(0.0)</td>
</tr>
<tr>
<td>3</td>
<td>2.3</td>
<td>3.2</td>
<td>3.3</td>
<td>2.3</td>
<td>3.4</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td>(0.6)</td>
<td>(0.6)</td>
<td>(0.5)</td>
<td>(0.6)</td>
<td>(0.6)</td>
<td>(0.9)</td>
</tr>
<tr>
<td>4</td>
<td>3.0</td>
<td>3.1</td>
<td>3.5</td>
<td>2.3</td>
<td>3.5</td>
<td>2.3</td>
</tr>
<tr>
<td></td>
<td>(0.0)</td>
<td>(0.7)</td>
<td>(0.8)</td>
<td>(0.6)</td>
<td>(1.4)</td>
<td>(1.0)</td>
</tr>
<tr>
<td>5</td>
<td>3.0</td>
<td>3.2</td>
<td>3.1</td>
<td>2.0</td>
<td>3.8</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td>(0.0)</td>
<td>(0.4)</td>
<td>(0.4)</td>
<td>(0.0)</td>
<td>(1.3)</td>
<td>(0.8)</td>
</tr>
<tr>
<td>6</td>
<td>3.0</td>
<td>3.5</td>
<td>3.2</td>
<td>1.7</td>
<td>3.9</td>
<td>2.2</td>
</tr>
<tr>
<td></td>
<td>(0.0)</td>
<td>(0.7)</td>
<td>(0.4)</td>
<td>(0.6)</td>
<td>(1.5)</td>
<td>(0.4)</td>
</tr>
<tr>
<td>Follow-up</td>
<td>2.0</td>
<td>3.3</td>
<td>3.0</td>
<td>1.5</td>
<td>4.0</td>
<td>2.8</td>
</tr>
<tr>
<td></td>
<td>(0.0)</td>
<td>(0.8)</td>
<td>(0.0)</td>
<td>(0.7)</td>
<td>(1.4)</td>
<td>(1.0)</td>
</tr>
</tbody>
</table>

Explanations for FS values. Participant SSC2 experienced less positive affective responses when she was experiencing physiological symptoms such as “feeling puffed” and having sore legs and when she was feeling “disappointed I didn’t complete the session as I would like to” and “disappointed that I had to slow down to rest my legs”. During the exercise she also commented on distracting her attentional focus from the exercise in order to feel good, for example, “I am just distracting myself with the music and trying not to think about the exercise”. More positive affective responses were related to having challenged herself and feeling like she had achieved something, as well as “feeling exhilarated” and “feeling better now that I am feeling more relaxed”.

PANAS. Negative affect varied across the intervention with scores ranging from 11-14 (see Figure 24). At follow-up, negative affect was above baseline and intervention levels at 16. Levels of negative affect were all in the lower range (below 25). Positive affect scores
decreased across the intervention from the baseline and week one score of 29 to 18 in week three. This was followed by an increase to 24 then a decrease to 22 in weeks five and six. At follow up, positive affect had decreased again to 19, a decrease of 10 from the baseline. From week two of the intervention and in the follow up positive affect was in the lower level (under 25), suggesting that the intervention has a negative influence on her psychological well-being.

Figure 24. PANAS (0-50) score for positive and negative affect at baseline, across the intervention and follow-up.

**Physical Activity Behaviour**

**Accelerometry.** At baseline she was achieving 65 min of moderate intensity exercise per week. During the intervention her physical activity participation increased and by week 6 she was achieving 164 min of moderate intensity physical activity per week. At follow-up she achieved 186 min of moderate intensity physical activity, an increase from her baseline and intervention level (see Figure 25). All exercise mins taken from the accelerometer were at moderate intensity with no vigorous mins recorded.

**7-day PAR.** In the 7-day PAR the participant reported 60 min of moderate intensity exercise per week at baseline. During the intervention she reported 245 min per week, which
was an additional 155 min above the 90 required for the intervention. Of these 245 mins, 155 were reported to be at a moderate intensity and 90 at a hard intensity. In the follow up she reported a weekly average of 180 min of exercise, with 100 of those at a moderate intensity and 80 at a hard intensity, an increase of 120 min from the baseline and a decrease of 65 min from the intervention (see Table 15). The exercise mins reported during the intervention differ from the accelerometry data. It would seem the participant had not reported some physical activity that she participated in and it may be that she did not perceive those behaviours as physical activity.

Figure 25. Accelerometer data at baseline, across the intervention and at follow-up.

Table 15

*Self-reported minutes per week of moderate, hard and very hard physical activity in the baseline, intervention and 6-week follow up periods.*

<table>
<thead>
<tr>
<th>SS2</th>
<th>Total</th>
<th>Moderate</th>
<th>Hard</th>
<th>Very Hard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>60</td>
<td>60</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Intervention</td>
<td>245</td>
<td>155</td>
<td>90</td>
<td>0</td>
</tr>
<tr>
<td>6 weeks post intervention</td>
<td>180</td>
<td>100</td>
<td>80</td>
<td>0</td>
</tr>
</tbody>
</table>

**Motivation**

**SE.** At baseline participant SSC2 had SE levels in the 90’s (%) for her confidence in completing the session, confidence in exercising at the intensity she had chosen, confidence in exercising when she was feeling the way she was on the FS and confidence in selecting
her own intensity. Once the intervention began her SE increased to 100 for all areas and remained at 100 throughout the baseline and in the follow-up.

**BREQ-2.** Participant SSC2 had low levels of non-self-determined motivation throughout the intervention. She displayed no amotivation and her level of external regulation was very low ranging from 0-0.5. Introjected regulation levels varied across the intervention with levels ranging from 0.3 at week two to 1.33 at week five. At follow-up it had returned to the baseline of 0.67. Self-determined forms of motivation increased across the intervention. Identified regulation increased from her baseline of 1.75 to 2.75 in week six before decreasing to 2.0 at follow-up. Intrinsic motivation ranged between 3.0 and 3.5 at baseline, intervention and follow-up (see Figure 26).

![Figure 26](image.jpg)

**Explanations for motivational outcomes.** Participant SSC2 explained that she felt her motivation had increased both during and post-intervention due to her “realising I had time in the week to do it” and “I can achieve a lot in 30 minutes which is really time efficient”. She also felt that her motivation had increased during the intervention due to experiencing the “benefits of challenging yourself and seeing that you are able to achieve something”. This may relate to the identified regulation scale of the BREQ-2 which
increased over the intervention from the baseline as the participant placed value on the challenge of the exercise and identified a personal benefit of this challenge.

**BPNS.** Perceived competence increased from a baseline value of 3.3 to 4.3 in week one and then decreased across the intervention to 3.7 in week six. At follow-up her perceived competence was 3.5.

Perceived choice increased from her baseline of 3.2 to 3.8 at week six and to 4.2 at follow-up. This showed that the intervention was successful in making this participant feel like she had more choice when it came to the exercise. Perceived volition was 3.7 at the baseline and increased during the intervention to 4.7 at week five and follow-up. This showed that she was feeling as though she felt she was more freely making the choice to participate in the exercise as the intervention went on. Perceived locus of causality increased across the intervention from a baseline value of 3.3 to 4.3 at week six and to 4.7 at follow-up (see Figure 27). This result suggests that over the intervention her locus of causality became more internal and she felt that she was engaging in the exercise more autonomously as the intervention went on.

![Figure 27. BPNS (0-5) scores at baseline, across the intervention and at follow-up.](image-url)
Explanation of how participant SSC2 felt about self-selecting intensity.

Participant SSC2 believed that having control over the intensity during the exercise sessions was “good because it meant I could challenge myself when I wanted to but when I wasn’t feeling too flash I could just build that in to my session and change the intensity accordingly”. She felt that she was successful in selecting her own intensity because she “felt that I had got to a stage where I had built up a level of fitness and then was just able to keep pushing the intensity from there”. If she had the choice she stated that she would prefer to continue to select her own intensity in the future as she felt comfortable in pushing herself. However, she also commented that now she was comfortable being pushed and “has a compulsion to exercise” she probably wouldn’t mind if someone imposed the intensity.

Participant SSC3

Participant SSC3 was a 49 year old woman, she was 1.55m in height and weighed 64.4kg, giving her a BMI of 26.8 kg/m² her \( \dot{V}O_2 \) at baseline was 30.89 ml/kg/min. She was relatively inactive before beginning the study, self reporting 30 min of moderate intensity physical activity per week and recording 23 min of moderate intensity exercise on the accelerometer over the baseline week.

Intensity

% HRmax. Participant SSC3 chose to exercise on average at 64% HRmax. In each week of the intervention she increased her intensity to 68%, 66% and 67% in the first three weeks and 73%, 75% and 74% in the final three weeks. At follow-up, she chose to exercise at 68% HRmax (see Table 16).
As Figure 28 shows, during each exercise session, she chose to gradually increase her intensity across the 30 minutes.

**RPE.** Despite the chosen intensity increasing each week, RPE stayed relatively stable, ranging between 9.5 and 10.5 (see Table 16).

**% HR at VT.** At baseline she chose to exercise at 70% of her HR at VT. During the intervention the intensity increased each week from 72-82% HR at VT. At follow-up she chose to exercise at 74% HR at VT.
Table 16

*Weekly means (and standard deviations) %HRmax, RPE and % HR at VT*

<table>
<thead>
<tr>
<th>Week</th>
<th>%HRmax</th>
<th>RPE</th>
<th>%HR at VT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>64</td>
<td>11</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td>(4.91)</td>
<td>(1.78)</td>
<td>(5.35)</td>
</tr>
<tr>
<td>1</td>
<td>68</td>
<td>10</td>
<td>74</td>
</tr>
<tr>
<td></td>
<td>(7.71)</td>
<td>(1.45)</td>
<td>(8.39)</td>
</tr>
<tr>
<td>2</td>
<td>66</td>
<td>10</td>
<td>72</td>
</tr>
<tr>
<td></td>
<td>(4.4)</td>
<td>(1.32)</td>
<td>(4.79)</td>
</tr>
<tr>
<td>3</td>
<td>67</td>
<td>10.5</td>
<td>73</td>
</tr>
<tr>
<td></td>
<td>(3.21)</td>
<td>(1.22)</td>
<td>(3.49)</td>
</tr>
<tr>
<td>4</td>
<td>73</td>
<td>10.5</td>
<td>79</td>
</tr>
<tr>
<td></td>
<td>(6.19)</td>
<td>(1.36)</td>
<td>(6.73)</td>
</tr>
<tr>
<td>5</td>
<td>75</td>
<td>10</td>
<td>82</td>
</tr>
<tr>
<td></td>
<td>(7.68)</td>
<td>(1.07)</td>
<td>(8.37)</td>
</tr>
<tr>
<td>6</td>
<td>74</td>
<td>9.5</td>
<td>81</td>
</tr>
<tr>
<td></td>
<td>(6.37)</td>
<td>(1.14)</td>
<td>(6.93)</td>
</tr>
<tr>
<td>Follow-up</td>
<td>68</td>
<td>11</td>
<td>74</td>
</tr>
<tr>
<td></td>
<td>(4.77)</td>
<td>(1.31)</td>
<td>(5.19)</td>
</tr>
</tbody>
</table>

**Explanations of intensity choices.** Participant SSC3 chose to increase her intensity due to psychological factors. For example “I have increased because I feel confident in finishing now”, “I was starting to plod a bit and wanted to finish strong” and “I felt like I was being lazy”. She explained that she chose not to decrease the intensity during her sessions because “I wanted to challenge myself by increasing the intensity and maintaining the speed until the finish” and “I wanted to finish hard so that I felt like I had achieved something”.

**Cardiovascular fitness.** The results from the pre and post-intervention $\dot{V}O_2$max tests show an increase in $\dot{V}O_2$max of 32.43% and an increase in $\dot{V}O_2$ at VT of 34.43%. The increase in $\dot{V}O_2$ max may be inflated because due to being very nervous on the treadmill and about the test, she terminated the baseline test before she reached a true max.
Affect

Table 17

Weekly mean (and standard deviation) FS scores pre during and post exercise across the intervention.

<table>
<thead>
<tr>
<th>Week</th>
<th>Pre</th>
<th>During</th>
<th>Post</th>
<th>Pre</th>
<th>During</th>
<th>Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>3.0</td>
<td>2.9</td>
<td>3.3</td>
<td>3.0</td>
<td>2.9</td>
<td>3.3</td>
</tr>
<tr>
<td></td>
<td>(2.0)</td>
<td>(1.1)</td>
<td>(0.8)</td>
<td>(1.0)</td>
<td>(0.9)</td>
<td>(0.8)</td>
</tr>
<tr>
<td>1</td>
<td>3.3</td>
<td>2.8</td>
<td>2.7</td>
<td>3.3</td>
<td>3.7</td>
<td>3.8</td>
</tr>
<tr>
<td></td>
<td>(0.6)</td>
<td>(0.6)</td>
<td>(1.4)</td>
<td>(1.0)</td>
<td>(1.0)</td>
<td>(1.5)</td>
</tr>
<tr>
<td>2</td>
<td>3.7</td>
<td>2.8</td>
<td>3.5</td>
<td>4.3</td>
<td>2.7</td>
<td>3.8</td>
</tr>
<tr>
<td></td>
<td>(1.2)</td>
<td>(0.7)</td>
<td>(0.8)</td>
<td>(1.2)</td>
<td>(0.6)</td>
<td>(0.8)</td>
</tr>
<tr>
<td>3</td>
<td>2.7</td>
<td>1.8</td>
<td>2.3</td>
<td>5.0</td>
<td>2.8</td>
<td>4.2</td>
</tr>
<tr>
<td></td>
<td>(0.6)</td>
<td>(0.7)</td>
<td>(0.5)</td>
<td>(1.5)</td>
<td>(0.6)</td>
<td>(0.8)</td>
</tr>
<tr>
<td>4</td>
<td>3.3</td>
<td>2.4</td>
<td>3.0</td>
<td>3.3</td>
<td>3.2</td>
<td>4.3</td>
</tr>
<tr>
<td></td>
<td>(1.2)</td>
<td>(0.7)</td>
<td>(0.5)</td>
<td>(1.2)</td>
<td>(0.9)</td>
<td>(0.5)</td>
</tr>
<tr>
<td>5</td>
<td>3.7</td>
<td>3.2</td>
<td>3.8</td>
<td>5.0</td>
<td>2.9</td>
<td>4.3</td>
</tr>
<tr>
<td></td>
<td>(0.6)</td>
<td>(0.6)</td>
<td>(0.4)</td>
<td>(1.1)</td>
<td>(0.6)</td>
<td>(0.5)</td>
</tr>
<tr>
<td>6</td>
<td>3.3</td>
<td>3.2</td>
<td>3.7</td>
<td>4.3</td>
<td>3.0</td>
<td>4.0</td>
</tr>
<tr>
<td>Follow-up</td>
<td>3.0</td>
<td>2.7</td>
<td>4.0</td>
<td>2.5</td>
<td>2.5</td>
<td>3.5</td>
</tr>
<tr>
<td></td>
<td>(0.0)</td>
<td>(1.0)</td>
<td>(0.0)</td>
<td>(0.7)</td>
<td>(0.5)</td>
<td>(0.6)</td>
</tr>
</tbody>
</table>

FS. Participant SSC3 experienced little change in affective responses across the intervention with FS scores during exercise ranging from 2.4 and 3.2. Week three was the anomaly where her affect was lower at 1.8. FS seemed to decrease from pre to during-exercise and then increase back to baseline levels post-exercise (see Table 17).

Explanations of affective responses. Participant SSC3 attributed less positive affective responses to a combination of physiological and psychological factors. When physiological symptoms were mentioned they were generally paired with psychological outcomes to explain the affective response. For example, less positive affective responses were explained by the “feeling in the legs” causing her to “feel quite anxious”, while “feeling really tired and hot” caused her to “not enjoy the session” and “not feel safe and switched on.
to everything” when walking on the treadmill which made her a bit nervous that she might fall off. These links between physiological and psychological responses were also made in relation to more positive affective outcomes. For example, “I liked the fact that I was puffing because I liked the challenge” and “I like feeling as though I have done something because I am sweaty and tired”. More positive affective responses were also linked to psychological factors such as her being “surprised that I am managing this intensity so well” and “thinking about how light and bouncy I feel”. In order to maintain more positive affective responses to the exercise she explained how she distracted her attention away from physiological symptoms that she perceived negatively. For example, “I am determined to finish at this intensity and I am trying to focus on things other than how my body feels” and “when I ‘tune out’ it becomes quite effortless”.

**FAS.** The FAS scores for participant SS3 show a decrease in arousal from pre to during-exercise and an increase in arousal from during to post-exercise (see Table 17).

**PANAS.** Negative affect decreased from a baseline value of 22 across the intervention to 10 at week six (see Figure 29). At follow up, negative affect had increased again to 17 but was still at a lower level than baseline. Levels of negative affect across all three periods were in the lower range (below 25). Positive affect scores increased from a baseline of 29 to 38 in week one and then decreased to 23 at week three. In the last three weeks of the intervention positive affect had increased back to 34 by week six. At follow up positive affect had decreased to below baseline at 24. The results of the PANAS suggest that the intervention had little impact on the individuals’ psychological well-being because although there was a decrease in negative affect, positive affect also decreased from baseline to follow up.
Figure 29. PANAS (0-50) scores at baseline, across the intervention and follow-up.

**Physical Activity Behaviour**

**Accelerometry.** At baseline she was achieving 23 min per week of moderate intensity exercise. During the intervention her physical activity levels increased and by week six she was achieving 145 min per week (see Figure 30). At follow up, she recorded 56 min of moderate intensity exercise in the week. All exercise mins taken from the accelerometer were at moderate intensity, with no vigorous intensity recorded.

Figure 30. Accelerometer data at baseline, across the intervention and at follow-up.

**7-day PAR.** In the physical activity recall, the participant reported a weekly average of 30 min of moderate intensity exercise per week at baseline. During the intervention she said she was achieving 134 min per week, an additional 44 min per week above the required exercise for the intervention. Of the 134 min per week she reported an average of 42 min at
moderate intensity and 92 min at a hard intensity per week. At follow-up, she reported a weekly average of 40 mins of exercise, with all 40 mins at a hard intensity, an increase of 10 min from the baseline and a decrease of 94 min from the intervention. Her self-reported level of physical activity was similar to the data recorded by the accelerometer, aside from her perceiving that she had exercised above moderate intensity. Overall her physical activity behaviour did not increase greatly from baseline in the follow-up period (see Table 18).

Table 18

*Self-reported minutes per week of moderate, hard and very hard physical activity in the baseline, intervention and 6-week follow-up periods.*

<table>
<thead>
<tr>
<th>Week</th>
<th>Total</th>
<th>Moderate</th>
<th>Hard</th>
<th>Very Hard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>30</td>
<td>30</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Intervention</td>
<td>134</td>
<td>42</td>
<td>92</td>
<td>0</td>
</tr>
<tr>
<td>Follow up</td>
<td>40</td>
<td>0</td>
<td>40</td>
<td>0</td>
</tr>
</tbody>
</table>

**Motivation**

**SE.** Participant SSC3 was very confident throughout all of the exercise sessions with 100% self efficacy during all weeks bar the familiarisation week (where she had 99% for confidence to exercise at a particular FS and 95% for confidence to self-select intensity.

**BREQ-2.** Participant SSC3 had no amotivation in any week of the intervention (see Figure 31). Her level of external regulation was 0.8 at baseline and decreased across the intervention to zero by week three and remained there through to the follow-up. Introjected regulation levels varied across the intervention, ranging from 2.3 at baseline to between 1.7 and 3.0 during the intervention. At follow-up, her introjected regulation had returned to baseline. Her levels of identified regulation remained at the baseline level of 3.25 for the entire intervention apart from week six where it increased slightly to 3.5 then decreased
again to baseline at follow-up. Her intrinsic motivation was at 2.75 in the baseline period and then increased throughout the intervention to reach 3.75 by week five. At follow-up her intrinsic motivation remained at 3.75.

Figure 31. BREQ-2 (0-4) scores at baseline, across the intervention and at follow-up.

**BPNS.** Participant SSC3’s perceived competence was 3.8 at baseline and ranged from 3.3 - 4 during the intervention. At follow up her perceived competence was at 3.5 (see Figure 32).

Perceived choice decreased from a baseline of 4.0 to 2.4 at week four then increased back to 3.0 by week six. At follow up, perceived choice remained at 3.0 (see Figure 32). Perceived volition decreased from 4.7 at baseline to 3.7 at week three, then increased to 4.3 by week six. At follow-up her perceived volition had decreased again to 3.7 which was below the baseline and the average of the intervention. There was a decrease in participant SSC3’s perceived locus of causality from the baseline of 14 to 10 in week three before increasing to 13 by week six. At follow-up her perceived causality had decreased again from the intervention to 1.0, below the baseline level. The decreases in the participant’s perceived choice, volition and locus of causality were not expected in the self-selected condition. It may be that this participant did not feel she was exercising because she wanted to, but because she felt that she had to as a participant in the study.
Figure 32. BPNS (0-5) scores at baseline, across the intervention and at follow up.

**Experiences of the intervention.** Participant SSC3 felt that although her physical activity behaviour had not increased following the study, it had made her think about exercise a lot more and "feel guiltier" that she wasn’t exercising. When the intervention ended she had planned to continue exercising but since she had not kept up with it she had been “feeling really guilty and annoyed that I wasn’t keeping going”. She believed that she felt this guilt because she knew that she “should be exercising” and “feels much better” when she does. Interestingly some of the decreases in introjected regulation she recorded during the intervention may be because she felt less guilt as a result of the exercise she was doing during the intervention sessions.

One of the reasons that participant SSC3 explained that she enjoyed the study was due to her increased perceived competence in exercising particularly the confidence she gained on the treadmill which she explained “gave me a whole different outlook on things and made me even consider joining a gym”. In terms of perceived autonomy she enjoyed the fact that “I could push myself and was in control” which allowed her to “set little goals and stuff”. Although she enjoyed this aspect of selecting her own intensity she also felt that “it would have been good if I had pushed myself a bit harder” and commented that her intensity choices were focussed around knowing that she would make the whole 30 minutes, but that she felt she focussed on this a bit too much which stopped her from “trying a bit harder at
times”. If she had the choice in the future she explained that she would like to have advice and information about selecting an intensity that would help her to push herself more, and that it might be good to have someone selecting the intensity for her now that she has her confidence and would like to “push harder and see what I can do under pressure”.

Self-Selected Condition Results Summary

Intensity

Participants in the self-selected condition chose to exercise at an average intensity of between 66 and 88% HR max. During each exercise session in the intervention, participants SSC2 and SSC3 chose to gradually increase their intensity, while SS1 repeatedly increased then decreased the intensity throughout each session. In relation to VT, participant SSC3 exercised below, SSC2 exercised at and SSC1 exercised above their VT. All participants in the self-selected condition experienced an increase in cardiovascular fitness over the six week intervention with \( \dot{V}O_2 \) max increasing by 7.71 to 32.43%.

Affective Responses

FS. When during-exercise FS values were compared across the intervention, results show that all participants recorded positive affective responses throughout the intervention and showed little change. Participant SSC1 remained within 0.7 of their pre-intervention FS values across the intervention, while participants SSC2 and SSC3 both increased slightly (0.3-0.4) from their pre-intervention FS values. All three participants remained between 1.0 and 4.0 (fairly good to between good and very good) on the FS during exercise across the intervention. At follow-up there was no change from the intervention FS scores. The affective responses to the self-selected condition seemed to be less variable than in the
imposed condition with all participants’ affective responses remaining stable and positive across the intervention.

**PANAS.** The PANAS results showed that for participants SSC2 and SSC3 negative affect was variable across the intervention but remained in the lower range, while participant SSC1 had a slight decrease in negative affect across the intervention. Positive affect increased from baseline to intervention in participant SSC1, while participant SSC2 decreased from baseline to the intervention. Participant SSC3 had variable positive affect scores across the intervention ranging from 23-38, with scores both below and above the baseline of 28. Therefore, the intervention did not seem to have changed negative affect, although participants had low levels at baseline. In terms of positive affect, the intervention did not result in positive changes. These results suggest that the self-selected intensity intervention did not improve psychological well-being.

**Motivation**

In the familiarisation sessions all of the participants in the self-selected group reported self-efficacy levels below 100%, with participants SSC1 and SSC2 reporting self-efficacy levels between 78 and 99% for all four dimensions while participant SSC3 reported 99 and 95% for her confidence in exercise while she was feeling a particular was on the FS and confidence in self-selecting intensity. This showed that they had some doubt about their ability in the baseline week. Once the intervention began participants SSC2 and SSC3’s increased to 100%, while participant SSC1 decreased in her confidence to exercise at her chosen intensity across the intervention from 78% at baseline to 27-61% during the intervention. At follow-up participants SSC2 and SSC3 remained at 100% while SSC1 decreased self-efficacy with a decrease of 8% in self-efficacy from her baseline level. In the follow-up session all three participants reported 100% self-efficacy in all four dimensions, which was a large increase from intervention levels for participant SSC1.
Participants SSC1 and SSC2 both reported increased perceived choice and volition from baseline across the intervention while SSC3 decreased. Participants SSC1 and SSC3 reported a lower internal locus of causality across the intervention while SSC2 became more internal. Perceived competence increased in participants SSC1 and SSC2 from baseline across the intervention and was variable in SSC3 but remained within 0.5 of her baseline level. These results suggested that the self-selected intensity supported the basic need of autonomy through increasing perceived choice and volition and also increased perceived competence.

Levels of non-self-determined motivation were low throughout the intervention. Participant SSC1 decreased in levels of amotivation and external regulation across the intervention while participants SSC2 and SSC3 displayed no amotivation at any point and had low levels of external regulation at baseline which did not change. Participant SSC1 increased in introjected regulation, while participants SSC2 and SSC3 had values both above and below baseline during the intervention. Levels of self-determined motivation were high with SSC1 showing no change in their high baseline levels of intrinsic motivation while participants SSC2 and SSC3 increased. Identified regulation was also high at baseline in participant SSC1 and SSC3 and was unchanged by the intervention, while participant SSC2 increased in identified regulation from baseline to intervention.

**Physical Activity Behaviour**

All participants in the self-selected condition self-reported an increase in physical activity during and in the six weeks following the intervention and this increase in activity was supported by the accelerometer data collected. The results of both the self-report and objective measure showed that although all three participants had increased in their physical activity behaviour from baseline to post-intervention, only participant SS2 was meeting physical activity guideline at follow up recording 180 min of physical activity in the week.
Overall Results Summary

Exercise intensities across both conditions ranged from 66-88% of HRmax. The intervention resulted in increases in $\dot{V}O_2$max from baseline to follow-up in all participants. In the follow-up condition, all three participants from the imposed condition self-selected different (participants chose higher and one chose lower) intensities at follow-up by 3-6% HRmax than what had been imposed on them during the intervention. In the self-selected condition all three participants had increased the intensity that they chose to work out over the course of the intervention. In the follow-up condition two of the self-selected intensity participants continued to increase their intensity higher than their final intervention week while the other slightly decreased the intensity. Scores on the FS became less positive from baseline to intervention in the imposed group but did not continue to decrease across the intervention. In the self-selected condition FS scores were more positive from baseline across the intervention and varied less from session to session.

Self-efficacy levels increased from baseline to the intervention in both conditions and remained high across the intervention and follow-up. In the imposed group levels of perceived choice were lower than that of the self-selected group. Motivation was more self-determined across the intervention in the self-selected group. This group decreased in non self-determined forms of motivation during the intervention while the imposed group increased in non self-determined forms of motivation.

Physical activity behaviour increased from baseline to intervention in both groups. At follow up, none of the participants from the imposed group were meeting physical activity guidelines or maintaining intervention levels of activity. In fact, two out of the three had decreased below their baseline levels of activity. From the self-selected group, only one out of the three participants was meeting physical activity guidelines and although two out of
three had not maintained intervention levels of activity, all three were more active than at baseline.
Discussion

The purpose of this research was to investigate the effects of a six week exercise intervention and compare the effects of self-selected versus imposed exercise intensity on (1) affective responses to exercise (2) basic needs and self-determined motivation and (3) physical activity behaviour. A single subject case design was employed in order to recognise individual differences in intensity preference, affective responses and motivation; and gather more in-depth information on how self-selected and imposed intensities influence affect, motivation and physical activity behaviour. Based on the results of previous research and theory it was hypothesised that (a) participants would self-select intensities below or at their VT,(b) affective responses to exercise would be more positive during exercise and less variable between participants in the self-selected condition compared to the imposed condition across the intervention, (c) self-determined motivation and fulfilment of basic needs would increase across the self-selected condition and be higher than the imposed condition and (d) physical activity behaviour would be greater in the self-selected condition than the imposed six weeks following the intervention.

The results of the study supported the hypothesis that participants would self-select at an intensity that was below or at VT, although one self-selected participant chose an intensity above VT. These selected intensities met ACSM (2009) guidelines for cardiovascular improvements and over the six weeks all participants increased in cardiovascular fitness. As hypothesised, affective responses during exercise were more positive and less variable between individuals in the self-selected condition compared with the imposed condition. Participants in the self-selected condition maintained scores on the FS that were positive (between 1-4) and very similar from session to session (within 0.7). Compared with participants in the imposed condition who experienced decreases in FS scores from baseline and more variability in FS scores during exercise. There were little differences in the motivation results between the two groups so the hypothesis that
motivation would become more self-determined in the self-selected group as a result of the intervention was not supported. The basic needs results partially supported hypotheses. As expected, two out of three participants in the imposed condition experienced a decrease in perceived choice during the intervention where as the self-selected participants did not. However, there were no differences in competence, perceived volition and perceived locus of causality. Finally, the physical activity behaviour results did not support the hypothesis, with participants in both conditions increasing in their physical activity behaviour to the same extent from baseline to intervention. However, only one self-selected participant was meeting the current physical activity guidelines six weeks post-intervention.

**Self-Selected and Imposed Exercise Intensities**

In the baseline sessions for the self-selected condition one participant chose an intensity that was (on average) below VT, one chose at VT and the other chose above VT. Participants in the imposed condition all selected intensities below VT. This result was not expected from the results of previous research (Lind et al., 2005; Lind et al., 2008; Parfitt et al., 2006; Rose & Parfitt, 2007) but is likely due to the limited exercise experience of these sedentary participants. This highlights the need for a period of familiarisation and practice at self-selecting exercise intensity. Individual variability in preferred exercise intensity was exemplified by the range of HR max values recorded (64-86% HR max in the self selected group and 66-84% in the imposed group). These results support previous research in showing that individuals differ in the intensity they prefer to exercise at (e.g., Ekkekakis et al., 2008; Farrell, Gates, Maksud & Morgan, 1982; Spelman, et al., 1993). The results also support the findings of previous research which has focussed on single exercise bouts and found that individuals do self-select intensities that meet ACSM guidelines (Ekkekakis & Lind, 2006; Parfitt et al, 2006; Rose & Parfitt, 2007).
In the self-selected condition, participants SSC2 and SSC3 increased their intensity across time in each session. Additionally, participant IC3 had increased her intensity across time in the baseline session therefore during her imposed intensity exercise sessions this pattern of intensity regulation was imposed on her across each session. This pattern of intensity regulation during exercise has been shown to occur regularly in single bout exercise studies which have asked participants to regulate their own exercise intensity (Lind et al., 2005; Parfitt et al., 2006; Rose & Parfitt, 2007). Studies which have asked participants to self-regulate their intensity using the FS in order to feel ‘good’ or ‘fairly good’ have also shown that exercise intensity increases across time (Parfitt & Hughes, 2009; Rose & Parfitt, 2008). Participant SSC2 decreased her intensity in the last 5 to 10 minutes of the sessions in half of her exercise sessions during the intervention. Similarly, the self-selected intensity that was imposed on participant IC1 decreased across the last 10 minutes of the exercise. This decrease in intensity toward the end of the exercise sessions may have been due to the participants warming down toward the end of the exercise and wanting to feel better at exercise completion. Brewer, Manos, McDevitt, Cornelius and Van Raalte (2000) investigated the influence of a 5 minute period of lower intensity at the end of an exercise session on perceived aversiveness of the exercise session. They found that when participants read the description of a 15 minute exercise session with increasing intensity compared with a 20 minute session where intensity decreased for the final 5 minutes, the 20 minute session was perceived as less aversive despite having a greater workload overall than the 15 minute session. The results of Brewer et al. (2000) and the results of Fredrickson’s (2000) review of the peak and end rule, suggested that some individuals may have a more positive affective memory of the exercise session if it ends with a period of lower exertion rather than increasing all the way to completion.

Participant SSC1 displayed a pattern of regulation that has not been described in previous studies. She increased and decreased her intensity throughout the session in an
interval training type style. She explained that her regulation of intensity during the sessions was driven by goals she had set herself for example, “I was going to try and run for another 2 minutes but I am going to go for 5 minutes instead of 2” and “I want to increase the running and decrease the recovery, those are the words going around in my head”. Participant IC2 also displayed a pattern in the baseline sessions not described in previous studies with an increase in intensity up to 15 minutes then a decrease to 15 minutes followed by a plateau to completion. This regulation of intensity may have been caused by the participant’s inexperience at self-regulating intensity which resulted in her selecting too high an intensity for the first half of the exercise then realising she needed to decrease intensity in order to be able to complete the 30 minute session. Since this occurred during the familiarisation sessions, this pattern of intensity regulation was imposed across the intervention.

**Affective Responses to Exercise**

The design of the current study had the advantage of allowing for the examination of individual differences in affective responses, rather than comparing group averages. We found that in the self-selected condition FS responses were positive despite the increasing intensity across the sessions and the range of intensities chosen (below to above VT) across the participants. Two out of three participants experienced more positive affective responses across the intervention and one remained at the high levels shown at baseline throughout. No other studies have examined changes in affective responses during exercise across an intervention. The expectation that FS would remain positive across the intervention in the self-selected condition was based on research from single exercise bouts that has hypothesised that individuals regulate their intensity in order to continue feeling good across time (Lind et al., 2008; Parfitt et al., 2000, 2006; Rose & Parfitt, 2007, 2012). The reasons that the participants gave for increasing their intensity across the session were that they wanted to “increase the challenge” and feel as though they had achieved something. These reasonings link to the DMM (Ekkekakis, 2003) through demonstrating the influence of
cognitive and interoceptive cues on affective responses. In order to continue experiencing positive affective responses across the session the intensity was increased. Interoceptive cues were signalling to the participants that they could work harder without the intensity becoming unpleasant. Concurrently, the cognitive appraisal process was causing participants to increase the intensity in order to experience positive psychological outcomes associated with feeling that they had overcome a challenge and achieved something in the session. In contrast, two out of three imposed condition participants had less positive affective responses during the intervention than at baseline. In the imposed condition there were less positive affective responses in two out of three participants despite all three exercising at an intensity below VT that they had previously self-selected. Less positive affective responses were expected in the imposed condition and were proposed to occur due to the lack of choice/autonomy in the imposed condition.

The use of a single subject case design proposes that the effect of the intervention will be clear if all participants react in the same way when the intervention is implemented. The FS data would suggest that the intervention was not successful according to the single subject case design. We know that individual differences exist in affect, therefore, the change at the introduction of the intervention was not expected to be the same across participants. Although the magnitude of change differed between participants in both groups, the results supported the overall hypothesis that more positive FS responses would occur in the self-selected condition.

Cognitive processes explain why affective responses occur during exercise below and at VT and investigation of these cognitive processes can provide insight into what it is about the exercise that results in an individual’s affective response to it. The cognitive processes that were found to have the greatest influence on affective responses in the current study were similar to those identified by Rose and Parfitt (2007, 2010). Participants experienced more positive affective responses when they felt that they were being challenged; felt they
had achieved something; were able to dissociate from the exercise and place their attentional focus elsewhere; felt they had improved; and when their perceptions of their physiological symptoms were positive (e.g. “I like feeling as though I have done something because I am sweaty and tired”). These themes within the qualitative data were common within both conditions.

Anticipation of the end was a common factor explaining positive affective responses in the imposed group, but not the self-selected group. This may have been due to the lack of control that participants in the imposed group had over their intensity and the consequent uncertainty over how hard the exercise was going to become, or perhaps that participants in the imposed intensity enjoyed the exercise less and therefore were looking forward to completion. In a recent study, Eston et al. (2012) examined the influence of anticipation of the end on affective responses, and found that affect became more positive in the final few minutes of exercise when participants were aware that end was approaching. However, at the same time point, when participants were not aware of the end approaching, affect continued to become more negative. Eston et al. (2012) suggested that the increase in positivity of affect in the final few minutes may be due to the increase in self-efficacy and fulfilment of goal expectations that resulted from finishing the exercise. This suggestion is supported by comments from participants in the current study who linked both self-efficacy (e.g., “feeling happy with myself that I have done it even though I really didn’t feel like exercising today”) and goal achievement (e.g., “I feel good because I was really determined to make it to the end”) to positive affective responses toward the end of the exercise.

The cognitive appraisal process that led to less positive affective responses was focussed around negative perceptions of physiological symptoms, disappointment of not achieving goals (self-selected condition) and negative perceptions of the intensity (imposed condition). The fact that negative perceptions of physiological symptoms was a key cognitive appraisal theme in the imposed condition, but not the self-selected, suggests that
the lack of choice in the imposed group, may have caused the participants to perceive their physiological symptoms more negatively because they knew that they could not change the intensity in order to relieve their symptoms (e.g., muscular soreness, breathlessness, feeling hot).

One participant in the imposed condition explained that her less positive affective responses during sessions were because she felt the exercise intensity was not challenging enough, although she did not experience a decrease in FS scores over the intervention. This individual lacked confidence on the treadmill during the baseline sessions (having never walked on one before), therefore she may have needed more familiarisation sessions to feel confident walking on the treadmill in order to find a challenging intensity. Another participant in the imposed condition perceived the imposed intensity as being more challenging during the intervention than it had been at baseline, even though it was the same as when she had self-selected it. Her RPE increased from 11 at baseline to 15 in the intervention. This phenomenon of increased RPE in imposed versus self-selected exercise of the same intensity has been shown in previous studies (Parfitt et al., 2000; Rose & Parfitt, 2007). This increase in RPE at imposed exercise intensities may be due to a combination of loss of perceived control over the intensity, and the participants’ lack of previous exercise experience. These factors may have resulted in the participants feeling that the exercise was more difficult, due to a lack of confidence and knowledge of their exercise ability, combined with being unable the change the intensity of their own free will.

**Motivational Outcomes of Self-Selected and Imposed Intensity Exercise**

The influence the intervention had on participants’ motivation was of particular interest due to the manipulation of perceived autonomy that was achieved through imposing a self-selected intensity. In line with expectations and the results of previous research (Lind et al., 2008; Parfitt et al., 2000; Rose & Parfitt, 2012; Vazou-Ekkeakis & Ekkekakis, 2009)
participants in the imposed group all experienced a decrease in perceived choice, while two out of three participants in the self-selected condition increased in perceived choice. In contrast to the results of Vazou-Ekkekakis and Ekkekakis’s (2009) acute exercise study, locus of causality did not become more external and perceived volition did not decrease in the imposed condition, with levels being similar to those from participants in the self-selected condition. All six participants in the current study entered the study with high levels of volition, this may have been expected since they willingly responded to an advertisement and agreed to be involved in an exercise intervention. By agreeing to participate they willingly gave up their control of the intensity to the researcher. Surprisingly, the imposed intensity intervention did not diminish the level of perceived volition or locus of causality. In the intervention follow-up interviews, participants IC1 and IC2 explained that they trusted that the researcher would not impose an intensity that was not able to be completed and therefore they felt comfortable exercising at the imposed intensity. Participant IC3 explained that she enjoyed the discipline and set pace and that she liked the researcher imposing the intensity for her because it stopped her “getting lazy”. This is in line with results from Rose and Parfitt (2007) who found that some of their participants were happy with the researcher imposing the intensity, as it made them feel like they had achieved more exercise than when they selected the intensity for themselves. Therefore, the intervention was successful in decreasing perceived choice, but the other aspects of autonomy remained high because the participants were happy to give up control to the researcher.

Perceived competence increased from baseline to intervention in all participants. This differs from the results of Vazou-Ekkekakis and Ekkekakis (2009) who found no change in perceived competence following imposed versus self-selected intensity exercise and suggested that this was due to the exercise consisting of a single exercise bout which did not allow the participants to evaluate their performance through self-comparison. Rose and Parfitt (2012) found that differences in perceived competence were caused by the
individuals’ level of exercise experience as opposed to the self-selected versus imposed intensity. This was not likely to be the case in the current research as the participants had all been inactive over at least the past six months. The intervention in the current research allowed each participant to evaluate her success/failure during exercise by looking back at her previous exercise sessions across the intervention and setting herself goals for future sessions. This was highlighted in the qualitative results where participants described comparing their performance to previous sessions and setting goals for their exercise sessions. The during exercise measure of self-efficacy found that only participant SS1 decreased in self-efficacy and only in her confidence to exercise at the intensity she had chosen across the intervention. However, her perceived competence increased across the intervention. This suggested that despite her low self-efficacy (27-61%) for exercising at the intensity she chose, once she had completed the exercise her sense of achievement in overcoming the challenge and meeting goals she had set herself may have led to the increase in perceived competence.

The fulfilment of the basic psychological needs for autonomy and competence have been linked to increased self-determined motivation which has been linked to improvements in general health and well-being (Edmunds, Ntoumanis & Duda, 2007). Little change was seen in psychological well-being in the current study, which may be due to the participants’ relatively high baseline levels of self-determination. In the current study, it was hypothesised that motivation would become more self-determined in the self-selected group compared to the imposed group because the self-selection of intensity would provide more support for perceived autonomy and competence than the imposed condition. This hypothesis was not supported by the results which showed that there was little difference in the motivation results between the two groups, which may have been due to levels of perceived volition and locus of causality being unchanged by the imposed intervention. In both the imposed and the self-selected conditions, two out of three participants increased in intrinsic motivation across
the intervention while the other slightly decreased. Identified regulation changed little from
the initial moderate-high levels in both the imposed and self-selected conditions.
Amotivation either remained at low baseline levels or decreased across the intervention (in
all participants except for participant IC1 who increased), supporting the contention that
participants entered the study motivated to change. External regulation remained very close
to baseline levels in all participants in the imposed condition and remained close to baseline
or decreased across the intervention in the self-selected condition. Interestingly, participants
had increased levels of introjected regulation in both the imposed and self-selected intensity
conditions. This was also highlighted in the qualitative data. A common theme was evident
in the participants’ responses that suggested they were motivated to attend the sessions
because they would feel guilty if they let the researcher down, as well as further guilt
following the intervention when they felt that they were not being physically active enough.

In a review paper, Teixeira et al. (2012) found that in studies that implemented a
SDT-based intervention to promote physical activity participation, levels of introjected
regulation increased across time. They also suggested that although positive associations
between introjected regulation and exercise have been reported, this positive relationship was
not likely to continue to mediate long term exercise behaviour. Furthermore, Silva et al.
(2011) found that only intrinsic motivation had a positive correlation with long term physical
activity behaviour. The results of these studies suggest that the increase in introjected
regulation in the current study may have played a role in the increase in physical activity
observed at the six week follow-up, but over a longer period of time increasing levels of
introjected regulation would most likely have a negative influence on physical activity
behaviour. Interestingly the only participant (SSC2) to record an increase in identified
regulation across the intervention also recorded the greatest increase in physical activity
behaviour both during and post-intervention, which was in line with Edmunds et al.’s. (2007)
finding that identified regulation was positively related to exercise adherence.
Physical Activity Behaviour Outcomes

The results of the 7-day physical activity recall and the accelerometry data differed in the amount of exercise minutes and exercise intensities recorded at baseline, during the intervention and at follow-up. All participants self-reported less physical activity minutes at baseline than what the accelerometer recorded, while during the intervention three participants reported less and three more than what the accelerometer recorded. Finally, at follow-up five out of six participants reported more physical activity minutes than the accelerometer. That self-report and accelerometer measures of physical activity can produce different results was highlighted in a review by Prince, Adamo, Hamel, Hardt, Gorber and Tremblay (2008). They concluded that self-report measures can result in physical activity levels both above and below direct measures of physical activity. The differences in results from the current study appear to be due to a combination of inaccuracy in self-report and non-compliance in accelerometer use. Despite these differences, the overall results from both measures of activity behaviour show that there was an increase from baseline levels of activity to during the intervention and at the six week follow-up in both groups. However, the increase was not large and at follow-up just one self-selected condition participant was meeting physical activity guidelines of 150 minutes of moderate intensity physical activity per week.

Previous research has shown a positive relationship between positive affective responses and increased physical activity behaviour (Kivineimi et al., 2007; Schnieder et al., 2009; Williams et al., 2008; Williams et al., 2012). The results of the current study indicated that the five participants who experienced positive affective responses both during (FS of 1-3) and post (FS of 3-4) exercise had an increase in physical activity minutes per week from baseline to follow-up. Participant IC2 who experienced less positive affective responses during exercise (FS of 0-1), but similar responses to baseline post-exercise (FS of 2-3.5), also increased her physical activity behaviour from baseline to follow-up. Positive affective
responses are proposed to influence future physical activity behaviour because of the anticipation of obtaining positive affective responses in future physical activity experiences and through the development of more positive affective associations with exercise (Kiviniemi et al., 2007; Williams, 2008). Participant IC2 experienced less positive affective responses during exercise and often described an anticipation of negative affective responses at the beginning of her sessions (e.g. “I am anticipating this is going to hurt a bit”), despite this her physical activity behaviour increased during and post-intervention. This suggested that her positive post-exercise affective response may have had a greater influence on her affective memory of the exercise, meaning that she focussed on how good she felt after the exercise rather than how she felt during, when deciding whether to exercise again.

The way that the participants regulated their intensity during the sessions may also have had an influence on their affective memory. Participants SSC2 and IC1 both decreased in intensity over the last 5-10 minutes of exercise. For these participants, ensuring they felt good at completion may have resulted in a more positive affective memory of the exercise, which may have influenced future physical activity behaviour. Although recent research has suggested that exercise should be structured to avoid less positive affective responses occurring during exercise due to the negative outcomes for exercise adherence (Hargreaves & Stych, 2012; Schneider et al., 2009; Williams et al., 2008), some researchers have suggested that post-exercise affective responses may outweigh less positive responses during exercise in the affect-adherence relationship (Parfitt & Eston, 1995). The hypothesis that participants in the self-selected condition would be more physically active than those in the imposed condition following the intervention was not supported. Although all participants increased from their baseline levels of physical activity they all decreased in physical activity minutes from intervention to follow-up and at follow-up just one participant was meeting the physical activity guidelines of 150 minutes of moderate intensity activity per week.
Limitations

The single subject research design employed in this intervention study had the advantage of allowing individual differences to be recognised, which is particularly important in research focusing on affective responses (Ekkekakis, et al., 2007; Parfitt et al., 2006; Rose & Parfitt, 2007; 2010). This research design allowed each participant’s unique affective experience of exercise and the resulting outcomes for motivation and physical activity behaviour to be captured. The research design also allowed for the collection of more in-depth information from the participants, providing greater insight into the cognitive processes that influenced their specific affective responses to exercise and the specific reasons behind changes in motivation and physical activity behaviour.

The small sample size of the current research and the single-subject case design method means that generalisations cannot be made from the findings presented. The sample was comprised of inactive females aged between 39 to 49 years so these findings are limited to this population. These findings are also specific to a 6-week intervention using a treadmill in a one-on-one setting, therefore another location, social setting or longer intervention may result in different results. The creation of the intensity profiles for the imposed condition may have been more accurate if further familiarisation sessions had been carried out, as one participant who lacked confidence on the treadmill in the beginning was then imposed an intensity that was not challenging enough for her during the intervention. This suggested that for participants who are particularly inexperienced in using a treadmill, three practice sessions may not be enough to find their true preferred intensity.

All six participants entered the study with relatively high motivation for exercise. They wanted to become more active and placed value on the perceived outcomes of physical activity and therefore volunteered for the study. This is highlighted in the results which showed high intrinsic motivation scores and that intrinsic and identified regulation were the
most dominant forms of motivation. This is a particularly difficult limitation to overcome due to the need for participants to willingly volunteer to participate in the study, which, as is often the case in exercise studies, attracts participants who want to get involved in exercise. In future studies, one method that may work to overcome this limitation, and recruit those with lower motivation for physical activity, may be to recruit participants through public or community health referrals. Levels of self-determined motivation may be lower in these individuals due to them being advised to exercise by a medical practitioner in order to improve their health, resulting in motivation to exercise being driven by more non-self-determined motivation.

A further limitation of this study was the measurement of physical activity behaviour through the combination of self-report (through the 7-day PAR) and accelerometry. The combination of these two measurements was a strength of the study in that it offered insight into what the participants thought they were doing, as well as providing an objective measure of what they are actually doing. However, there were reliability and accuracy issues with both measures which resulted in differences in the results between the two measures. In a review, Prince et al. (2008) suggested that physical activity behaviour results may not be comparable between self-report and direct measures and that it may be preferable to use different measures for different purposes. For example, self-report can tell us the individual’s perception of their exercise behaviour and what mode of exercise they carried out, while direct measures can tell us more about specific exercise intensities as well as incidental activity.

The accuracy of the information gathered from the 7-day PAR may be increased by implementing a more thorough briefing and information sheet regarding what comprises ‘physical activity’ and differentiation between different intensities and asking participants to keep a daily physical activity diary rather than self-report at the end of the week as the participants found it difficult to remember everything they had done in the week. In terms of
the accelerometer use, the accuracy of the data would have been improved by participants keeping a diary of wear hours of the accelerometer each day (e.g., when they put it on and when they took it off) and receiving reminders about wearing the accelerometer via phone call, email or text message as there was some lack of compliance in the use of the accelerometers reported by all of the participants. In the daily wear time validation conducted through Actigraph results showed that participants were not meeting the daily wear time of 13 hours per day required for accuracy in measuring physical activity (Herrmann, Barreira, Kang & Ainsworth, 2012).

There were also some limitations in the collection of qualitative data. To increase the validity of information the interview questions were asked during exercise sessions; however, full and complete information could not always be provided by the participants due to breathlessness. In working toward overcoming this limitation in the future, a further set of interview questions at the cessation of the exercise session or talking over their during exercise responses and asking them to elaborate on their answers, may serve to clarify the answers to any of the interview questions that were asked during exercise.

The measurement of intensity was limited by the fact that VO2 was only measured pre and post-intervention and therefore all associations made to VT during the intervention were estimated from the heart rate at VT from the VO2max test data collected pre intervention. This decrease in accuracy was accepted, due to the difficulty of directly measuring VO2 during the intervention exercise sessions without causing discomfort to the participants that would negatively influence affective responses. In the future, accuracy in terms of where participants were exercising in relation to their VT could be increased by taking direct measures of VO2 for one minute during the exercise, on a regular basis throughout the intervention.
Future Research Suggestions

Future research expanding on the findings of the current research with a larger and more diverse sample is necessary to support the findings of this research. This area of research is important in order for exercise professionals to gain a greater understanding of how to assist inactive individuals in becoming more active in a way that promotes their long term participation in physical activity. By repeating the same protocols with a larger sample size results would be more applicable to exercise prescription for the general population through including a greater range of participants in terms of age, gender, health status and physical activity experience.

With the findings of the current research suggesting that previously inactive individuals would like to be guided in their intensity choices, it may be of interest to investigate the influence of an educational protocol in self-selection of intensity for previously sedentary individuals. This could involve an intervention period where participants are encouraged to self-select their intensity but are given advice and support in their self-selection, compared with those not given guidance or simply given an imposed intensity. Research of this nature may assist in developing practical strategies to increase adherence in the general population and educate exercise professionals to become more autonomy supportive in exercise prescription.

In order to further investigate the influence of imposed versus self-selected intensities on future exercise behaviour it may also be beneficial to increase the length of the follow-up period. Previous research has shown that less-self determined forms of motivation, such as introjected motivation may result in short term increases in physical activity behaviour, however in the long term these types of motivation have negative behavioural outcomes (Teixeira et al., 2012). Additionally, it may be of interest to investigate the impact that a transition period from intervention to follow-up has on motivation. This transitional period
could involve the participants exercising on their own with the support of the researcher via exercise programming and email/phone contact. This may decrease introjected regulation by encouraging the participants to think about what activity they want to do as well as how and why they want to do it, rather than just showing up to the sessions each week as a commitment to the study.

In order to fully investigate the influence that the loss of perceived autonomy has on affective responses and physical activity behaviour researchers need to manipulate perceived volition and locus of causality rather than just perceived choice. One way this may be achieved is through attempting to recruit participants that are less intrinsically motivated to begin physical activity; for example, recruiting participants through public health referrals, rather than recruiting people who independently take an interest and volunteer to be involved in a physical activity study.

**Practical Implications**

The current research provides a ‘qualified’ case for the self-selection of exercise intensity, with the finding that participants selected intensities that met ACSM (2009) guidelines, demonstrating that individuals are successful in self-regulating their intensity across time and that this self-selected intensity results in positive affective responses. Exercise professionals can also take the practical implication from this study that the loss of control over even a previously self-selected exercise intensity caused it to be perceived less positively in two thirds of the participants. This highlights the importance of promoting perceived choice in exercisers, particularly when they are new to exercise. Exercise professionals may provide autonomy support through allowing exercisers to self-select their exercise intensity and assisting them in setting realistic goals that will increase their sense of achievement and perceived competence in physical activity.
The current research also suggested that introjected regulation may be a common type of motivational regulation in sedentary women beginning exercise. In order to reduce introjected regulation it may be useful for exercise professionals to ask exercisers to list the reasons that they want to participate in physical activity and then use this list during the goal setting process to set goals for physical activity that are focussed around internalised motivators. It is also important for exercise professionals to be aware of the negative impact of guilt on self-determined motivation in the long term and to aim to reduce such feelings in exercisers by avoiding guilt provoking language and focussing on encouraging exercisers to participate in physical activity because they value the positive outcomes - such as enjoyment, rather than out of guilt or internal pressure.

It may also be beneficial to talk over the exercise session or each exercise activity briefly with exercisers and encourage the participant to recall the positive aspects of the exercise. This could contribute to a more positive affective memory of the exercise and increased perceived competence, therefore increasing the likelihood of future participation. Furthermore, to encourage a positive affective memory of an activity, exercisers should be encouraged to alter their intensity in a manner which results in positive affective responses, particularly at exercise completion. In order to promote positive affective responses during exercise exercisers may benefit from being able to dissociate from the physiological symptoms that they are experiencing. Exercise professionals may encourage this by introducing distractions such as music or talking to the exerciser about something aside from the exercise. If an individual is particularly focussed on physiological symptoms it may be helpful to talk through the physiological symptoms with them and encourage them to either practice altering their intensity in order to avoid these symptoms or help them to develop coping strategies such as dissociation.
References


119


Appendices
Appendix A

Intervention Manual

1. At the beginning session the participant is given the heart rate monitor to put on and asked to report their FS and FAS score.

2. The participant then gets on the treadmill, those in the self selected group are instructed that “you will be exercising for 30 minutes in the exercise session and you may choose whatever intensity that you feel comfortable exercising at and can change the intensity at any time.” Participants in the imposed condition will have the intensity imposed to a level that reaches their heart rate profile from the baseline sessions. Keep an eye on their HR and adjust when necessary to ensure that it stays within 5 bpm of the specified HR.

3. In the self-selected condition when the participant adjust their intensity ask them the following questions:
   a) Why have you chosen to exercise at this intensity?
   b) Why have you chosen to change the exercise intensity?
   c) How did you feel after you had made this change to the intensity, compared to how you felt before you change it?

4. At 4.45, 9.45, 14.45, 19.45, 24.45 and 29.45 min marks in every session ask the participants to rate their scores on the FS, FAS, RPE and SE scales in that order every time in order to maintain consistency across sessions.

5. In the third session of the week follow the FS, FAS, RPE and SE scales with the following questions.
   a) Can you explain why you chose ‘x’ on the feeling scale? What about the exercise made you feel that way?
b) What is going through your head while you are exercising?

6. For the self-selected condition add the intensity questions from step and if they have not changed the intensity ask why they have chosen to remain at the same intensity.

7. At completion of the exercise in the final session of the week ask the participant how they feel having completed the session.

8. Once the participant is off the treadmill ask them to remove the heart rate monitor and take a seat. After 5 minutes ask them to report their scores on the FS and FAS scales. Repeat at 10 minutes.

9. In the third session of the week the participant will fill out the BREQ-2, BNS, PANAS and 7-day PAR in that order after they have scored the FS and FAS at 5 and 10 minutes.

10. Session complete. Download HR data and enter during exercise information to spreadsheet.
Appendix B

Physical Activity Readiness Questionnaire (PARQ)

Client: .................................................................................................
Consultant: ...........................................................................................

Please answer the following by circling the appropriate response:

1. Has your doctor ever said that you have a heart condition and
   recommended only medically approved physical activity? YES / NO
2. Do you have chest pain brought on by physical activity? YES / NO
3. Have you developed chest pain at rest in the past month? YES / NO
4. Do you lose consciousness or lose your balance as a result of dizziness? YES / NO
5. Do you have a bone or joint problem that could be aggravated
   by the proposed physical activity? YES / NO
6. Is your doctor currently prescribing medication for your blood
   pressure or heart condition? YES / NO
7. Are you aware, through your own experience or a doctor’s advice,
   of any other reason against your exercising without medical approval? YES / NO
Appendix C

<table>
<thead>
<tr>
<th>Feeling Scale</th>
<th>Felt Arousal Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>+5 Very good</td>
<td>1 Low arousal</td>
</tr>
<tr>
<td>+4</td>
<td>2</td>
</tr>
<tr>
<td>+3 Good</td>
<td>3</td>
</tr>
<tr>
<td>+2</td>
<td>4</td>
</tr>
<tr>
<td>+1 Fairly good</td>
<td>5</td>
</tr>
<tr>
<td>0 Neutral</td>
<td>6 High arousal</td>
</tr>
<tr>
<td>-1 Fairly bad</td>
<td></td>
</tr>
<tr>
<td>-2</td>
<td></td>
</tr>
<tr>
<td>-3 Bad</td>
<td></td>
</tr>
<tr>
<td>-4</td>
<td></td>
</tr>
<tr>
<td>-5 Very bad</td>
<td></td>
</tr>
</tbody>
</table>
Appendix D

The Positive and Negative Affect Schedule

This scale consists of a number of words that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent you have felt this way in the last week.

Use the following scale to record your answers.
1 = very slightly or not at all
2 = a little
3 = moderately
4 = quite a bit
5 = extremely

<table>
<thead>
<tr>
<th>Interested</th>
<th>Enthusiastic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distressed</td>
<td>Proud</td>
</tr>
<tr>
<td>Excited</td>
<td>Irritable</td>
</tr>
<tr>
<td>Upset</td>
<td>Alert</td>
</tr>
<tr>
<td>Strong</td>
<td>Ashamed</td>
</tr>
<tr>
<td>Guilty</td>
<td>Inspired</td>
</tr>
<tr>
<td>Scared</td>
<td>Nervous</td>
</tr>
<tr>
<td>Hostile</td>
<td>Determined</td>
</tr>
<tr>
<td>Attentive</td>
<td>Jittery</td>
</tr>
<tr>
<td>Active</td>
<td>Afraid</td>
</tr>
</tbody>
</table>
Appendix E

Behavioural Regulation in Exercise Questionnaire-2 (BREQ-2)

Age: ___________ years  Sex: male  female (please circle)

WHY DO YOU ENGAGE IN EXERCISE?

We are interested in the reasons underlying peoples’ decisions to engage, or not engage in physical exercise. Using the scale below, please indicate to what extent each of the following items is true for you.

<table>
<thead>
<tr>
<th>Item</th>
<th>Not true for me</th>
<th>Sometimes true for me</th>
<th>Very true for me</th>
</tr>
</thead>
<tbody>
<tr>
<td>I exercise because other people say I should</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>I feel guilty when I don’t exercise</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>I value the benefits of exercise</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>I exercise because it’s fun</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>I don’t see why I should have to exercise</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>I take part in exercise because my friends/family/partner say I should</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>I feel ashamed when I miss an exercise session</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>It’s important to me to exercise regularly</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Statement</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>I can’t see why I should bother exercising</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I enjoy my exercise sessions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I exercise because others will not be pleased with me if I don’t</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I don’t see the point in exercising</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I feel like a failure when I haven’t exercised in a while</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I think it is important to make the effort to exercise regularly</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I find exercise a pleasurable activity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I feel under pressure from my friends/family to exercise</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I get restless if I don’t exercise regularly</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I get pleasure and satisfaction from participating in exercise</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I think exercising is a waste of time</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix F

Basic Psychological Needs Satisfaction

Please circle a number between one and five that explains how you feel about the statement, with one being not true for you, three being sometimes true for you and five being very true for you.

Perceived Competence

I feel that I am able to complete exercise that is personally challenging

1 2 3 4 5

I feel confident I can do even the most challenging exercise

1 2 3 4 5

I feel confident in my ability to perform exercise that personally challenges me

1 2 3 4 5

I feel capable of completing exercise that is challenging to me

1 2 3 4 5

I feel like I am capable of doing even the most challenging exercise

1 2 3 4 5

I feel good about the way I am able to complete challenging exercise

1 2 3 4 5

Perceived choice

I feel free to choose which exercise I participate in

1 2 3 4 5

I feel that I have control of what to do and whether to do it

1 2 3 4 5

I feel free to make my own exercise decisions

1 2 3 4 5

I feel like I am in control of my exercise intensity

1 2 3 4 5

I feel like I am the one who decides what exercise I want to do

1 2 3 4 5
Perceived Volition

While exercising I feel as though I am participating willingly

1 2 3 4 5

When I exercise, I feel that I am being pressured or forced to do something that I don’t want to do

1 2 3 4 5

I choose to participate in exercise according to my own free will

1 2 3 4 5

Perceived Locus of Causality

When I exercise, I feel I am doing what I want to be doing

1 2 3 4 5

When I exercise I am doing what others want me to do

1 2 3 4 5

When I exercise I feel I am doing what I want to do, in pursuit of my own goals

1 2 3 4 5
Appendix G

Interview Outline for Third Exercise Session of the Week

1. Can you explain why you chose ‘x’ on the feeling scale? What about the exercise makes you feel this way?
2. Why have you chosen to exercise at this intensity?
3. Why have you chosen to change the exercise intensity?
4. How did you feel after you had made this change to the intensity, compared to how you felt before you changed it?
5. What is going through your head while you are exercising?
6. Please describe how do you feel having completed the exercise?

Interview Outline for 6 Week Follow Up

1. What influence do you think the exercise sessions have had on your motivation?
2. What influence do you think the exercise sessions have had on your physical activity behaviour?
3. Why do you think that is?
4. Was there anything in particular that you enjoyed about the sessions?
5. Was there anything you didn’t enjoy?
6. How did you feel about having the exercise intensity (insert either chosen for you or imposed on you as appropriate to condition)?
7. Do feel that you were successful in regulating your own intensity? (self-selected condition only)
8. If you had the choice would you prefer to regulate your own intensity or have someone select it for you or tell you what to do?

9. Why?

10. Is there anything else you would like to add about your experience of the physical activity in the study?
Appendix H

Seven Day Physical Activity Recall Question Form

1. Were you employed in the last seven days?

2. How many days of the last seven did you work?

3. How many total hours did you work in the last seven days?

4. Last night, what time did you go to bed? (Repeat for all seven days)

5. What time did you get out of bed this morning? (Repeat for all seven days)

6. What physical activities have you engaged in during the past seven days, starting with yesterday and going back seven days?

7. Can you please categorize the physical activity you have carried out by intensity, moderate, hard or very hard (moderately hard is comparable to walking at a normal pace, very hard is running and hard is in between the two)
8. How long did you take part in the activity for (excluding time spent standing still or resting)?

9. What strength and flexibility exercise have you engaged in in the past seven days, starting with yesterday and going back seven days?

10. How many minutes did you spend on each?

11. Is there anything you had forgotten that you would like to add?

12. In comparison to the past three months was your level of physical activity in the past seven days the same, more, or less active?
Appendix I

Self-Efficacy for Exercise Scale

Please rate your confidence in relation to these statements on a scale of 0% (not confident at all) to 100% (completely confident)

1. Confidence in completing the exercise session.

2. Confidence in exercising at this intensity.

3. Confidence in ability to continue exercising while you are feeling (insert feeling scale value chosen).

4. Confidence in selecting what intensity to exercise at.
### Appendix J

**Borg’s (1998) Ratings of Perceived Exertion Scale**

<table>
<thead>
<tr>
<th>Rating</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>No exertion</td>
</tr>
<tr>
<td>7</td>
<td>Extremely light</td>
</tr>
<tr>
<td>8</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Very light</td>
</tr>
<tr>
<td>10</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Light</td>
</tr>
<tr>
<td>12</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Somewhat hard</td>
</tr>
<tr>
<td>14</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Hard</td>
</tr>
<tr>
<td>16</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Very hard</td>
</tr>
<tr>
<td>18</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Extremely hard</td>
</tr>
<tr>
<td>20</td>
<td>Maximal Exertion</td>
</tr>
</tbody>
</table>
Thank you for showing an interest in this study. Please read the following before deciding whether or not to participate in this study. If you decide to participate, thank you.

**What is the aim of this project?**

This project is being undertaken as part of the requirements for a Masters Degree in Physical Education. The aim of the project is to investigate the responses that people have to exercise and how they change over time.

**What participant is being sought?**

Six female participants over the age of 30 and under the age of 60 who are physically inactive (have not participated in moderate intensity physical activity for more than 150 minutes a week over the last six months) are required for the study.

**What will the participant be asked to do?**

Should you agree to participate, you will be asked to make available three hours of your time, three times a week over a seven week period as well as being contactable to carry out measures over the phone or via email once a week for a maximum of three weeks prior to beginning the exercise sessions and on one occasion six weeks following the completion of the exercise sessions. You will also be asked to participate in a maximal exercise test (VO2 max test) which will involve exercising to the point of exhaustion and will last between 10 and 15 minutes in duration. You will be asked to questions regarding medical conditions, injury history and previous exercise experience to ascertain your suitability for the study.

Each of the twenty one sessions will involve 30 minutes of exercise on a treadmill. During each session you will be required to rate how you feel and your perceived difficulty of the exercise. During the last exercise session of each week you will be asked to answer some interview questions during the exercise and fill in a series of questionnaires at the completion of the exercise. Throughout the exercise session your heart rate will be recorded as well as the intensity of exercise.

**Can Participants Change their Mind and Withdraw from the Project?**

You may withdraw from participation in the project at any time and without any disadvantage to yourself of any kind.

**What Data or Information will be Collected and What Use will be Made of it?**

The information collected during each of the exercise sessions will be used in the write up of Jade’s masters thesis. This information will include data providing insight in to how you felt about exercise before, during and after being involved in the exercise sessions.

This project involves an open-questioning interview. The exact nature of the questions, which will be asked, have not been determined in advance, and will depend on how the interview unfolds.
This means the University of Otago Human Ethics Committee is aware of the general areas to be explored in the interview, but has not been able to review the exact questions that will be used.

If the line of questioning does develop in such a way that makes you feel hesitant or uncomfortable, you have the right to decline to answer any particular question(s) and also that you may withdraw from the project at any stage without any disadvantage to yourself of any kind.

The information obtained in the interviews will remain anonymous.

The results of the project may be published and will be available in the University library but your anonymity will be preserved. You will be supplied with a copy of the results of the study once they have been written up.

The data collected from interviews and recorded on tape recorder will be securely stored in such a way that only the two involved researchers will be able to gain access to it. At the end of the project any personal information will be destroyed immediately except that, as required by the University’s research policy, any raw data on which the results of the project depend will be retained in secure storage for five years, after which it will be destroyed.

What if Participants have any Questions?

If you have any questions about our project, either now or in the future, please feel free to contact either:-

Jade Fleming
Department of Physical Education
Telephone: 479-8941
Email: jade.fleming@otago.ac.nz

Dr Elaine Hargeaves (Supervisor)
Department of Physical Education
Telephone: 479-8941
Email: elaine.hargreaves@otago.ac.nz

Dr Jim Cotter (Supervisor)
Department of Physical Education
Telephone: 479-9109
Email: jim.cotter@otago.ac.nz
Appendix L

INDIVIDUAL RESPONSES TO EXERCISE OVER TIME

CONSENT FORM FOR PARTICIPANTS

I, ....................................................................... (Please print name) have read the Information Sheet concerning this project and understand what I am being asked to do. I have had the opportunity to discuss the study and to ask questions, these have been answered to my satisfaction. I understand that I am free to request further information at any stage.

I know that:-
1. My participation in the project is entirely voluntary;

2. I am free to withdraw from the project at any time without any disadvantage;

3. The data will be destroyed on completion of the project but any raw data on which the results of the project depend will be retained in secure storage for five years, after which it will be destroyed.

4. I will be required to complete a screening session a week of familiarisation sessions consisting of three 30 minute exercise sessions, and a VO2 max test followed by a six week period of 30 minute exercise sessions three times a week. I will also be required to be contactable via phone email or post 6 weeks after the exercise period to carry out follow up measures.

5. Some discomfort is likely to be experienced in the exercise, particularly in the VO2 max tests

6. I am aware that the interview process involves an open-questioning technique which may develop in such a way that makes me feel hesitant or uncomfortable.

7. The data audio-tapes will be destroyed at the conclusion of the project but any raw data on which the results of the project depend will be retained in secure storage for five years, after which it will be destroyed.

8. The results of the project may be published and available in the University library but my anonymity will be preserved.

I agree to take part in this project.

............................................................................. ............................
(Signature of participant) ...........................
(Date)
This study has been approved by the University of Otago Human Ethics Committee. If you have any concerns about the ethical conduct of the research you may contact the Committee through the Human Ethics Committee Administrator (ph 03 479 8256). Any issues you raise will be treated in confidence and investigated and you will be informed of the outcome.

[Note: The above statement should not be included if the project has been considered and approved at departmental level]
Appendix M

Modified AHA/ACSM Screening Form

Name: ........................................... Date: ..................................

Help assess your health needs by marking all true statements.

History
You have had:
__ a heart attack
__ heart surgery
__ cardiac 141 athetization
__ coronary angioplasty (PTCA)
__ pacemaker/implantable cardiac defibrillator
   or rhythm disturbance
__ heart valve disease
__ heart failure
__ heart transplantation
__ congenital heart disease

Symptoms
__ You experience chest discomfort with exertion.
__ You experience unreasonable breathlessness.
__ You experience dizziness, fainting, blackouts.
__ You take heart medications.

Other health issues
__ You have musculoskeletal problems.
__ You have concerns about the e safety of exercise.
__ You take prescription medication(s).
__ You are pregnant.

Cardiovascular risk factors
__ You are a man older than 45 years.
__ You are a woman older than 55 years or
__ You have had a hysterectomy or you are postmenopausal.
__ You smoke.
__ Your blood pressure is >140/90.
__ You don’t know your blood pressure.
__ You take blood pressure medication.
__ Your blood cholesterol level is >240 mg/dL.
__ You don’t know your cholesterol level.
__ You have a close blood relative who had a heart attack < 55 (father/brother) or < 65
   (mother/ sister).
__ You are diabetic or take medicine to control your blood sugar.
__ You are physically inactive (ie., you get <30 minutes of physical activity on at least 3 days
   per week).
__ You are >10 kg overweight.
__ None of the above is true.