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**An investigation into the development of
ACT-based approaches to increase physical
activity**

**Thesis submitted in accordance with the requirements of the
University of Chester for the degree of Doctor of Philosophy
by Anthony Paul Whalley
January 2021**

Author Declaration

University of Chester, January 2021.

I hereby declare that:

The material being presented for examination is my own work and has not been submitted for an award of this or another HEI except in minor particulars which are explicitly noted in the body of the thesis. Where research pertaining to the thesis was undertaken collaboratively, the nature and extent of my individual contribution has been made explicit.

Anthony Whalley

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Abstract

Anthony Paul Whalley - An investigation into the development of ACT-based approaches to increase physical activity

It is well documented that regular physical exercise supports physical and mental wellbeing. Despite the promotion of physical activity by world health experts and governments, physical inactivity within the population remains a cause for concern and disorders associated with sedentary lifestyles have continued to increase. Evidence suggests that the uncomfortable private-events people experience during physical exertion can become psychological barriers to participation in physical activity and thus result in avoidant behaviours. Acceptance and commitment therapy (ACT) has been used to promote increased physical exercise by enhancing psychological flexibility in relation to private-events that are perceived as unpleasant. However, relationships between the individual ACT processes and the theories which underpin their use in interventions designed to promote physical activity have yet to be fully explored. Understanding the relationship between ACT processes and physical exercise is key for appropriate and robust intervention development.

This thesis aimed to explore the theoretical and practical application of ACT processes in relation to exercise and inform further development of effective brief interventions designed to increase activity levels. The programme of work within this thesis had two phases. The first phase included two studies: a systematic review to explore the existing evidence; and a quantitative survey study to determine if associations exist between physical activity levels and the individual core processes of ACT. Results from phase one found that the reviewed literature failed to explore the

use of Relational Frame Theory (RFT) critical to ACT, and a survey suggested that ACT processes of defusion, self-as-context and personal values were likely to play a significant part in activity levels. The second phase comprised of three interrelated quantitative intervention studies designed using RFT. Each explored the ACT processes by measuring task duration and the intensity of private-events experienced during exercise. The first intervention study combined defusion and self-as-context with no significant effects on an exercise task. The second combined defusion, self-as-context and value orientated cues to behaviour change. Exercise duration was significantly increased in the ACT intervention, while there was no decrease in the intensity of private-events. The final study tested a values clarification task with cues to behaviour change and reported significantly increased exercise duration.

The thesis demonstrates that relational frame theory applied to ACT processes can influence the duration of exercise although the relationship with private-events remains uncertain. The robust, theory focused approach to this work represents a small but valuable contribution to the development of intervention strategies and has implications for future research. Strategies worked best using a combination of both deictic and hierarchical relations for training cognitive defusion and self-as-context, and especially for the clarification of personal values used as cues to behaviour change. Further research is needed to establish both the external validity and longevity of observed effects.

Presentations generated by this research

Conference Presentations:

Whalley, A., Hulbert-Williams, L., Lafferty, M., & Hulbert-Williams, N. (2016). Acceptance and commitment-based approaches for promoting physical activity: A systematic review and narrative synthesis. Poster presented at the European Health Psychology Society and Division of Health Psychology Conference 2016, Aberdeen, Scotland.

Whalley, A., Hulbert-Williams, L., Lafferty, M., & Hulbert-Williams, N. (2017). A brief acceptance and defusion intervention for increasing physical activity: Effects of contextually specific training. Presented at University of Chester Post Graduate Research Conference 2017, Chester UK

Whalley, A., Hulbert-Williams, L., Lafferty, M., and Hulbert-Williams, N. (2018). Components of acceptance and commitment training as predictors of levels of physical activity. Presented at the Chester Contextual Behavioural Science Research Colloquium 2018, Chester UK

Whalley, A., Hulbert-Williams, L., Lafferty, M., & Hulbert-Williams, N. (2019). The effect of cognitive defusion and values on pain tolerance. Presented at the University of Chester Post Graduate Research Conference 2019, Chester UK

Whalley, A., Lafferty, M., Hulbert-Williams, L., & Hulbert-Williams N. (2019). The effects of a brief psych-educational intervention on the tolerance to exercise related discomfort. Poster presented at the British Psychological Society Division of Sport and Exercise Psychology Annual Conference 2019, Birmingham, UK

Chapter 1

Introduction to the Thesis

1.0 Introduction

There is now compelling evidence that regular engagement in physical exercise is an effective way of reducing the long-term risk of physical health conditions such as coronary heart disease, diabetes, hypertension, obesity, and some cancers (Reiner et al., 2013; Warburton & Bredin, 2017). In recent times, sedentary lifestyles have even been suggested as synonymous with the risk of hospitalization from Covid-19 (Hamer et al., 2020; Qingxian et al., 2020). Functional use of exercise can help maintain musculoskeletal health, which not only improves resistance to injury and disease, but also aids physical mobility which is crucial for the enjoyment of physical activity (Berger et al., 2010; Eime et al., 2013; Rasinaho et al., 2006; Wallace & Cumming, 2000). Even recreational participation, in sports such as football and running, show consistent improvements in cardiovascular fitness (Oja et al., 2015).

Unsurprisingly, being more physically active is also associated with better mental health. Biddle and Asare (2011) in a systematic review showed that regular physical exercise can alleviate anxiety and depression. Indeed, a meta-review by Rebar et al. (2015) extended these claims and suggested that being physically active can actually prevent the onset of depression in non-clinical populations. Studies that focused on people diagnosed with mental illness have found that patients who engaged in physical exercise regularly, often placed personal intrinsic value on participation in exercise by associating it with positive personal experiences and an improvement in their symptoms (Béland et al., 2020; Crone & Guy, 2008; Hodgson et

al., 2012). Weight loss and interestingly, improved mood and stress reduction (Firth et al., 2016) were also identified and cited as motivational factors, which suggests that personal perception of such potential benefits could be a critical factor in motivation for physical activity. This was recognised in a systematic review by Graham et al. (2016) who suggested that both psychological and physical factors impact on mood, which in turn influences quality of life indicators.

The remainder of this chapter defines physical activity within the context of the thesis, outlines existing issues surrounding the prevalence of sedentary lifestyles, identifies pitfalls in existing approaches aimed at increasing physical activity, and finally introduces a potential alternative approach focused on overcoming unhelpful personal experiences related to exercise.

1.1 Working Definitions of Physical Activity

In 2010, The World Health Organisation (WHO) published guidance on what constitutes physical activity, and how much is considered beneficial for health maintenance. The report's recommendations were grouped according to age, children being aged between 5 and 17 years, adults aged between 18 and 64, and older adults over 65 years of age. There are also recommendations for children under 5 years WHO (2019). More recently, these guidelines have been supplemented to include recommendations for pregnant women and also for people with disabilities WHO (2020). This thesis focuses on the largest age range, that of adults aged 18-64 years. Importantly, WHO (2010) identified physical activity as more than just sport and exercise, a concept that is mirrored throughout this thesis. They group physical activity into broad domains of life during which peoples' level of activity can be

evaluated. Typical daily domains such as leisure-time, occupation, travelling from place to place, household chores and cleaning as well as planned exercise activities and play with family or within the community. However, for there to be a physiological benefit from participation in physical exercise, WHO state that the activity should be of moderate or vigorous intensity. Moderate is defined as an activity that is performed between 3.0 and 5.9 times the intensity of rest. Vigorous activity is performed at 6.0 to 8.0 times the intensity of rest. Both moderate and vigorous are relative to the personal capacity of the individual, and assume an absolute scale of 0 to 10. Critically, one of the problems of such a scale is the subjective experience of physical activity, which makes it difficult for people to accurately gauge and report their activity level. Nevertheless, the definitions are necessary in order to measure long-term changes in behaviour. The levels of intensity used by WHO are therefore a simplified version of well-established empirically derived measures of exercise intensity, by for example, Ainsworth et al. (1993). The recommendations suggest that adults should aim to accumulate between 150 and 300 minutes of moderate intensity, or 75 to 150 minutes of vigorous physical activity per week. Sessions of activity should be longer than 10 minutes, and muscle strengthening activity (for example, digging in the garden, lifting and carrying loads, or weighted resistance exercises) should also be considered on two occasions per week. The combination of these activities are targeted at improving cardiovascular and muscle fitness, increased bone density, and developing increased resistance to non-communicable disease and depression (WHO, 2010). Similar overarching principles were also recommended by the UK Department of Health guidelines (2011), which reported that adults should aim to have at least 30 minutes of

moderate physical exercise on five days a week, or 75 minutes of vigorous exercise twice a week.

1.2 Costs of Inactivity

A second WHO report published in 2013, recognised the burden of non-communicable diseases worldwide. Member-states proposed voluntary global objectives for health. These included a 10% relative reduction in the prevalence of physical inactivity by 2025. More recently, a study by Guthold et al. (2018) commissioned by WHO, pooled data from 358 surveys in 168 countries, giving a sample size of 1.9 million people. It showed that globally 1 in 4 adults (over 1.4 billion people worldwide) are at increased risk from non-communicable diseases (NCD's) strongly linked to insufficient physical activity (Guthold et al., 2018). The report went on to suggest that, despite goals agreed by WHO, the trend of sedentary lifestyle was still increasing, most noticeably in high-income western countries. Consequently, in 2019 WHO revised its objectives to a 15% reduction in physical inactivity by 2030.

The increasing trend in inactivity is evident in the UK and has led to the development of government initiatives such as Health Matters (2016), which is overseen by Public Health England. They predict that in the 2030's the UK population as a whole will be 35% less active than in the 1960's. Survey results published in 2012 stated that in the UK, only 67% of men and 55% of women aged 16 and over, met the recommendations for aerobic activity (Health and Social Care Information Centre, 2014). Through extrapolating these figures it could be suggested that in 2019, of the 44 million adults aged between 16-64 in the UK, over fourteen and a half million adults (33% of the adult population) did not meet recommended levels of physical

activity (Health and Social Care Information Centre, 2020). The economic impact on health services of diseases associated with physical inactivity was reported by the National Institute for Health and Clinical Excellence (NICE). They suggested that directly associated costs to the UK National Health Service (NHS) in 2018 were in excess of 1 billion pounds; a figure which will in the current circumstances increase each year (Scarborough et al., 2011).

1.3 Barriers to Exercise

Despite the apparent health risks and burden on society, the increasing trends of physical inactivity suggests that the methods used to encourage regular exercise are still not working. From a clinical perspective for example, the disabling impact of poor mental health can offer one explanation for lack of engagement (Department of Health and Social Care, 2019; Richardson et al., 2005). One of the most significant challenges for those suffering from anxiety and depression is the thought of engaging with any physical exertion (Dishman et al., 2004; World Health Organization, 2011). People engaging with treatment for depression are encouraged to take part in regular physical exercise in order to aid their recovery and future well-being (Chalder et al., 2012). This approach is particularly useful when exercise participation is promoted in an informal group or a team-sports setting (Dore et al., 2018). Uptake however, especially on a long-term basis, is limited and many recovering from mental health problems appear to actively avoid physical activity (Glover et al., 2013; Roberts & Bailey, 2011). While low mood and stress associated with poor mental health can contribute to avoidance of exercise participation (Firth et al., 2016), lack of self-efficacy (Ashford et al., 2010) and the effects of medication (Johnstone et al., 2009;

Roberts & Bailey, 2011) have also emerged as reasons explaining lack of engagement in this sub-population.

Avoidance of exercise is not unique to people struggling with their mental health. There is a high rate of attrition within physical activity programmes for overweight adults who, consistently report exercise engagement as more physically uncomfortable, less pleasant and more difficult to engage in than adults of healthy weight (Ekkekakis & Lind, 2016). It is perhaps not surprising that the perceived discomfort associated with exercise makes the commitment to regular physical activity a potential cognitive barrier, allowing people to foster avoidant behaviours (Biddle & Mutre, 2008; Chatzisarantis et al., 2008; Hayes et al., 1999/2003; Rose & Parfitt, 2010). Functional impairment, such as restricted movement, may hinder people with obesity (Heo et al., 2010), and emotional and psychological experiences such as feeling self-conscious also play a significant role in exercise adherence (Ball et al., 2000). Pain associated with common aging processes like arthritis, especially in older adults (Austin et al., 2011), or even busy parents in sedentary employment trying to make ends meet (Rosenbaum et al., 2018) offer further explanations for levels of physical inactivity.

There are also societal inequalities that are considered contributory to the existing statistics (Public Health England, 2016). A government health survey for England published by The Health and Social Care Information Centre in 2017 concluded that nearly 60% of people in the more prosperous areas of England met moderate activity guidelines of 150 minutes per week, compared to 30% in the least prosperous areas. This suggests that with deprivation comes a lack of resources, such

as sports facilities, or disposable income. Whereas, affluent socio-economic areas have higher disposable income and more access to resources. This evidence contrasts with other groups, such as those in physically inactive employment or from areas of dense population, who are more likely to attribute their lack of exercise to barriers such as family commitments, or financial constraints (Whitall et al., 2011; Baruth et al., 2014).

Interestingly, a state of frustration often exists for people who, in spite of being aware of the risk to health while people often avoid physical activity, even though taking part corresponds in some way to the things in life that they value most (Beauvois et al., 1999; Festinger, 1957; Gawronski, 2012, Hayes et al., 1999/2003). The natural desire to resolve such dissonance suggests that education in regard to the values of being more active, and association between personal values and quality of life may offer a motivational means to overcome avoidance of exercise, rather than education into the risks of inactivity.

All of this evidences that increasing levels of inactivity are influenced by complex individual and societal factors, based on large scale economic and technological changes (Public Health England, 2016). Explaining physical inactivity, therefore, requires us to look further than individuals. Such multifaceted reasons may be understood from a biopsychosocial contextual perspective. This model suggests that biological factors (for example, age or body mass index), psychological factors (for example, the perception of health or ability), and social factors (for example, personal finances, education, social interactions) influence attitudes to exercise behaviours (Haughton-McNeil et al., 2006; Peeters et al., 2013).

1.4 Promoting Behaviour Change Concerning Exercise

The Transtheoretical Model (TTM; Prochaska et al., 1992) takes into account the bio-psycho-social influences on health-behaviour and has been the focus of a large number of published studies (Kleis et al., 2021; Spencer et al., 2006). The TTM integrates several psychological constructs, including Social Cognitive Theory, (Bandura, 1977) and Learning Theory (Skinner, 1953/2014). The TTM suggests that people transition through stages, and are influenced by their environment, which in turn influences motivation and readiness to engage with changes in health-behaviours. The model is cyclical in nature and describes five stages though with people transition. The stages are applicable to any health-behaviour change, although the following examples are specific to exercise.

- Pre-contemplation relates to a person that has no current intention to change their behaviour in relation to physical activity.
- A Contemplator is someone who is generally inactive but intends to be more active in the future.
- When a person is in the Preparation stage, they are somewhat active but realise that their level of activity is insufficient
- In the Action stage, a person exercises sufficiently
- The Maintenance stage is considered for people who have been in the Action stage for an extended period of time.

The stages of change are influenced by cognitive processes such as self-efficacy and decisional balance. Self-efficacy is described by Bandura (1977) as a person's belief in their ability. Decisional balance describes the process of evaluation during which a person takes account of the pros and cons of behaviour change (Prochaska

et al., 1994). These processes impact not only positive behaviour change but also relapse behaviour, during which a person may return to either the pre-contemplation, contemplation, or preparation stages (Biddle & Mutrie, 2008). The model was first applied to behaviour associated with addiction (Prochaska et al., 1983; Prochaska et al. 2003) and the stages detailed by the TTM were quickly related to other health behaviors such as adherence to weight-loss programmes, engagement with dietary requirements, and also contraceptive usage (Ogden, 2012).

Stage-based interventions designed to increase exercise levels using the TTM have provided mixed results and some studies suggest that the Stages of Change (SOC) which make up part of the TTM may be overly simplistic because individuals often show non-sequential movement between the stages (Littell & Girvin, 2002; West, 2005). For example, a study by Spencer et al. (2006) systematically reviewed 150 studies that used stage-matched interventions designed to increase physical activity. Spencer concluded that staged interventions reported onward positive progression through the stages and in some cases increased levels of physical exercise was evident. However, when compared to control groups less than 50% of stage-matched studies reported better outcomes. Interestingly, outcomes of the reviewed studies were influenced by study population and study definitions of exercise. Spencer suggested that the TTM failed to take such differences into account and as such there was inconsistent support for the construct validity of the TTM in relation to exercise engagement. A review conducted by Adams and White (2004) suggested that although 73% of stage-based interventions were more effective than control conditions at follow-up of less than six months, this figure dropped to 29% at follow-up of six months or more. Further, a separate systematic review by Riemsma

et al. (2002) suggested that staged-based interventions for promoting adherence to regular exercise were no more effective than control conditions when measured at 12 weeks post-intervention. A more recent review by Kleis et al. (2021) explored the effectiveness of the TTM in studies designed to increase levels of physical activity. The reviewed evidence included studies conducted between 2001 and 2020. Consistent with previous review findings, Kleis reported continuing inconsistent support for the use of the transtheoretical model to promote increases in physical activity. The combination of these reviews suggest that stages-based interventions based on the TTM may be insufficient to produce long-term change in exercise behaviours. Adams and White (2004) suggest several reasons for these findings. Primarily, they argue that staged-based approaches using the TTM for physical activity promotion do not work in the longer-term because of the complex nature of motivation around physically activity. The processes which form part of the TTM such as evaluation of pros, cons and self-beliefs about, for example, cycling to and from work every day are very different from those in regard to cycling with friends during leisure time (Adams & White, 2004). Indeed, a more recent systematic review reported that self-monitoring, goal-setting and personal values are all likely to significantly influence engagement (Knittle et al., 2018). This demonstrates that engagement in physical activity is not a single type of behaviour and therefore interventions designed to improve physical activity require a multi-level approach to evaluating motivational readiness.

Development of such a multi-level approach, known as exercise consultation was described by Farnham and Mutrie (1998/2014). Designed as an intervention based on the TTM, exercise consultation used motivational interviewing techniques

to promote physical activity. Loughlan and Mutrie (1997) also used the staged-approach to target contemplators of exercise from a population of sedentary adults. They tested an exercise consultation intervention on attendance levels for exercise classes that provided participants with the opportunity to discuss their exercise history, pros and cons to changing behaviours and importantly, barriers to engagement, social-support and goal-setting. Whilst there was support for the process of exercise consultation and the stage-targeted approach to the inclusion of participants, the dropout rates over time remained high. Further development of exercise consultation by Hasler et al. (2000) used exercise consultation to achieve short-term increases in exercise rates for a clinical population with type 1 diabetes. Later, similar success was detailed for people with type II diabetes in a review by Kirk et al. (2007) which identified the use of both the stages of change and motivational interviewing techniques in the delivery of exercise consultation. Interventionists reported that barriers to engagement identified during the intervention included physical discomfort and feeling self-conscious. Although dropout remained an issue, Kirk et al. suggested that up to 69% of intervention participants remained physically active at extended follow-up intervals of up to two years.

The Motivational Interviewing (MI) techniques (Rollnick et al., 2008) used in exercise consultation by for example Loughlin and Mutrie (1997) are person-centered and based on the TTM. Motivational Interviewing has been used independently in healthcare settings where avoidance of physical exercise is likely. Bachmann et al. (2018) for example suggest focusing support on developing self-efficacy and motivation is vital in increasing adherence to prescribed exercise programmes for people recovering from painful surgery. Studies highlight that where such

interventions show possible benefits, then there is a need for further development of these approaches to promote active lifestyles in other clinical as well as the general population (Bize et al., 2007; Blair, 2009; Castelnuovo et al., 2014; Ogilvie et al., 2007; Van Sliujs et al., 2007). Others suggest that although such behaviour change methods show some favorable results, there remains the need for further research to understand the long-term effects (Greaves et al., 2011). For example, MI techniques can be used to help people make effective decisions about taking more exercise (Samdal et al., 2017). However, a brief MI intervention is a person-centered and staged approach designed to broker short-term decision making based on an individual's values and reported effect sizes on the long-term increases in physical activity levels are often small (O'Halloran et al., 2014; Rollnick et al., 2008). As a consequence if behaviour relapses as a result for example of environmental or social changes, the general criticism of interventions using the TTM would suggest that MI alone might lack the contextual flexibility to help promote long-term lifestyle change (Adams & White, 2004; Spencer et al., 2006; Knittle et al., 2018).

Other person-centered approaches such as Cognitive Behavioural Therapy (CBT), help to address this issue by providing a more comprehensive and structured framework in which an individual may identify and challenge unhelpful personal thoughts and feelings (Söderlund et al., 2009). However, like MI, CBT is most often administered as part of a package of treatment for existing chronic health issues such as depression (Bernard et al., 2018). As such, there is a need for further development of a cost-effective method to encourage long-term engagement and subsequent adherence to physical activity by helping people to overcome personal psychological barriers, such as discomfort, low self-efficacy and their resultant avoidant

behaviours.

Acceptance and Commitment Therapy (ACT) is a person-centered approach to promoting behaviour change (Hayes et al., 1999/2003). ACT is also branded as one of the newer "third wave" approaches to psychological therapy (Hayes, 2004/2016). ACT assumes that negative or unpleasant feelings are part of human life. As such, we are susceptible to entrenched, inflexible behaviour patterns based on experiential avoidance; attempting to avoid personal psychological events (private-events) that we find unpleasant. It is suggested that ACT is perhaps less directive than classical forms of CBT or MI (Bricker & Tollison, 2011; McLeod, 2009). However, there are several conceptual overlaps that are apparent between MI and contextual behavioural therapies such as ACT (Ehman & Gross, 2019; Wagner et al., 2012). Similarly, CBT, ACT and MI recognise that people become stuck in unhelpful patterns of behaviour and adopts a client centered unconditional empathic stance to help clients explore and implement behaviour change towards a more fulfilling life based on values. However, in MI therapists identify statements offered by the client about their desire, ability or benefits of behaviour change, whereas in ACT clients are empowered by learning meta-cognitive skills that enable them to change their relationship with their personal experiences. Some forms of CBT might do this using a positive coping strategy, thought challenging or distraction technique rather than encouraging a person to change their relationship with the contents of thoughts (Ruiz, 2010). Through ACT, people interact with thoughts and behaviours by shifting their perspective to adapt to contextual life situations in a way that aligns with their personal-values (Kashdan & Rottenburg, 2010). A measure of how well an individual can achieve this is defined as their degree of psychological flexibility (Bond et al.,

2006). The ACT model errs away from the self-efficacy, pros and cons processes in the stage-based interventions and instead provides the skills, learned by ACT clients, that tackle the contextual influences that cause relapse from physically active to a contemplation or pre-contemplation (Bricker & Tollison 2011). ACT shares some overlap with the literature detailing the use of stage-based behaviour change constructs for exercise promotion such as exercise consultation. However, the founders of ACT suggest that this contextually driven approach provides an opportunity for long-term behaviour change (Hayes et al., 2004), it is therefore plausible that ACT may possibly improve long-term and consistent outcomes for exercise promotion compared to that of the stage-based exercise promotion interventions noted in the literature (Adams & White, 2004; Kleis et al., 2021; Knittle et al., 2018; Spencer et al., 2006).

1.5 Overview of Acceptance and Commitment Therapy

From a philosophical standpoint, ACT is based on Functional Contextualism (Biglan & Hayes, 1996), a framework which has, in behavioural terms, prediction and influence as a scientific goal. This pragmatic approach attempts to identify variables that may be used to predict and subsequently influence behaviour (Zettle et al., 2016) based on the idea that psychological events (sometimes called private-events) are both functionally and contextually specific to the individual because our behaviours are related to our experiences. Observing these events and understanding their relationships with behaviours provides the individual the opportunity to explore change. Thus, rather than challenge, reduce or reject thoughts or emotions ACT

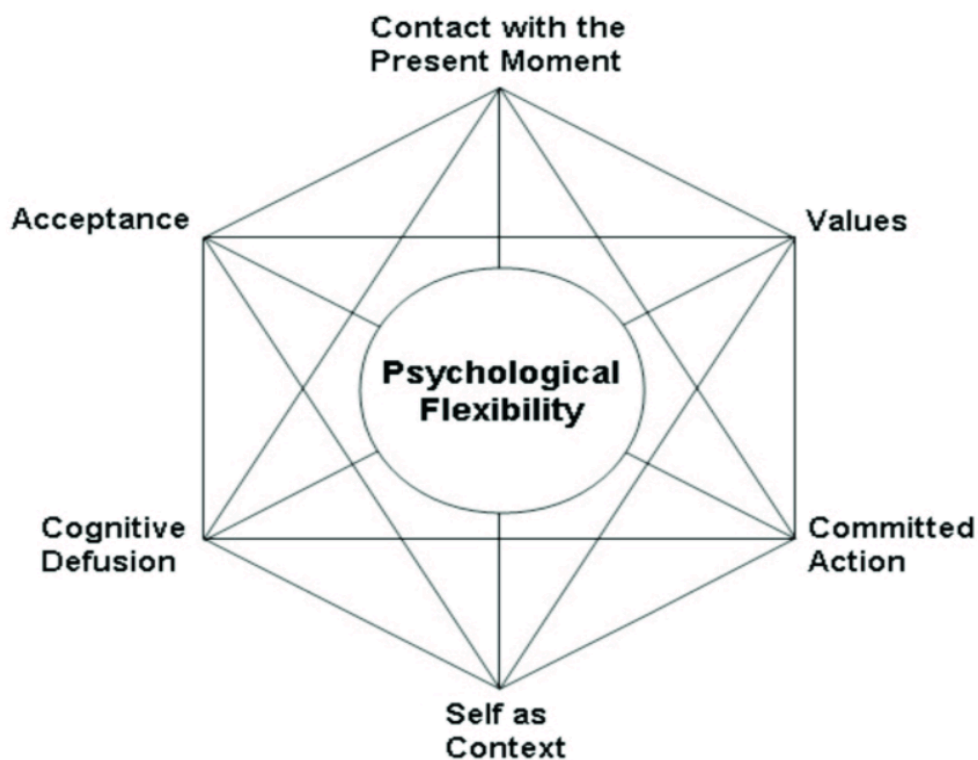
attempts to reduce their intensity and thus their impact.

From a theoretical perspective, ACT can be understood through *Relational Frame Theory* ([RFT]; Blackledge, 2003; Hayes et al., 2001). Both ACT and RFT were based on Skinner's theories of rule-governed behaviours that stem from the relations made between our learned experiences and their consequences (Hayes et al., 1999/2003). RFT describes how from an early age language development occurs in tandem with contextual cues to form two-way relationships known as stimulus equivalence. It is the process that allows us to learn a two-way relationship between, for example, the word ball and an actual ball, which are abstractly equivalent. This relational frame of correspondence is the process that enables us to see an object and derive the equivalent word. This concept can be applied abstractly to a third concept, for example, the experience of playing football, which can then act arbitrarily as a contextual cue. Thus the word football acts as a stimulus function with a response (deriving a relationship between the football the object and the experience of playing football) even though the word football was not learned in the context of the experience of playing football. Our unique human ability to derive arbitrary relations with stimuli (contextual cues) to create relational frames via language serves to form stimulus functions which influence behaviour in a process called relational responding (Torrence et al., 2008). Transformation of stimulus function occurs when other words become arbitrarily equivalent. For example, the word silly is learned as also meaning stupid or an idiot or inferior. In this instance, someone may derive arbitrary equivalence between having a recurring thought of "I am silly, and so I am an idiot". The stimulus function in this case, might be the urge to behave in a way as to avoid being silly. Thus if we hear the term "he is an idiot" in

an unrelated context, for example to describe a jogger running down the street, it allows transformation of stimulus function. In transformation, we create an arbitrary relation between the unrelated contextual cue and "being an idiot". Once again the stimulus function is the urge for avoidant behaviour, experienced as a private-event, even though we have no direct exposure to the experience of being a jogger. Thus we can form complex networks of relational frames which can have a tremendous impact on our beliefs and behaviours (Torneke, 2010).

In practice, ACT is often explained in what its' founders call 'mid-level' terms (Hayes, Strosahl, & Wilson, 2012). These terms describe the processes involved in their application. There are six core ACT processes; acceptance, personal values, defusion, mindfulness, self-as-context and committed action. Although described in ACT literature as individual processes they occur in an interdependent and overlapping relationship which, when applied, are designed to increase psychological flexibility and promote behaviours in keeping with fundamental personal values (Hayes, Strosahl, & Wilson, 2012).

The six processes are presented pictorially (see Figure 1.1) in what Harris (2019) describes as an ACT model of psychopathology, which pictorially represents the interrelated overlapping nature of the processes all of which impact on ACT's central premise, psychological flexibility. The following sections explain each of the processes according to the ACT literature.

Figure 1.1*The Psychological Flexibility Model*

Note: Model as depicted by Harris, 2019; Hayes, Strosahl, & Wilson, 1999/2003).

1.5.1 The Six Core Processes of ACT

1.5.1.1 Acceptance

Acceptance is the willingness to become aware of painful thoughts and in having this awareness, subsequently making allowance for them (Hayes, Pistorello, & Levin, 2012). ACT therapists sometimes call this making room for uncomfortable private-events (Harris, 2019). For example, a person struggling with avoidance of social situations (for example attending a gym) may be encouraged to observe how struggling with avoidance can be futile and letting go of fears can bring a sense of

perspective. In ACT the promotion of acceptance is often aligned with other processes (for example, present moment awareness and defusion) to promote mindful observance of thoughts and experiences. For this process, acceptance is presented to the client as the inverse of avoidance and is sometimes seen as a precursor to increased psychological flexibility (Hayes et al., 2012).

1.5.1.2 Contact with the Present Moment (Mindfulness)

Those engaged in ACT are encouraged to generate an awareness of the present moment and view this as a stream of experiences, influenced by psychological and contextual private-events (Harris, 2009). This contact with the present moment, sometimes called self-as-process, is the observation of the continual stream of interacting thoughts, emotions and perceived experiences (Hayes et al., 2012).

1.5.1.3 Cognitive Defusion

Defusion can be described as the process of looking *at* thoughts rather than *from* thoughts (Harris, 2009). It is also described as the process of holding thoughts lightly, noticing how they come and go (Hayes, 2004). Combined with present-moment awareness, it is the process through which, a person can become conscious of the nature of their thoughts in direct relation to private-events (Hayes et al., 2012). The process of defusion permits observation of thoughts from an external point of view. For example, one might feel tired while running and think of stopping, defusion, in this case, is the observation of the thought to stop in relation to the discomfort associated with sweating. In theory, defusion provides the opportunity to behave in

a chosen way, rather than blindly reacting to the private-event.

Luciano et al. (2011) used scripted defusion-based interventions aimed at alleviating compulsive avoidant behaviours in adolescents. The intervention scripts were manipulated to be sequentially more inclusive of ACT processes. The study compared the efficacy of three interventions, the first which consisted of a defusion protocol focusing on the deictic arrangement of noticing thoughts and subsequent behaviour. What the authors describe as "I – HERE, THOUGHT - THERE". The second protocol extended this arrangement by also including hierarchical relations. These were statements that encouraged participants to derive a sense of "I AM - MORE THAN - MY THOUGHTS". This it could be argued, is producing a sense of context about the nature of thoughts and so is an extension of defusion, known in ACT as self-as-context (Harris 2019). This arrangement was further empowered in the third protocol by including statements acting as appetitive cues aimed at encouraging alternative behaviours based on personal values. The authors called this third arrangement Defusion II. Complex in nature, defusion II included aspects of self-as context, personal values and defusion. These three ACT processes are a key focus of this thesis and so to reduce the chance for misunderstanding the development of defusion II is explored in more detail in chapter 3.

1.5.1.4 Self-as-Context

Within ACT there is also the position of self and what is termed self-as-context (Hayes et al., 2012). ACT promotes self-as-context by incorporating mindfulness exercises, the use of metaphors, and the experiential processes of acceptance and defusion. In essence, self-as-context is the quiet thoughtless observing. In contrast to

defusion which is the process of noticing thoughts and resulting behaviours, self-as context is observing that process (Harris, 2019).

1.5.1.5 Values

ACT maintains that living a life incongruent to our most fundamental personal values is a direct route to human suffering (Hayes et al., 1999/2003). As such, a principal aim of ACT is to increase psychological flexibility with the express purpose of undermining thoughts and behaviours incompatible with leading a valued existence (Hayes, 2004). Values themselves are abstract concepts, qualities that offer purposeful life direction. Living life according to ones' values offers the potential for meaningful experiences, and so it is suggested that in essence values have the potential to motivate behaviours (Rollnik et al., 2008). Some name the application of values as motivational elements of ACT interventions as appetitive augmenters (Gil-Luciano et al., 2016; Siera et al., 2016). For this, individuals become aware of ongoing behaviours via processes of defusion and self-as context. A change in the function of private-events is then possible because of the appetitive effect of having a choice of alternative functions based on valued actions (Hayes, 2004; Kissi et al., 2017).

1.5.1.6 Committed Action

Committed action aims to translate the processes of defusion, self-as-context and values into meaningful action by developing increasing patterns of values-based action (Hayes et al., 2012). Committed action involves the willingness to experience, identify and observe ongoing private-events and engaging in ever increasing amounts

of chosen alternative actions, guided by the motivation of valued actions (Harris 2019). ACT shares methods adopted by other behaviour therapies such as homework in CBT (Bricker & Tilloson, 2011). The aim of this is for individuals to practice mindfully using skills learned such as acceptance, defusion within the context of everyday life. This means that when situations arise as a priority for change, people can choose a value to pursue that is contextually related and take meaningful action guided by their values (Harris 2019).

1.6 Statement of the Problem

There is a growing evidence base for successful long-term outcomes resulting from ACT interventions (González-Menéndez et al., 2014; Bach et al., 2012). Clinical effectiveness of ACT for chronic pain is well established (Feliu-Soler et al., 2018). A systematic review by Hann and McCracken (2014) concerning physical discomfort showed that defusion and "self-related" processes, were especially useful in terms of improved social functioning which is described by Franklin and Tate (2008) as a vital determinant of a healthy lifestyle. Studies also displayed significant reductions in the perceived intensity of pain and its ability to interfere negatively with intended behaviour (Veehof et al., 2016). A meta-analysis conducted by Hughes et al. (2017) however, found that effect sizes for such improvements were small. Nevertheless, the discomfort experienced during exercise by an adult who is overweight (Ekkekakis & Lind, 2006) is different from pain associated with being physically active whilst suffering from arthritis, and both are considered a psychological barrier to physical activity (Austin et al., 2012; Biddle & Mutrie, 2008). As such, ACT approaches have provided some empirical success when targeted on the psychological discomfort

associated with weight loss (Forman et al., 2015; Lillis & Kendra, 2014; Tapper et al., 2009) and also in relation to increasing levels of physical activity (Butryn et al., 2011; Moffitt & Mohr, 2014).

A study by Ivanova et al. (2015) found that participants increased their exercise duration after exposure to an intervention that included a combination of ACT and listening to music. By contrast, studies using defusion and values-based motivation protocols to explore discomfort induced by immersion of a hand into cold water reported increased tolerance to physical discomfort (Gil-Luciano et al., 2016; Sierra et al., 2016). These studies suggest that the perception of physical discomfort experienced during, for example, exercise (Ivanova et al., 2015) may be influenced by individual ACT processes. However, these studies do not make it possible to ascertain whether the effects were a function of just one or the interaction of ACT processes. Additionally, there have there been no empirical studies exploring which of the ACT processes hold the most potential to most influence behaviour during physical activity.

There are few empirical studies exploring the use of ACT directly to promote increases in physical exercise within the general population and no studies investigate increasing physical activity behaviour using a purely defusion and values intervention strategy. The processes involved in defusion II appear to be useful for changing behaviours related to uncomfortable private-events and because defusion II utilizes only a small part of the ACT model it may be possible to use defusion and values as a behaviour change strategy that is potentially less demanding on resources than methods using the whole of the ACT model. Further, the increasing trend in sedentary lifestyle reported by The World Health Organisation (2013, 2019) suggests

that existing means of changing physical activity behaviours require improvement. There is therefore a continued demand for simple, cost-effective behaviour change strategies that can be adapted to both clinical and nonclinical populations in order to successfully encourage uptake and promote sustained engagement in increased levels of physical exercise. Further, in light of the relationship between ACT and discomfort (Hann & McCracken, 2014; Invanova et al., 2015; Veehof et al., 2016) and also the aforementioned development of defusion and values-based protocols focusing on both physical and psychological discomfort (Foody et al., 2013; Foody et al., 2014; Luciano et al., 2011; Gil-Luciano et al., 2016; Sierra et al., 2016) there is a need to better understand the relationship between physical activity and the processes used in ACT.

This thesis proposed two phases of work in response to this problem. The first phase included two exploratory studies, the first of which systematically reviewed the literature on ACT interventions to promote increases in physical activity among sedentary populations. The second study surveyed existing levels of physical activity and the relation to individual ACT processes for a non-clinical population. Conclusions drawn from these exploratory studies then informed the second phase of the programme of work which included a series of controlled empirical experiments designed to investigate ACT processes in relation to exercise-induced discomfort. Outcomes were expected to contribute to future intervention design.

1.7 Aims of this Thesis

The aims of the thesis are:

1. To explore practical and theoretical understanding of ACT process for behaviour change in relation to increasing levels of physical activity.
2. To develop and model interventions empirically in order to establish an evidence base for efficient and effective intervention content, that are less demanding on resources such as therapist or client time.

1.8 Overview of the Research in Phase One

1.8.1 Systematic Review and Narrative Synthesis of the Literature

A systematic review (see Chapter 2) that evaluated the efficacy of ACT to increase physical activity in sedentary populations is presented in chapter 2. The review details a comprehensive search and systematic inclusion of peer-reviewed literature. The purpose of the review was to evaluate and where possible to synthesise evidence from empirical research that used ACT with the intention to increase physical activity in populations at risk of sedentary lifestyle or factors associated with sedentary behaviour, when the principle target outcome was engagement in physical activity/exercise. The primary aim was to address the review question: How does the literature describe the use of ACT, when applied to populations at risk of sedentary behaviour, encourage increases in physical activity. The review presents an exploration of the existing literature followed by a narrative synthesis of the gathered evidence in order to identify limitations in the evidence that inform the starting point for this thesis. The review objectives were:

1. To systematically identify and evaluate the nature and quality of the existing empirical evidence concerning the theory and practice of ACT to promote engagement with physical activity.
2. To highlight gaps in the literature and so provide a premiss for the programme of work contained thereafter within this thesis.

1.8.2 A Survey of Levels of Physical Activity in Relation to ACT Process Scores

A survey, the focus of chapter 3, was conducted to investigate if specific ACT processes were predictive of levels of activity. The survey was developed to gather information from a broad and representative sample, so much as is possible within the limits of the time and resources available. The nature and amount of participant physical activity was compared with participant scores on ACT process measures of avoidance, cognitive fusion, values, committed action, present moment awareness and self-as-context, in order to help identify associations between the psychological processes of ACT and exercise rates. The study hypothesised that ACT process scores indicative of greater psychological flexibility would be predictive of higher levels of physical activity. Survey objective was therefore to identify ACT processes likely to have the greatest potential to influence physical activity behaviours.

1.9 Overview of the Research in Phase Two

Informed by the systematic review and the survey study, a series of empirical lab-based studies addressed the thesis aims and objectives and are presented in the subsequent chapters (See chapters 4, 5 & 6). Principally, findings from this first phase of the programme of work suggested that gaps lay in understanding the impact of

each ACT component and reflected the need to understand how the processes were integrated into interventions. Additionally, there was little reference to how RFT impacted on the outcomes or how the intervention content was framed. Secondly, the survey highlighted that defusion and values showed potential to have a significant impact on outcomes. Defusion II, which takes an RFT approach to intervention design utilizing defusion and values-based cues was therefore used as the focus of the remaining empirical study in this thesis. Defusion II can be thought of as having three distinct focuses. Firstly, it aims to teach defusion techniques using deictic relations, secondly, by using hierarchical relations in relation to defusion techniques it promotes self-as-context. Finally, it encourages changes in ongoing behaviour based on value-orientated cues. In order to explore these concepts systematically, a series of three controlled laboratory-based empirical studies were designed.

1.9.1 Empirical Study 1

The first empirical study is reported in chapter 4. The study was designed, in RFT terms, to test a brief defusion intervention using hierarchical relations and explore the effects on the duration of exercise engagement and perception of exercise related discomfort. The study also tested differences in the effectiveness of training in defusion when participants were exposed to multiple exemplar training that included either a contextually specific physical experiential or mental visualisation element. This randomised repeated measures study, measured duration of exercise engagement and also the perception of discomfort when defusion

protocols were compared to controls. Specific predictions for the first empirical study were:

1. People exposed to defusion training would exercise for longer and experience less discomfort post-intervention than controls.
2. People exposed to defusion training that included physical experiences, would exercise longer and perceive less discomfort than those exposed to teaching that included imagined physical experiences.

1.9.2 Empirical Study 2

The second empirical study combined defusion, self-as-context and values. This was a partial replication of work published by Gil-Luciano et al. (2016) that employed what is known as defusion II (as introduced in section 1.5.1.3 of this chapter). The defusion and values-based protocols focused on both the deictic and hierarchical relations used to present scripted training before exposure to aversive stimuli. In Gil-Luciano's study participants were exposed to physical pain, by submerging their hand into cold water followed by an aversive film containing images of surgical procedures. They aimed to measure tolerance of the aversive stimuli in conjunction with multiple exemplar training when framing ongoing personal experiences through different relational frames, Specifically, either using deictically framed defusion or hierarchical relations containing defusion, self-as-context and a values-based behavioural cue. The study conducted in chapter 5 of this thesis investigated the effects of multiple exemplar training, comparing framing ongoing personal experiences through the ACT processes similar in description to those use by Gil-Luciano et al. (2016). Participants were exposed to two types of physical discomfort; firstly, placing their hand in cold

water and then engaging in an exercise task. It was predicted that this partial replication would provide comparable outcomes for the cold pressor task reported by Gil-Luciano et al. (2016) and by contrast provide some substance for the outcomes of our exercise task.

Specific predictions for the second empirical study were:

1. There would be a difference in exercise duration and also the perception of discomfort between participants exposed to a defusion protocol compared to controls.
2. There would be a difference in duration for which participants would leave their hand submerged in cold water, and also the perception of discomfort, between participants exposed to defusion compared to controls.
3. There would be a difference in exercise duration and also the perception of discomfort for participants exposed to a defusion plus a values-based protocol compared to controls and also compared to participants exposed only to a defusion protocol.
4. There would be a difference in duration for which participants would leave their hand submerged in cold water and also the perception of discomfort for participants exposed to defusion plus a values-based protocol than controls and also compared to participant exposed to only a defusion protocol.

1.9.3 Empirical Study 3

The third empirical study reported in chapter 6 concluded the empirical investigation. For this the focus shifted from the multiple ACT processes to one concentrating directly on clarification of personal values in relation to discomfort.

Sierra et al. (2016) investigated the role of values-based stimuli they termed *appetitive functions* within a commonly used ACT tool, the Swamp Metaphor (Hayes et al., 1999/2003; Gutierrez et al., 2004). The metaphor was scripted and participants exposed to one of four conditions, including a control. The independent variables, statements within the metaphor, had the presence or absence of common physical properties with a cold compressor task and the presence or absence of augmental functions to pain tolerance (Sierra et al., 2016). Results showed that participants exposed to a metaphor containing both common physical properties and appetitive augmental functions had statistically significant greater change scores. There was no statistically significant difference between the change scores of those exposed to only common physical properties and those exposed to only augmental functions. All had significantly higher increases than controls.

The final study presented in this thesis expands on the outcomes of work detailed in chapters 4 and 5, and also the work by Sierra et al. (2016). The swamp metaphor, was adapted to describe contextually similar physical properties to an exercise task. The aim was to test the effect of the value-orientated cues when participants were either trained to explore their personal-values in direct relation to physical activity or provided the generic values presented in the swamp metaphor. Specifically, the final study compared results of exercise duration and perception of discomfort pre-post intervention and the presence or absence of a combination of both deictic and hierarchically framed values-based augmental cues to overcome private-events. Specific predictions for the third empirical study were:

1. There would be a difference in exercise duration and perception of discomfort for participants receiving either of the swamp metaphor protocols compared to controls.
2. There would be a difference in exercise duration and perception of discomfort for participants receiving the swamp metaphor containing a generic values protocol compared to those receiving the swamp metaphor with personally derived values protocol.

1.10 Introduction Summary

To summarise, this thesis aims to systematically test which combination of defusion and values is likely to be best suited for incorporation into intervention protocols designed to promote increased engagement with physical activity by focusing on the mitigation of private-events experienced during physical exercise. This thesis will contribute to the existing literature by providing a better understanding of the role that ACT processes of defusion and values play concerning exercise discomfort. Moreover, there will be a critical evaluation as to the importance of how the relational framing of interventions involving defusion and values-based protocols are both developed and delivered.

Phase 1
Chapter 2

Acceptance and Commitment Based Approaches for the Promotion of Physical

Activity: A Systematic Review and Narrative Synthesis of the Literature

2.1 Introduction

In spite of the widely accepted benefits of regular physical exercise, most people fail to meet the recommended levels set out in international guidelines (World Health Organisation, 2015). The UK Department of Health and Social Care (2019) suggest that adults should aim to have at least 30 minutes of moderate physical exercise on five days per week, or alternatively 75 minutes of vigorous exercise twice per week. Whilst the trend in the uptake of physical exercise appears to be increasing in developed countries, it is widely acknowledged that lifestyles lacking in physical activity contribute to the risk of mortality on a global level (Health and Social Care Information Centre, 2014; The World Health Organisation, 2015).

The need for effective interventions designed to promote behavioural change around active lifestyles has been highlighted by studies of both clinical (Austin et al., 2011; Castelnovo et al., 2014; Glover et al., 2013; Heo et al., 2010; Van Sliujs, et al., 2007) and general populations (Baruth et al., 2014; Whittall et al., 2011). Physical exercise uptake is limited in, for example, people recovering from mental health problems (Ashford et al., 2010; Johnstone et al., 2009; Richardson et al., 2005; Roberts & Bailey, 2011). However, people who engaged in regular prescribed exercise intervention programmes appeared to place personal and intrinsic value on their activity and associated physical exercise with positive personal experiences (Béland

et al., 2020; Crone & Guy, 2008; Hodgson et al., 2012). Within the general non-clinical population such intervention strategies are not typically available. However, the instances of sedentary lifestyle continue to rise (Public Health England 2016), thus increasing the likelihood of the possible need for clinical intervention in the long-term (Social Care Information Centre, 2014). This in turn contributes to the health service costs which in 2018 were estimated in excess of 1 billion pounds (Scarborough et al., 2011).

One possible explanation for why some physically able people avoid physical exertion is the potential to associate physical exercise with a degree of discomfort. In turn there is a tendency to foster avoidant behaviours and establish beliefs about exercise that may not correspond to a persons' true values (Chatzisarantis et al., 2008; Hayes et al., 1999/2003; Hayes 2004; Rose & Parfitt, 2010). There is evidence to suggest established clinical methods of behaviour change such as traditional Cognitive Behaviour Therapy (CBT) or Motivational Interviewing provide support for people struggling to overcome unhelpful patterns of behaviour in such circumstances (Bricker & Tilloson, 2011; Rollnick et al., 2008). However, the consensus of opinion appears to reflect the need for more research using alternative brief intervention frameworks for use in non-clinical settings (Bricker & Tilloson, 2011; Greaves et al., 2011; McLeod, 2009; Ruiz, 2010; VanBuskirk et al., 2014).

Acceptance and Commitment Therapy (ACT) is an established method for promoting behaviour change (Hayes et al., 1999/2003). A key assumption of ACT is that people have a tendency to develop inflexible patterns of avoidant and unhelpful behaviours due to the occurrence of thoughts and emotions that arise as a result of

their learning histories. ACT seeks to increase psychological flexibility and promote a lifestyle more aligned with an individual's personal values (Hayes, Strosahl, & Wilson, 2012). There is a growing evidence-base of successful long-term outcomes resulting from ACT-based interventions for clinical populations such as the reduction of symptoms associated with drug rehabilitation and also with the adoption of positive coping behaviours associated with mental health issues (see, for example, Bach et al., 2012; González-Menéndez et al., 2014). Studies have also provided empirical evidence supporting the use of ACT in relation to unhelpful avoidant behaviour resulting from, for example the psychological discomfort associated with weight loss (Forman et al., 2009; Lillis & Kendra, 2014). Whilst these studies incorporate both ACT and physical exercise as part of weight reduction programmes they do not report levels of physical activity as a primary outcome of the ACT intervention. However, given the apparent usefulness of ACT-based techniques in targeting psychological inflexibility associated with lifestyle changes needed for weight loss, it is surprising that few studies have explored the direct use of ACT-based techniques to promote physical exercise within other populations.

The nature of behaviour-change interventions for increasing levels of physical activity is undeniably complex. Credible exploration and establishment of sound evidence-based development should in the first instance focus on systematic identification of existing empirical understanding (Craig et al., 2013). In light of this the present chapter aimed to explore the evidence from empirical research that tested potential intervention strategies. The purpose of this work was to gain understanding of not only the extent of the current empirical work but also the extent of any uncertainty in relation to ACT facilitated increases in physical activity

(Petticrew & Roberts, 2006). Mindful of guidance on both the requirements of intervention development and also on conducting literature reviews in health related research, the purpose of the review was to explore the background literature to identify weaknesses and gaps in the research by exploring the extent of the literature in order to justify further research (Craig et al., 2013; Hart, 1998; Levey & Ellis, 2006; Paré et al., 2015; Sylvester et al., 2013). To achieve this, the review systematically constructed and implemented wide ranging and specific literature searches, identified appropriate studies, assessed study quality and formulated a synthesis of the findings (Petticrew & Roberts, 2006).

2.1.1 Aims and Objectives of the Literature Review

This aim of this investigation was to systematically review the available empirical research on interventions using Acceptance and Commitment Therapy (ACT) when the principle target outcome is promoting increased engagement in physical activity/exercise. The objectives were:

1. Evaluate the nature and quality of the existing empirical evidence concerning the theory and practice of ACT to promote increases in physical activity.
2. To identify gaps and weaknesses in the literature and so provide a premise for the programme of work for the thesis.

2.2 Methods

The framework for the evaluation and synthesis of the available literature was based principally on the Preferred Reporting Items for Systematic Review and Meta-

Analysis (PRISMA) guidance, published by The PRISMA Group (Moher et al., 2009). More specific guidance for undertaking systematic reviews in healthcare was sourced from the Centre for Research and Dissemination (CRD, 2008). Further instruction with regard to conducting narrative synthesis of such reviews was drawn from Popay et al. (2006), and also from the guidance detailed by Petticrew and Roberts (2006).

2.2.1 Search Strategy

University of Chester library online resources were used to carry out informal scoping searches of peer-reviewed literature. Search terms for these were: Acceptance and Commitment Therapy AND Physical Activity OR Exercise. Studies were retrieved when the Title or Abstract indicated the use of ACT as a means of promoting increased levels of physical activity. Results of the scoping searches revealed few empirical studies, this informed the development of the formal search criteria used in the systematic search. In line with Petticrew and Roberts (2006) search strings were developed that allowed for a high level of inclusivity specific to the subject.

The systematic searches included consideration of the two main topics, that of Acceptance and Commitment Therapy and also physical activity. ACT involves six core processes (see Chapter 1 for an overview of ACT) each of which are identified in the Psychological Flexibility Model (Bond et al., 2006; Harris, 2019; Hayes et al., 1999/2003). The processes are referenced across ACT literature and therefore offer consistent terminology for use as search terms for ACT-based studies. However, in the interest of making the searches as inclusive as possible the term for the ACT process of “present moment awareness” was omitted from our searches. Instead, a

more inclusive term of “mindfulness” which was used in its place. Broader terms relating to ACT include those of its theoretical underpinning, Relational Frame Theory ([RFT]; Blackledge, 2003; Hayes et al., 2001), and also ACT’s position within therapeutic literature where it is grouped as a ‘third-wave-therapy’. Physical activity is hugely varied in nature, and so it was necessary to use more general than specific terms to ensure a high level of inclusivity. The search terms for both ACT and physical activity were identified during three rounds of discussion between the reviewers, during which time potential terms were evaluated against the review objectives. The final list of search terms are detailed in Table 2.1 using a structure adapted from methods suggested by Petticrew and Roberts (2006).

Table 2.1

Search Terms and Sources of Literature

Terms relating to ACT	ACT Acceptance and Commitment Therapy Commitment Cognitive Defusion Mindfulness RFT Relational Frame Theory Personal Values Self as Context Third Wave
Terms relating to physical activity	Physical Activity Exercise Sport
Electronic databases	CINHAL Cochrane Library Medline PsycINFO Psychology and Behavioural Sciences Collection
Hand searches	Association for Contextual Behavioural Science Journal of Contextual Behavioural Science Research Gate

Electronic databases relevant to healthcare and social sciences were identified using EBSCOhost platform. Databases included PsycINFO, CINHAL, MEDLINE, Psychology and Behavioural Sciences Collection (PBSC) and Cochrane Database of Systematic Reviews.

The search terms were ANY of the 'Terms Relating to ACT' AND 'Physical Activity' OR 'Exercise' OR 'Sport'. Each search term was incorporated into a coded search string specific to each database. Medical Subject Headings (MeSH) or similar terms particular to each database, were incorporated into the code where possible to ensure a high level of inclusivity for the searches. A complete list of search strings is provided in Appendix 1. The searches were limited where possible to those subject to peer review, published in English language and published between 1984 and the time when the searches took place in April 2015. A hand search of the Journal of Contextual Behavioral Science was carried out and the Association of Contextual Behavioral Science (ACBS) website database was also used to search for grey literature that may have been missed in the database searches. Additionally, requests for available unpublished or ongoing work were posted on the ACBS web-based forum for Sports, Health and Human Performance. A similar request was also made to the wider research community using Research Gate. A list of sources of literature is included in Table 2.1 The titles and abstracts of all the located studies were collated using EndNote X6.

2.2.2 Study Selection Strategy

Standardised inclusion criteria were developed in order to control for potential selection bias and increase specificity based around the focus of the review (Centre for Reviews and Dissemination [CRD], 2008). The inclusion criteria are listed in Table 2.2

Electronic and manual de-duplication was applied to the identified literature. This was then placed into a single Endnote file. Empty sub-files were created within Endnote into which reviewers could segregate included and excluded literature. A copy of the entire file was then distributed separately to two reviewers (myself and an independent reviewer).

Table 2.2

Inclusion Criteria Applied By Independent Reviewers

List one

The paper claims to be describing the use of Acceptance and Commitment Therapy

The paper claims to be describing the use of Acceptance and Commitment Based Approaches

The paper cites key ACT literature e.g. the work of Stephen Hayes, Kelly Wilson or Kirk Strosahl

The paper claims to be describing the use of any one or more of the 6 core components of ACT (Cognitive Defusion; Acceptance; Being Present; Self as Context; Personal Values; Committed Action)

List two

The target behavioural change outcome of the study is physical/sporting activity or exercise of non-athletes.

Note: A paper was included IF, the paper met at least one criteria from list one AND at least one of the criteria from list two.

Screening took place in two rounds. For the first round, each reviewer worked independently from the other and applied the inclusion criteria (detailed in Table 2.2) to the title and abstracts. Once this process was complete, reviewers compared their findings and de-duplicated their results. In cases where there was disagreement, the

paper was carried forward to the second round. The second round involved the retrieval and screening of full texts of all studies not excluded during the first round. Once again, the reviewers worked independently, each applying the inclusion criteria to the full paper. The reference lists of articles included in the full paper screening process were also scrutinised by comparing titles of referenced articles against the inclusion criteria. Disagreements and studies which reviewers remained unsure of, were scrutinised by a third intermediary reviewer, a consensus reached by vote and the details recorded.

2.2.3 Quality Assessment Strategy

The guidance literature (Centre for Reviews and Dissemination, 2008; Higgins & Green, 2011; Petticrew & Roberts, 2006) was used to identify three potential quality assessment tools. The first of these, Downs and Black (D&B) is a 27 item assessment for use with either randomised and non-randomised studies. This tool showed good levels of test-retest ($r = .88$) and inter-rater ($r = .75$) reliability (Downs & Black, 1998). The second of three potential tools was the Newcastle-Ottawa Scale (NOS) by Wells et al. (2000). This eight-item scale has been developed for use with cohort studies. Although the NOS is cited in guidance literature, for example Petticrew and Roberts (2006) information on its initial development is scarce. Independent evaluation of this scale suggested that both inter-rater and test-retest reliability was highly variable (Hartling et al., 2013) Indeed, both the Downs and Black and NOS were compared directly in a study by Hootman et al. (2011) who suggested that both scales displayed inconsistent inter-rater reliability. The third potential quality rating tool was developed by Thomas et al. (2004) for the Effective Public

Health Practice Project (EPHPP). The content and development was based on established guidance by Jadad et al. (1996). Internal validity and test-retest reliability are accepted as good by systematic comparison with other measures (Armijo-Olivo et al., 2010; Deeks et al., 2003). Established in 1998, the aim of the EPHPP (Thomas et al., 2003) was to assist in the provision of evidence based research for Canadian health ministries. Thomas and his colleagues initially developed The Quality Assessment Tool For Quantitative Studies in 2004 (which later became the EPHPP) as part of a larger process for conducting systematic reviews in a public health setting (Appendix 2). Assessors using the EPHPP award ratings based on a set of comprehensive definitions and instructions published in an accompanying manual (The Effective Public Health Practice Project Dictionary, 2009). These findings provided sufficient evidence to choose the EPHPP as a valid and reliable assessment tool for the review detailed in this chapter.

The EPHPP is split into eight sections, intended to be applied by two reviewers working independently. Results are then compared, and a synthesis of each reviewers' findings conducted in order to award an overall rating. Sections cover aspects such as selection bias, study design, the likelihood of confounds, data collection and analytical methods. Selection bias covers participant recruitment, asking whether participants are likely to be representative of target populations, and what percentage of those selected went on to participate in the study. The appropriateness of methods used are assessed, and studies are rated using a list of possible designs. Randomised designs are rated more strongly than case studies and cohort designs. Potential confounds including between group differences at baseline, and measures within the study to control for such confounds are reviewed. Strong

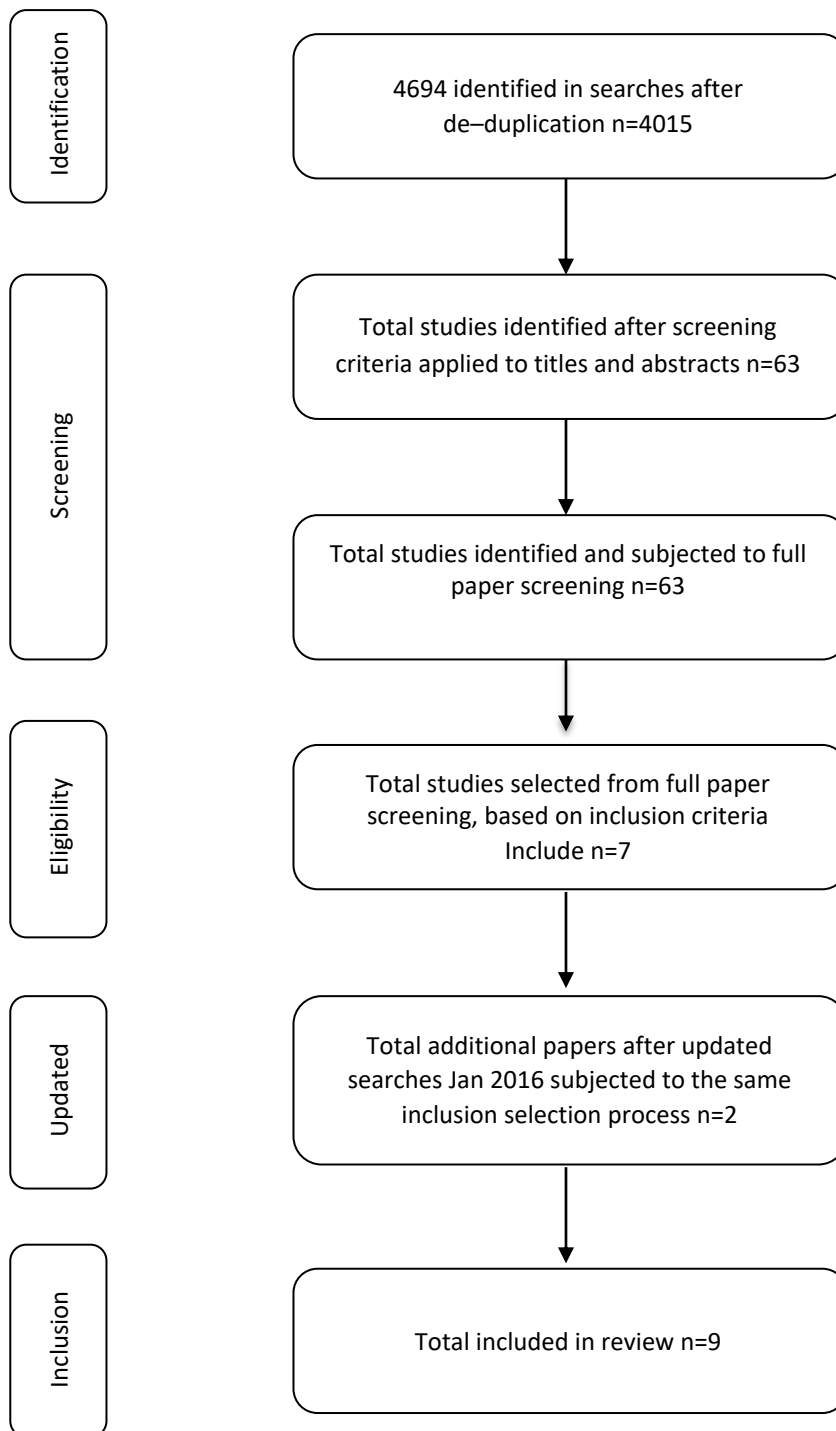
ratings are awarded for studies reporting higher percentage of relevant confounding variables that were controlled within the design or analysis. Stronger ratings are awarded to studies that incorporated methods where researchers and participants were blind to the intervention content. While studies for which participants are aware of the research question or such details are not reported are awarded moderate or weak ratings. Reliability and validity of data collection methods, such as questionnaires, are scrutinised with strong ratings attributed to, for example established self-report questionnaires with known validity. Percentage levels of attrition and whether studies report the reasons for dropout are reviewed with higher participant retention being considered stronger. Account is also made of study integrity and the appropriateness of the analysis used. Although no formal rating is allocated to these, the assessment tool nevertheless provides the opportunity to discuss any potential impact during comparison of the assessment between the two reviewers.

2.3 Results

Initial database and hand searches yielded 4694 articles. Following electronic and manual de-duplication, title and abstract screening was applied to 4015 papers. This process resulted in the identification of 63 potentially relevant papers for which full text screening was applied. Seven studies were eligible for inclusion in the review. Further hand searches of the reference lists of these seven (carried out up to January 2016) resulted in the identification of two further potentially relevant papers, each of these were subjected to the same screening process. A final total of nine studies were included in the review.

Figure 2.1

A Stage Diagram of the Inclusion Process



2.3.1 Quality Assessment Results

The EPHPP rating of quality are detailed in Table 2.3 below. Final EPHPP rating was determined obtained by both reviewers agreeing on scores based on individual assessment. Where there was disagreement consensus was reached by consensus with third party reviewer.

Table 2.3

EPHPP Ratings Indicating the Risk of Possible Bias for Each Study Included in the Review

Study Author	Selection bias	Study Design	Confounds	Blinding	Data collection	Dropout Rate	Global Rating
Butryn et al. (2009)	1	1	1	2	1	1	1
Fletcher (2011)	2	1	2	2	1	1	1
Goodwin et al. (2012)	3	2	3	2	1	2	3
Ivanova et al. (2015)	2	1	1	3	1	1	2
Kangasniemi et al. (2015)	1	1	1	2	1	2	1
Katterman et al. (2014)	1	1	3	2	1	2	2
Moffitt & Mohr (2014)	2	1	1	2	1	2	1
Tapper et al. (2009)	1	1	2	1	1	3	2
VanBuskirk et al. (2014)	3	1	3	2	1	1	3

Note. 1 = Strong, 2 = Moderate, 3 = Weak. Weak indicates a greater possibility of bias.

2.4 Preliminary Synthesis

The preliminary synthesis (summarised in Tables 2.3 to 2.6) included systematically extracted information from each of the studies. A complete list of the key topics extracted is detailed in Table 2.4.

Table 2.4

List of Study Details Included in the Preliminary Synthesis

Author details
Outline of main aims and or hypotheses
Study design, inclusion/exclusion criteria and method of assignment
Behaviour theories influencing the study procedure
Participant details and demographics
Details of experimental conditions, intervention content and delivery method
Outcome measures description and method of measurement
Process measures description and method of measurement
Participant dropout details
Outcome measure results
Process measure results
Between conditions results
Conclusions and limitations

Note: These categories refer to the information presented in Table 2.5

The data presented in Table 2.5 outlines the information specific to each study extracted information from each study based on the topics listed in Table 2.4 above. A further table (Table 2.6) then summarizes the both the results of critical appraisal of bias (detailed in Table 2.3) and presents the statistical results reported by each study.

The diverse nature of intervention methods, measures and study populations reported by the reviewed literature suggested the use of meta-analysis would be unreliable. Instead, where possible, the effect sizes were tabulated individually, rather than combining data. Results were then synthesised narratively and discussed with reference made to statistical significance of changes in outcome scores.

Table 2.5
Preliminary Synthesis of Data Extracted from the Reviewed Studies

Citation	Primary aim and hypothesis	Participants	Design and Procedure	Outcome Measures
Butryn et al. (2011)	<p>Aim- Assess the effectiveness of ACT to increase levels of physical activity.</p> <p>Hypothesis - ACT participants would have greater increase in physical activity than those on comparison group</p>	<p>54 students.</p> <p>Inclusion criteria – 18-35 female, not fresher, not sports club member, physically able</p> <p>Demographics – US population. Controlled across the groups - Mean age 23 , 57% US Caucasian</p>	<p>RCT</p> <p>Intervention: ACT + Exercise Education Control: Exercise Education</p> <p>Delivery: Group, 2x2hr over 2wks Method: Presented in group sessions Use of metaphors and experiential exercises. Reference to Intrinsic motivation Theory no reference to RFT</p> <p>ACT targeted: Willingness skills, defusion, strengthening commitment to exercise related values.</p>	<p>Objective outcome measure– gym attendance</p> <p>Process measures – PHLMS, DDS, PA-AAQ</p> <p>Baseline (week 1), Post intervention (week 5), Follow-up (week 8)</p>
Fletcher (2011)	<p>Aim -. Explores the role of ACT in relation to physical activity and the reduction of obesity.</p> <p>The primary hypothesis - ACT intervention would lead to an increase in physical activity when compared with a control group.</p>	<p>60 female 12 male, clinical population.</p> <p>Inclusion criteria – Current or past enrolment on weight loss programme, interest in increasing fitness level, age >18yrs, English speaking.</p> <p>Demographics – US population. Controlled across the groups. - Mean age 53.1, Ethnicity 88.3% US Caucasian</p>	<p>RCT</p> <p>Intervention: ACT Control: Waitlist</p> <p>Delivery: Group 1 x 6hr Method: Group workshops using metaphors exploring values barriers commitment, acceptance, defusion No reference to specific theory of behaviour change or RFT</p> <p>ACT targeted: values, barriers, acceptance, defusion, stigma, commitment</p>	<p>Self-report outcome measures – IPAQ, GHQ, DASS-21, Kcal estimates diet adherence.</p> <p>Objective outcome measures - Height, weight, BMI, blood pressure, breath holding, physical fitness.</p> <p>Process measures –FFMQ AAQ-2, AAQ-W, PAAQ, Bulls eye, DTS, MPAM, RSES, WSQ.</p> <p>Assessment pre-post intervention (Week1) Follow-up (week12)</p>

Goodwin et al. (2012)	<p>Aim - assess the feasibility and acceptability of an ABBT programme.</p> <p>Hypothesis - intervention would improve participant adherence to a heart healthy lifestyle – this includes increased physical exercise, decreased calorific, fat and sodium intake</p>	<p>11 female 5 male, Clinical population</p> <p>Inclusion criteria - Acute cardiac syndrome and a BMI >25, current diagnosis of high BP or diabetes, age 18-75, English speaking, not blind/deaf, unable to participate due to MH diagnosis.</p> <p>Demographics – US population. Not controlled – Mean age 56.4, 56.3% African American, 43.8% employed, 56.3 % Married/relationship</p>	<p>Cohort study Intervention: ABBT</p> <p>Delivery: Group 4 x 1.5hr Method: Group sessions use of metaphors and experiential exercises. acceptance values defusion tolerance. No reference to specific theory of behaviour change or RFT</p> <p>ABBT manual targeted: Psychoeducation, mindfulness and distress tolerance, committed action, values, goals</p>	<p>Self-report outcome measures – IPAQ, ASA-24</p> <p>Process measures - PHLMS, DDS, FAAQ, PA-AAQ. Feedback questionnaire.</p> <p>Assessment – baseline (week 1) and post intervention (week 4)</p>
Ivanova et al. (2015)	<p>Aim – Evaluate the effectiveness of an ACT intervention to promote long-term physical activity behaviours when compared to an education-based intervention.</p> <p>Hypothesis – Exercise behaviour would be increased in both conditions, but only the ACT condition would produce increases in levels of enjoyment.</p>	<p>32 female participants, general population</p> <p>Inclusion criteria – Female, age 18-55, physically inactive, medically able, contemplating or preparing to commencement of regular physical exercise.</p> <p>Demographics – Canadian population. Controlled for age and BMI across the groups – Mean age 22.4, Majority of the population White 40.6% and East Asian 40.6%. Average BMI 21.8</p>	<p>RCT Intervention: ACT Control: Implementation Intention Delivery: Group 1 x 40min Method: Scripted group using metaphors Selection process specific to SOC Theory. No reference to RFT</p> <p>ACT targeted: Acceptance and defusion, implementation Intention Control targeted: implementation Intention</p>	<p>Self-reported outcome measure for physical activity – GLTEQ. Enjoyment – PACES</p> <p>All participants report at baseline and follow-up (week 26)</p>
Kangasniemi et al. (2015)	<p>Aim – ACT plus personalised, objectively measured physical activity and body composition reports (feedback) were provided for participants engaging in a study that attempted to monitor amounts of physical activity among a cohort of sedentary adults.</p> <p>Hypothesis - ACT as well as feedback would be more effective in enhancing physical activity and the conditions related to it, than feedback alone</p>	<p>138 participants, general population 115 female</p> <p>Inclusion criteria– age 30-50, physically inactive.</p> <p>Demographics- Swedish population. Controlled across the groups – Mean age 43.5 gender with the majority of participants 83.3% female, 73.3% in a relationship, 54.2% educated to degree level, <25% had children under the age of seven.</p>	<p>RCT Intervention: ACT plus feedback Control: Feedback.</p> <p>Delivery: Group 6 x 1.5hr over 9-weeks. Method: Group sessions, values clarification, action plans, diary and self-reflection. No reference to specific theory of behaviour change or RFT</p> <p>ACT targeted: Health behaviours, values, barriers, living in the present moment, self-processes and physical activity, flexible actions.</p> <p>Feedback targeted: Activity level</p>	<p>Self-report outcome measure – physical activity min/day, BDI-II, Beliefs and intentions.</p> <p>Objectively measured outcome measure – accelerometer data HEPA and MVPA.</p> <p>Process measures – PAAQ</p> <p>All participants received feedback on physical activity levels at baseline, post intervention (week 12) and at follow up (week 26). ACT + Feedback group participants reported PAAQ scores at baseline, post intervention (week12) and follow up (week 26).</p>

Katterman et al. (2014)	Aims – to test the efficacy of a brief acceptance-based behavioural intervention in facilitating weight gain prevention. To assess the longitudinal effects on weight self-efficacy, physical activity, eating habits, experiential acceptance and changes in body weight.	58 participants, undergraduate student population Inclusion criteria – Age 18-30 female with a body mass index between 23 and 32 kg/m ² Demographics – US population. Controlled across the groups – Mean age 22.35, 62% US Caucasian, middle income families	RCT Intervention: ACT Control: waitlist Delivery: Group 8 x 75min over 5 months Method: Group sessions Metaphors as “change facilitators” No Reference to specific theory of behaviour change or RFT ACT targeted: Experiential acceptance, willingness, values, mindfulness, defusion, committed action	Self-report outcome measures – PAH, TFEQ Objective outcome measures – Weight, BMI Process measures – AAQ-2, FAAQ, PA-AAQ, WEL Assessment was at baseline, 6 weeks, 16 weeks and 1 year.
Moffitt & Mohr (2014)	Aims - explore the efficacy of an ACT intervention, delivered via a DVD, for initiating and maintaining engagement in a physical activity programme. Hypotheses - there would be a greater increase in level and in adherence to a physical activity programme for participants in the ACT group as opposed to the control group. Increased levels of physical activity in the ACT group would correspond with improved scores on the process measures associated with the ACT intervention	76 participants general population Inclusion criteria- Age 18-65, no medical condition preventing engagement in walking activity, contemplating or intending to begin exercise, low or moderate level of physical activity. Demographics –Australian population. Controlled across the groups - Mean age 43, majority female (reported at final analysis stage), ethnicity, marital, financial or employment status was not reported.	RCT Intervention: ACT plus walking programme Control: walking programme Delivery: Group session plus DVD, sessions split into 5 modules, 15 - 25 mins over 5 days. Walking programme 12wks Method: Recorded intervention on DVD including metaphors. Selection process specific to SOC Theory. No reference to RFT ACT targeted: Personal values, acceptance, cognitive defusion, willingness to engage, committed action.	Self- report outcome measures IPAQ Objective outcome measures BMI, Accelerometer data. Process measures – AAQ, VLQ, Participants feedback on exercise goals and achievements. Assessment Assessments were carried out at baseline and follow-up assessment post intervention at 12 weeks. Step counts from the accelerometers were assessed at 4, 8 and 12 weeks
Tapper et al. (2009)	Aim- to explore the effectiveness of a brief group ACT based intervention for weight loss in women. Hypothesis – no specific hypotheses.	62 female participant general population; divided into clinical and non-clinical subcategories. Inclusion criteria - Age >18, BMI >20, attempting to lose weight, medically able, available to attend classes. Demographics – UK population. No significant differences across the groups (with exception – participants in ACT group reported starting diet at older age than Controls. P=,05) Mean age 41 Mean BMI 31.57, level of education reported. No ethnicity or financial status reported.	RCT Intervention: ACT plus diet Control: diet Delivery: Group 3 x 2hr over 3wks plus 1 x 2 hr 3 months later. Methods: Group workshops, homework, manual, cd, use of metaphors and homework. No reference to specific theory of behaviour change or RFT Intervention targeted: Values, defusion, acceptance, self -awareness, committed action. Control: Continuation with existing dietary regime	Self –report outcome measures were – BPAT and GHQ-12 Objective outcome measure was BMI Process measures were – DEBQ, EEQ, BES, AAQ-2 Assessments were carried out at baseline, post intervention at 4 months and follow-up at 6 months.

VanBuskirk et al. (2014)	<p>Aims- effect of ACT and CBT interventions on levels of physical activity Determine associations between physical activity measured by accelerometer and other methods of self-report data on the levels of physical activity in a clinical cohort seeking treatment for chronic pain.</p> <p>Hypotheses - Engagement in ACT or CBT focused on relieving pain interference would result in increases in physical activity Objectively measured physical activity would correlate modestly with self-reported physical activity measures</p>	<p>87 Participants targeted clinical population</p> <p>Inclusion criteria - Pain on a subjective pain scale of 5/10 for a min 6 months Participants with current mental health problems or already receiving psychotherapy excluded</p> <p>Demographics – US population. Mean age 56, 70.1% US Caucasian, 43% married or in a relationship. Mean age of education 15.46 years. 26.4% Current Major depression. Financial or employment status not reported.</p>	<p>Random assignment comparison study to either the ACT condition or CBT</p> <p>Delivery: ACT condition was group based during an unspecified number of sessions over 8 weeks. Methods: non specified No Reference to specific theory of behaviour change or RFT</p> <p>Interventions: both described as treatment. Participants attended weekly sessions of their assigned condition for a total of eight weeks.</p>	<p>Self-report outcome measures – WHYMPI, BPI- SF, BDI-II, QOL-SF12</p> <p>Objective outcome measures – Accelerometer data Self-report – using subscale of WHYMPI</p> <p>Assessment – Baseline (Week1), Post intervention (Week 8), Follow-up (week26)</p>
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Note. PHLMS – Philadelphia Mindfulness Scale; PAAQ (PA-AAQ) – Physical Activity Acceptance Action Questionnaire; DDS – Drexel Defusion Scale; IPAQ – International Physical Activity Questionnaire; GHQ – General Health Questionnaire; DASS-21 – Depression and Anxiety Scale; FFMQ – Five Facets of Mindfulness Questionnaire; AAQ-2 – Acceptance and Action Questionnaire; AAQ-W – Acceptance and Action Questionnaire for Weight; DTS – Distress Tolerance Scale; MPAM – Motivation for Physical Activity Measure; RSES – Rosenberg Self-esteem Scale; WSQ – Weight Stigma Questionnaire; FAAQ – Food Acceptance and Action Questionnaire; ASA-24 – Automated Self-Administered 24hr Dietary recall; BDI-II – Beck’s Depression Inventory-II; GLTEQ – The Godin Leisure-Time Exercise Questionnaire; PACES – Physical Activity Enjoyment Scale; HEPA – Health Enhancing Physical Activity; MVPA – Moderate to Vigorous Physical Exercise; WEL – Weight and Lifestyle Questionnaire; VLQ – Valued living questionnaire; BPAT – Brief physical assessment Tool; DEBQ – Dutch eating behaviour Questionnaire; EEQ – Emotional eating questionnaire; BES – Binge eating scale; BPI-SF – Brief pain inventory short form; WHYMPI – West Haven-Yale Multidimensional Pain Inventory.

Table 2.6*Summary of Outcomes Reported by the Reviewed Studies*

Lead author and year of publication	EPHPP rating	Study design	N	Sex	Population	PA Outcome measure used	Effects over time	Time by intervention type interaction	Between group follow-up
Butryn et al. (2009)	Strong	RCT ACT+ Education v Education	n=54	F	Student	Visits to gym	Main effect $F(1,42)=30.78$, $p < .01$, $\eta^2 = .62$	$F(1,42)=3.90$, $p=.05$, $\eta^2=.15$	Pre intervention to 8 week follow up
Fletcher (2011)	Strong	RCT ACT v Waitlist	n=72	>F	Clinical	IPAQ	ACT group change over time $d^*=5.77$, $p =.043$	Difference between change scores $d^*=0.52$	Pre intervention to 12 week follow up
Goodwin et al. (2102)	Weak	Cohort ABBT	n=12	>F	Clinical	IPAQ	Cohen's $d = .54$, $p =.22$	No between group analysis	Pre intervention then after each session.
Ivanova et al. (2015)	Mod	RCT ACT v Implementation Intentions	n=32	F	General	GLTEQ	Main effect $F(1,30) = 7.48$, $p = .01$	$F(1,30)=2.44$, $p =.13$	Post intervention day 1 to week 26 follow up
Kangasniemi et al. (2015)	Strong	RCT ACT+Feedback v Feedback	n=138	>F	General	HEPA self-report	FB: $\chi^2=8.755$, $p =.013$ ACT+FB: $\chi^2=9.606$, $p.008$	$\chi^2=3.734$, $p =.155$	Pre intervention to week 26 follow up
						HEPA Actigraph Accelerometer	FB: $\chi^2 =8.505$, $p = .014$ ACT+FB: $\chi^2 = 13.114$, $p =.001$	$\chi^2=0.557$, $p =.757$	Pre intervention to week 26 follow up
Katterman et al. (2014)	Strong	RCT ACT v Waitlist	n=58	F	Student	PAH	$F(1,52) = 2.38$, $p =.125$, $d=.25$	$t=1.54$, $p = .125$, $d^*=0.51$	Post intervention week 6 to weeks
Moffitt & Mohr (2014)	Strong	RCT Walking programme v ACT+Walking programme	n=76	>F	General	IPAQ	$F(1,42) = 11.05$, $p < .01$, $\eta^2_p .20$	$F(1,42) = 4.43$, $p < .05$, $\eta^2_p .09$	Pre intervention to week 12 follow up
						Accelerometer	$F(1,42) = .73$, $p > .05$, $\eta^2_p .03$	$F(1,42) = 3.81$, $p < .05$, $\eta^2_p .16$	Week 4 to week 12 follow up
Tapper et al. (2009)	Mod	RCT ACT+TAU v TAU	n=62	F	General	BPAT	$d^* = 0.51$	$t(44)=2.46$, $p=.018$	Post intervention week 3 to week 26 follow up
Van Buskirk et al.(2014)	Weak	RCT ACT v CBT	n=87	>F	Clinical	Accelerometer	$b = 104.67$, $p =.92$	Group by time interaction $b=-902.06$, $p =.64$, $sr^2=.09$	Post intervention week 8 to week 26

2.4.1 Review of Risk of Bias

The quality assessment for each of the selected studies is detailed in Table 2.3. The six categories rated for risk of bias; 1 as low risk, 2 as moderate risk, and 3 as high risk, are summarised sequentially in the following section.

The potential for selection bias was defined by the likelihood that participants were representative of the target population and also the percentage of participants that agreed to take part in the study before they were allocated to intervention groups. Selection bias was low in four studies (Butryn et al., 2009; Kangasniemi et al., 2015; Katterman et al., 2014; Tapper et al., 2009), moderate in three studies (Fletcher 2011; Ivanova et al., 2015; Moffitt & Mohr, 2014) and higher risk for two studies (Goodwin et al., 2012; VanBuskirk et al., 2014). Overall study design was assessed as the likelihood of bias due to the allocation process.

All of the reviewed studies claimed to be randomised control trials, with the exception of a cohort study reported by Goodwin et al. (2012). This meant Goodwin et al. (2012) was also judged to have a moderate risk of bias within the overall design of the study, all others were considered as low risk. Confounds were defined as any variable associated with the intervention that could be causally related to the outcome of interest. The potential for high risk of bias due to confounds was reported for three studies (Goodwin et al., 2012; Katterman et al., VanBuskirk et al., 2014), some moderate risk was identified for the studies by Fletcher (2011) and Tapper et al. (2009). Only Tapper et al. (2009) was assessed as having a low risk of bias for blinding whereas the other studies suggested a medium risk, and Ivanova et al. (2015) a high risk of bias due to blinding. Primary outcome measures were scrutinised for validity

and reliability and method of data collection. All nine studies scored a low risk of bias for their data collection methods. The risk of bias due to dropout was reported as high for Tapper et al. (2009), medium risk for four studies (Goodwin et al., 2012; Kangasniemi et al., 2015; Katterman et al., 2014; Moffitt & Mohr, 2014). The studies with highest retention were therefore Butryn et al. (2009), Fletcher (2011), Ivanova et al. (2015) and VanBuskirk et al. (2014). Calculation of the global (overall) risk of bias, which took into account all of the categories assessed, revealed that four of the reviewed study were of good quality with a low risk of bias (Butryn et al., 2009; Fletcher, 2011; Kangasniemi et al., 2015; Moffitt & Mohr, 2014). Three studies obtained the moderate rating (Ivanova et al., 2015; Katterman et al., 2014; Tapper et al., 2009) and two studies suggested they were at a higher risk of bias (Goodwin et al., 2012; VanBuskirk et al., 2014).

2.4.2 Study Characteristics

All nine included studies were compared in this preliminary synthesis of the information. The participant demographics (detailed in the synthesis Table 2.5) show that a total of 595 people were recruited. The total number of participants reported across all nine studies was 595 and sample sizes ranged from $n = 16$ (Goodwin et al., 2012) to $n = 138$ (Kangasniemi et al., 2015). Two of the studies (Moffitt & Mohr, 2014; VanBuskirk et al., 2014) did not report the ratio of male and female participants. The number of female to male participants across the remaining seven studies was calculated as 392 to 40 respectively. Interestingly, four of these seven (Butryn et al., 2009; Ivanova et al., 2015; Katterman et al., 2014; Tapper et al., 2009) specified female only inclusion criteria. Age was generally reported as a mean value, and the

mean of these figures across the nine studies was calculated as 40 years. Ethnicity was not consistently reported, but ethnicity reported across the studies included: Aboriginal, African American, African, Asian/Pacific Islander, East Asian, Hattian, Hispanic, Native American, Middle Eastern, South Asian, US Caucasian, and White.

A number of patterns emerged from the data reported in table 2.5. Firstly, studies used a range of methods to report levels of physical activity, which could be grouped by two main features; objective measures (for example, accelerometer data) or self-report measures. A second grouping was between study populations, which displayed two main features, that of clinical or a non-clinical. A clinical background being, for example, people recruited on a weight reduction programme, compared to a non-clinical background such as a student population. This second grouping could be further subdivided, based on whether or not studies targeted populations that were defined by behaviour change theory, such as those voluntarily contemplating taking up regular exercise, defined through stages of change theory, versus those populations that could be considered clinically obliged or motivated (Prochaska et al., 2008; Reed et al., 1997). Finally, a third group emerged where studies incorporated ACT as part of a broader intervention package such as education on healthy lifestyles. The following synthesis explores these groupings and then discusses potential strengths and weaknesses of the empirical approach to the identified studies.

2.4.3 How Studies Reported Physical Activity Outcomes

The method of reporting level of physical activity/exercise varied across the studies. However, measures of physical activity levels could be broadly classified as either objective (for example, pedometer data), or alternatively as self-reported

questionnaire data. Four of the nine studies (Butryn et al., 2009; Kangasniemi et al., 2015; Moffitt & Mohr, 2014; VanBuskirk et al., 2014) reported levels of physical activity using objective measure. Of these, Butryn et al. (2009) used gym attendance monitored by access cards, whereas the other three studies (Kangasniemi et al., 2015; Moffitt & Mohr, 2014; VanBuskirk et al., 2014) reported data from accelerometers worn by the participants. A larger proportion of studies collected data on levels of activity using self-report questionnaires (Fletcher et al., 2011; Goodwin., 2012; Ivanova et al., 2015; Katterman et al., 2014; Tapper et al., 2009), whilst two studies used a combination of accelerometer data and self-report measures (Kangasniemi et al., 2015; Moffitt & Mohr, 2014). Both objective and self-report measures are subject to reporting errors. Typically for physical activity, especially vigorous physical activity, self-report measures have a tendency to produce overestimated results (LeBlanc & Jansen, 2010; Manios et al., 2013). Researchers noted that objective measures were employed to add confidence in the data reported (Kangasniemi et al., 2015; Moffitt & Mohr, 2014). However, objective measures in the reviewed work still required participants to remember to wear accelerometers at the appropriate times. A similar criticism was of the use of gym attendance reported by Butryn et al. (2009) without taking into consideration the nature or amount of the exercise adopted by the participants.

2.4.4 Populations Covered by Studies

Whilst all the reviewed studies aimed to recruit people leading sedentary lifestyles, there was some disparity between the target populations. Research that could be considered as non-clinical, recruited from general populations such as

University students (Butryn et al., 2009; Katterman et al., 2014) or via newspaper advertisements (Kangasniemi et al., 2015; Moffitt & Mohr, 2014). Clinical studies however, tended to be highly focused on a single clinical issue such as the effect of chronic pain on physical activity levels (VanBuskirk et al., 2014), or more commonly recruitment onto a weight reduction programme (Fletcher, 2011; Goodman et al., 2012; Tapper et al., 2009). The recruitment process was also influenced by inclusion criteria which for three studies required that participants be currently contemplating a change in behaviour that involved increasing their level of exercise (Ivanova et al., 2015; Tapper et al., 2009; Moffitt & Mohr, 2014). Understandably this method targeted a population that was motivated to engage in exercise, thus reducing the external validity of their results. Conversely, it could also be argued that by enrolling in a clinical programme intention to increase levels of activity is implied.

2.4.5 Intervention Content of Studies

All the reviewed studies, with the exception of VanBuskirk et al. (2014), included a group/classroom approach for delivery of ACT. However, three studies also offered additional support in the form of training reinforcement via a DVD (Moffitt & Mohr, 2014) and/or a course manual (Tapper et al., 2009) or written feedback of participant progress (Kangasniemi et al., 2015). Some less clinically focused interventions concentrated purely on using ACT processes to increase activity level (Butryn et al., 2009; Ivanova et al., 2015) whereas the more clinically focused interventions included psychological training which targeted the particular clinical issue specific to the study. Because of this there was a disparity in the instruments used to assess the non-physical activity related outcomes across the research. Importantly this meant that

the intervention content varied across the reviewed literature, this is highlighted in Table 2.7.

Table 2.7

Summary of Intervention Content and ACT Outcomes Reported by the Reviewed Studies

Citation	Study description of intervention content based the available evidence	ACT processes	ACT Outcome measures
Butryn et al. (2011)	ACT targeted: Willingness skills, defusion, strengthening commitment to exercise related values.	Acceptance, defusion, committed action, values	Mindfulness, Defusion, Acceptance
Fletcher (2011)	ACT targeted: values, barriers, acceptance, defusion, stigma, commitment	acceptance, defusion, committed action, values	Mindfulness, Acceptance, Values, Defusion
Goodwin et al. (2012)	ABBT manual targeted: Psychoeducation, mindfulness and distress tolerance, committed action, values, goals	Present moment awareness, committed action, values	Mindfulness, Defusion, Acceptance
Ivanova et al. (2015)	ACT targeted: Acceptance and defusion, implementation Intention	Acceptance, defusion	none
Kangasniemi et al. (2015)	Health behaviours, values, barriers, living in the present moment, self-processes and physical activity, flexible actions.	Acceptance, present moment awareness, self-as context, values	Acceptance
Katterman et al. (2014)	ACT targeted: Experiential acceptance, willingness, values, mindfulness, defusion, committed action	Acceptance, present moment awareness, defusion, committed action, values	Acceptance
Moffitt & Mohr (2014)	ACT targeted: Personal values, acceptance, cognitive defusion, willingness to engage, committed action.	Acceptance, defusion, committed action, values	Acceptance, values
Tapper et al. (2009)	ACT targeted: Values, defusion, acceptance, self-awareness, committed action	Present-moment-awareness Acceptance, defusion, committed action, self-as-context, values	Acceptance
VanBuskirk et al. (2014)	Interventions: details not provided	Details not provided	none

Clinical measures also varied between studies, for example, stigma associated with obesity was reported by Fletcher (2011) and clinical level of depression was reported by VanBuskirk et al. (2014) Whilst body mass index was reported by three studies (Moffitt & Mohr, 2014; Katterman et al., 2014; Tapper et al., 2009). Direct

comparison of study outcomes using these measures was therefore not possible. Similarly, there were differences in regard to the inclusion of ACT processes measures across the reviewed literature. Interestingly, whilst studies (Butryn et al., 2009; Fletcher 2011; Goodwin et al., 2012; Kangasniemi et al., 2015; Katterman et al., 2014; Moffitt & Mohr, 2014; Tapper et al., 2009) provided a brief listing of ACT processes covered during interventions, only a small proportion of these processes were reported using outcome measures pre-to-post intervention (see table 2.5). Thus, it was difficult to judge which of the ACT processes involved held the greatest potential for change in exercise behaviour or if the outcomes were the result of the combination of the whole intervention.

2.5 Discussion

The present review has thus far systematically identified available empirical literature that reported on the use of ACT to promote increases in levels of physical exercise for sedentary populations. The quality of the included studies has been assessed and a preliminary synthesis of the available evidence conducted that suggested patterns in the nature of the reviewed work. The following section further explores the relationships between the studies with the purpose of identifying and evaluating strengths and weaknesses in the identified work.

2.5.1 Intervention Outcomes

The number of ACT processes incorporated into the interventions were not consistent across the reviewed research. Studies gave a limited description of the specific content incorporated into each intervention. Butryn et al. (2011) for example

reported that their ACT intervention targeted willingness skill, defusion, strengthening commitment to exercise related values. This suggests that the ACT sessions included the ACT processes of acceptance, defusion, committed action and values. Whereas, Kangasniemi et al. (2014) described the focus of the ACT intervention as targeting values, barriers to exercise, present moment awareness, self-processes and flexible actions. This suggests the use of the ACT processes of values, present moment awareness, and acceptance. However, in both these examples the exact details of the individual ACT processes included were not reported. A complication for extracting such detail from the reviewed studies was the terminology used to describe the intervention processes. Butryn et al. (2009), for example, reported that an intervention session was aimed at acceptance, whereas Kangasniemi et al. (2015) described a session that targeted flexible actions. Both terms can describe the ACT component of acceptance, but the latter could also describe multiple components of ACT, such as acceptance and defusion. Furthermore, ACT involves a two-way interaction between the client and the therapist in order to develop client understanding of the complex and abstract nature of processes such as defusion. This subjective delivery of ACT protocols across the reviewed literature suggests that reproducibility of such interventions on an empirical level would be difficult. To enhance the reproducibility of their findings, Ivanova et al. (2015) produced scripted outlines of material to be used as guidance by the intervention provider. Similarly, Moffitt and Mohr (2014) produced a DVD for their participants and Tapper et al. (2009) produced a report detailing the content of workshops designed to teach the ACT processes used (Tapper et al., 2009). However, such details were not provided in the remaining literature. Table 2.7 highlights the inconsistency

of ACT content used based on the methodological descriptions provided in the reviewed studies and the interpretation of which ACT processes were incorporated given the available evidence.

2.5.2 Physical Activity Outcomes

When it came to the measurement of levels of physical activity, the majority of the studies reviewed suggested that their interventions promoted increases in physical activity levels. Indeed, six of the nine studies (Butryn et al., 2011; Fletcher, 2011; Ivanova et al., 2015; Kangasniemi et al., 2015; Moffitt & Mohr, 2014; Tapper et al., 2009) reported statistically significant increases in physical activity immediately post intervention. Follow-up duration varied across the studies from between six weeks and 12 weeks. Only three of the nine studies report statistically significant differences in levels of physical activity at follow-up of eight weeks or more (Butryn et al., 2011; Moffitt & Mohr, 2014; Tapper et al., 2009), which suggests that the effects of the intervention diminish over time.

2.5.3 Control Conditions

The type of control conditions also varied across the studies. For example, Ivanova et al. (2015) compared participants receiving ACT with controls that used “implementation intentions” training; a method of planning future behaviours, which was specifically aimed at physical exercise. Ivanova et al. (2015) reported a significant main effect of time but no statistically significant interaction effects between the conditions, which suggests that control conditions may also have influenced exercise participation. By contrast, Moffitt and Mohr (2014) reported significant increases in

post intervention exercise for participants receiving a walking programme plus ACT, compared to those receiving only the walking programme. However, the wait-list controls employed by Katterman et al. (2014) showed no statistically significant post-test interaction effects. Interestingly, Van Buskirk et al. (2014) compared CBT and ACT as “Gold Standard” interventions for use in a clinical population affected by pain. Contrary to findings by the other reviewed studies, VanBuskirk concluded that engagement in physical activity was not significantly predicted by time for people receiving an ACT intervention. Furthermore, variance in physical activity was not significantly predicted by the type of intervention (CBT or ACT) (Van Buskirk et al., 2014). However, evaluation of the reviewed literature in these terms may not provide a true representation of the overall intervention effects simply because sedentary behaviours due to clinical issues like chronic pain, are substantially different from sedentary behaviours attributable to, for example, prolonged academic study (Butryn et al., 2011; Katterman et al., 2014), obesity (Fletcher 2011; Tapper et al., 2009), or those people who are simply avoidant of exercise (Ivanova et al., 2015). These types of differences make precise statistical comparisons unreliable (Petticrew & Roberts, 2006) due to heterogeneity of reviewed data. Because of this, a narrative approach to synthesising the results was adopted (Popay et al., 2006).

2.5.4 Outcomes in Theoretical Terms

A further common feature was that studies consistently reported on outcomes in terms of an increase in the level of physical activity but did not provide an explanation of the theoretical mechanisms of change. Three studies (Ivanova et al., 2015; Tapper et al., 2009; Moffitt & Mohr, 2012) bound their selection process using

Stages of Change theory, by targeting participants that were contemplating change (Prochaska et al., 2008; Reed et al., 1997). However, there was little account of how the intervention processes responsible for the behavioural outcomes related to the theoretical concepts that underpin ACT. The constructs referred to in Relational Frame Theory (Torneke, 2010), can be used, for example, in the arrangement of metaphors, commonly used in ACT to teach clients processes such as defusion (Harris, 2019; Luciano et al., 2011). There was no account made by the reviewed literature of whether such concepts were used to present intervention content. It has been argued by some that RFT is simply a different way of explaining the ACT process (Harris 2019). However, the guidance literature for development of complex interventions insists that for evidence-based intervention research to be robust, it should be bound both in theoretical and practical evidence (Craig et al., 2013). ACT is inextricably linked to RFT (Hayes et al., 2001) because ACT addresses the psychological problems created due to our derived relational responding to human language (Torneke, 2010; Villate et al., 2015). In recent times there have been calls by the developers of ACT for the design of empirical studies investigating ACT protocols to be clearly related to the RFT concepts (Barnes-Holmes & Hayes, 2003). Reporting of these points are somewhat lacking from the reviewed work, and thus represent a significant gap in the research literature on the use of ACT to increase levels of physical activity in sedentary populations.

2.6 Strengths and Weaknesses of the Review Process

The evidence collected and presented in this review is underpinned by the use of thorough systematic methods, detailed by high quality guidance on conducting

systematic reviews in health care (Centre for Reviews and Dissemination, 2009; Higgins & Green, 2011; National Collaboration Centre for Methods and Tools 2008; Petticrew & Roberts, 2006; Popay et al., 2006). There was a great deal of methodological variation in the reviewed evidence. Group populations, measures used, and the nature of controls differed to such a degree that incorporation of meta-analysis would have presented unreliable data. Tailoring the focus of initial searches to the research objectives produced a high level of inter-rater agreement during the screening of the located studies lends weight to the robustness of the selection process.

The limited amount of available literature may provide sufficient grounds to broaden the inclusion criteria in order to increase the number of studies for review. However, to do so would have undermined the precise nature of the review questions and increased heterogeneity of results. Assessment of bias using EPHPP, showed a variation in the quality of the work identified during the literature searches and inclusion process. Suggestions are made as to possible impacting factors on outcomes and gaps in the identified literature in the conclusion section. The quality assessment of the reviewed studies undertaken using the EPHPP (Thomas et al., 2004) were performed so as to provide information about the potential for bias within studies on an individual basis. It should be noted therefore that, given the varied nature of the studies, that the EPHPP could not support detailed comparisons across the reviewed papers. Nevertheless, the assessment did reveal an overall variation in quality of the published work.

2.7 Conclusions

This systematic review identified some evidence to suggest that ACT based intervention could be used to promote physical activity in sedentary populations. ACT was employed in both clinical and general populations and although there were mixed results, most of the reviewed work suggested ACT-based interventions had a positive impact on physical activity levels post-intervention. However, there were significant disparities in the ACT processes used, the methods of intervention delivery and nature of controls, all of which hold the potential to affect the reproducibility of the interventions. In addition, studies tended not to explore their findings in theoretical terms or detail the theoretical constructs that underpin ACT when explaining the results. The gaps in the literature highlight the requirement to establish a robust evidence-based approach to further intervention development in accordance with guidance on the development of complex interventions (Craig et al., 2013). This review suggests that future work should focus on the gaps and weaknesses identified in order to investigate how ACT components are best tailored, and delivered, specific to physical activity. In order to achieve this future work should therefore attempt to: Firstly, identify ACT processes likely to influence physical activity behaviour. Secondly, investigate the methods of delivery of interventions. Thirdly, embed Relational Frame Theory into the design and explanation of empirical studies.

Chapter 3

Survey of ACT Processes and Activity Levels

3.1 Introduction

Principally, therapists provide the means by which people learn ACT skills to identify private-events; thoughts, feelings and sensations, which can promote avoidant behaviours. However, a significant gap in the empirical evidence reviewed in chapter 2 was the inconsistency as to which, and how, skills taught in ACT were provided to participants as interventions designed to increase levels of physical activity. This suggested that reproducibility of empirical evidence and the effective use of therapist time and resources was unlikely. The number of learning sessions a person requires, and the specific focus of ACT processes are not fixed, as they are dependent on the individual situation (Harris, 2019). This suggests that the development of ACT strategies for increasing levels of exercise should include exploration as to the impact of the individual taught components of ACT relative to physical activity engagement. In short, which of the ACT processes influence an individual's action and reaction to engagement. Increased understanding will allow for the development of viable interventions developed from a contextually specific evidence base. In turn, this will allow for the development of targeted and specific training that will be cost effective, have increased fidelity and be of benefit to clients of either clinical or general populations.

A recent qualitative study targeted a general population and the six processes involved in the application of ACT (Jenkins et al., 2019). They explored how people

used the different elements of ACT for maintaining regular exercise. Participants were not provided with any formal training in ACT skills; instead, the researchers provided them with a short explanation of each ACT process and participants were then asked to comment as to whether they used any of the skills to help them maintain regular exercise. Participants universally identified the processes of acceptance (as opposed to avoidance), values and committed action as playing a role in helping them maintain regular physical activity, especially in regard to the personal experiences of discomfort and effort associated with exercise. However, the participants did not rate defusion or self-as-context as influential, and there was little support for present-moment-awareness. By contrast, quantitative clinically focused intervention studies such as those by Luciano et al. (2010, 2011), McCracken and Vowles (2014) and Gil-Luciano (2016) showed that multiple exemplar training based principally on cognitive defusion, self-as-context and personal values, could be used as a method of overcoming uncomfortable private-events. This suggests that the abstract complexity of defusion and self-as-context, which involve noticing thoughts in relation to the self, make understanding the processes difficult.

Researchers have explored methods of intervention delivery designed to reinforce client understanding whilst reducing costly, repeated face to face therapy sessions. Moffitt and Mohr (2014) used a DVD recording to guide participants through ACT training while other studies utilised a group classroom-based approach (Butryn et al., 2011; Kangasniemi et al., 2015). Adopting a shortened group-based format has the advantage of being less costly to run than individual therapy, which suits a primary care setting (Brackensrass et al., 2006). A further advantage highlighted by Mohr et al. (2006) is that therapeutic interventions presented as a workshop, are perceived as

less stigmatising than a one-to-one psychological therapy approach (Mohr et al., 2006). This is especially relevant when potential intervention recipients may already feel social stigma related to, for example, body weight (Vartanian & Shaprow, 2008; Vartanian & Novak, 2011).

Interestingly, Harris (2019) maintains that, dependant on the situation, interventions containing only key elements of ACT can still provide significant benefits. This highlight two key points. Firstly, it suggests that therapists could shorten or abbreviate interventions to focus on client knowledge and understanding. More importantly, it would enable the development of specific strategies to tackle issues directly related to their avoidance of physical activity.

A pertinent example of a non-clinical application of core ACT elements is the mindfulness acceptance commitment (MAC) approach developed by Gardner and Moor (2004). The intervention included skills training in; acceptance, values, and committed action processes with the aim of helping athletes improve performance and overcome anxieties and stress related to their sport. The MAC approach was recently examined by Gross et al. (2018) who found that the intervention had a significant effect on emotion regulation and psychological flexibility in athletes, which resulted in the reduction of substance misuse and levels of anxiety. Interestingly, there was also a significant increase in sports performance for participants receiving MAC training. Although research questions of this thesis are concerned with the amount of physical activity rather than physical performance, Gross's findings substantiate the notion by Harris (2019), that not all of the processes included in ACT are required in order to achieve changes in behaviour. This suggests that a limited number of core processes used in ACT could be focused on as a protocol for a non-

clinical physical activity population, to achieve positive results. However, as to what these are is not fully understood.

The systematic review (see Chapter 2) highlighted an inconsistency in the types of ACT skills taught during intervention delivery in the empirical studies. This approach to development could lead to a lack of understanding of intervention efficiency, and the specific impact of the underpinning constructs on a targeted population, such as people with obesity. Given the potential impact of each of the ACT processes in relation to physical exercise, as discussed above, it became apparent that a more systematic approach was needed to account for the individual nature of physical activity levels. Because of this, a rational approach to developing a focus for brief interventions was required before any evaluation of its efficacy could begin.

Such an approach is the basis of guidance on the development of complex interventions published by The Medical Research Council ([MRC]; Craig et al., 2013). The guidance refers to the nature of interventions, especially those aimed at health service populations, where personal and situational circumstances can influence both engagement in, and the outcome of an intervention. Recommendations raised by the guidance suggest that the intervention content should be based on empirically developed evidence and be replicable, ecologically valid and cost-effective (Craig et al., 2013). In light of this evaluation, this chapter reports on an investigation of whether ACT processes are associated with existing level of physical activity and if so, which elements of ACT have the strongest association with activity levels, and whether individual processes are significant predictors of physical activity.

3.2 Aims and Objectives

The principal aim of the present study was to examine levels of reported physical activity and identify whether any relationships existed with respect to the central constructs of the ACT model. Specifically, the objective was to examine participant scores on established measures of acceptance, defusion, personal values, committed action, present moment awareness, and self-as-context in relation to how physically active they were. It was expected that the findings would provide an avenue of further investigation into development of a focused brief intervention to promote physical activity.

3.3 Hypotheses

Findings of the studies identified in the introduction to this chapter suggested that more active people would report higher scores of ACT process measures in line with increasing psychological flexibility, although the strength of relationships was uncertain. These ideas gave rise to two principal hypotheses.

1. Overall levels of physical activity determined by self-report would be predicted by scores on ACT process measures indicative of greater psychological flexibility.
2. Levels of chosen/leisure-time physical activity would predict scores on ACT process measures indicative of greater psychological flexibility.

Of particular interest were defusion, self-as-context and personal values, because interventions with prominent empirical evidence have shown this combination to be effective when included in very brief interventions for pain and discomfort (Gil-Luciano et al., 2016; Luciano et al., 2010, 2011; McCracken et al., 2014).

Therefore, secondary hypotheses were that:

3. People with higher trait levels of defusion would have higher levels of leisure-time physical activity.

4. People who reported value in being physically active would be predictive of higher overall levels of physical activity.

3.4 Method

3.4.1 Participants Characteristics

Participants were recruited through advertising via posters, information leaflets, direct email, and social media posts. As such the population was a convenience sample comprised of members of the general public living locally to the university, members of staff, and also students attending the university. All were aged over the age of 16 years. No restriction was made on maximum age, however participants were required to be physically and medically fit to engage in exercise.

3.4.2 Sampling Procedures

Participants took part on an individual basis and all data collected was anonymous. Data collection took part between April 2017 and March 2018. There were no financial incentives for the general public, but students of psychology within the university were offered two research participation credits. Ethical approval was obtained via University of Chester Department of Psychology ethics committee in accordance with the British Psychology Society Code of Human Research Ethics (2014).

3.4.3 Sample size Power

There was relatively little evidence on which to base a power analysis and so the present study drew on work with the smallest effect sizes of any of the reviewed studies. Goodwin et al. (2012) examined change scores of ACT processes for an intervention designed to increase physical activity in population of cardiac patients. The smallest effect size for any of the measured ACT processes was between scores for avoidance, measured by the AAQ, and physical activity ($r = .15$). To detect an effect of this magnitude, with power of 0.8 and an alpha of .05 the current study required a sample size of 270. It should further be noted that the associations reported by Goodwin were based on the correlations between change scores during an intervention, not, as was the case for the present study, on the association between scores observed naturalistically.

3.4.4 Measure of Physical Activity Level

The International Physical Activity Questionnaire ([IPAQ]; Booth, 2000) explores both the type and amount of engagement in physical activity over the previous 7 days (Appendix 10). Data can be reported in either categorical (low, medium or high level of physical activity) or continuous terms (Metabolic Equivalent [METS]; Jetté et al., 1990). The IPAQ asks about physical activity across several domains including work, travel, home and leisure-time. Craig et al. (2003) reported adequate reliability, (Spearman's $r^2 = 0.8$) and Criterion validity, ($r^2 = 0.30$).

3.4.5 ACT Process Measures

3.4.5.1 Values

Currently there are no validated self-report quantitative measures permitting the clarification of personal values in relation to physical activity. In order to measure this construct the current study adapted an existing and well established measure; the Valued Living Questionnaire ([VQL]; Wilson & Murrell, 2004; Wilson et al., 2010). The original version of the VLQ is in two parts. The first part of the VLQ asks respondents to rate 10 *valued domains* of living on a 10-point Likert scale that ranges from 1 = *not important* to 10 = *extremely important*. The second part uses an identical scale and respondents rate how consistently they feel that they live their life according to each valued domain. The second part of the VLQ was adapted for the present study. Respondents rated how consistent their behaviours were with each valued domain in relation to physical activity. A copy of the adaptations is provided in Appendix 12 and the original version of the VLQ in Appendix 11. The scoring method for the VLQ includes calculating the product of the *valued domains* and *consistency* across the two parts of the questionnaire. The mean of the product scores is called the *Valued Living Composite* score (Wilson et al., 2010).

3.4.5.2 Defusion

The Cognitive Fusion Questionnaire ([CFQ]; Gillanders et al., 2014) comprises seven items, with responses given on a Likert scale ranging from 1 = *never true* to 7 = *always true* (Appendix 15). Increasing scores represent higher levels of trait fusion. Alternatively, scores may be reversed as a measure of cognitive defusion; in other words, the ability to defuse from uncomfortable private-events in the form of

thoughts and feelings. Gillanders et al. (2014) reported test-retest reliability ($r = .81$, $p < .001$). Construct validity was determined via comparisons with established ACT constructs. Correlations between, for example, the Acceptance Action Questionnaire ([AAQ-II]; Bond et al., 2011) was ($r = .72$, $p < .001$).

3.4.5.3 Committed Action

The Committed Action Questionnaire ([CAQ-8]; McCracken et al., 2015) is an 8-item measure asks people about personal goals and uses a Likert scale with anchors of 0 = *never true* to 6 = *always true* (Appendix 18). McCracken et al. (2015) reported good levels of test retest reliability ($r^2 = .87$), good correlations with AAQ-II ($r = -.63$).

3.4.5.4 Psychological Flexibility / Experiential Avoidance

The Acceptance Action Questionnaire - II ([AAQ-II]; Bond et al., 2011) is a 7-item questionnaire again using a Likert scale with anchors of 1 = *never true* to 7 = *always true* (Appendix 13). The AAQ-II is a multi-factorial measure of avoidance and psychological flexibility. The developers of the AAQ-II show that the measure has good levels of test retest reliability over an extended period of three to twelve months ($r = .81$) to ($r = .79$), respectively. Higher scores are indicative of higher levels of avoidance, which can also be described as psychological inflexibility. Validity was assumed by strong correlation with scores on Beck's Depression Inventory (DBI-II) for both a student and also a clinical population ($r = .71$, $p < .001$) and ($r = .70$, $p < .001$) respectively.

3.4.5.5 Present Moment Awareness

The Mindful Attention Awareness Scale ([MAAS]; Brown & Ryan, 2003; Carlson & Brown, 2005) is a 15-item questionnaire with anchors of 1 = *almost always* to 6 = *almost never*, which assesses the core characteristics of present moment awareness (Appendix 16). This single factor measure showed internal consistency of ($\alpha = .82$) and test retest reliability of ($r^2 = .81, p < .0001$). The Likert scale reports higher mindful awareness corresponding to higher scores.

3.4.5.6 Self as Context

Measures of self-as-context are still in the developmental stages and two potential measures were identified for the present study. The Self Experiences Questionnaire (SEQ) recently developed by Yu, McCracken and Norton (2016) and the Self-as-Context Scale (SACS) developed by Gird (2013). The SEQ was developed in the context of chronic pain using a clinical population. Yu took self-as-context as being somewhat multifaceted; the self-as-content (I am the sum of my thoughts), and self-as-context (the distinction of being more than or containing ones' thoughts). The awareness of this during ongoing experiences is the third facet; they term this self-as-process. Yu and colleagues used a Delphi-type approach to identify 29 potential items for the measure. Factor analysis produced 15 items loaded on to two dimensions which they then termed self-as-distinction and self-as-observer. They then tested these as a 15-item questionnaire using 528 adults suffering from chronic pain and looked for associations using scales of depression, social adjustment and pain interference. Although high levels of validity were reported, the authors doubt the use of their findings beyond that of a clinical pain population. Additionally, a failure

to capture the dimension of self-as-process may mean that the list of terms may have been flawed.

The second potential measure developed by Gird in 2013. This 11 item measure, which uses a seven point Likert scale (1 = *strongly disagree* to 7 = *strongly agree*) demonstrated good internal consistency. The developers adopted a Delphi-type approach to identifying scale items. However, unlike Yu et al. (2016), Gird tested the scale on a more general population and included a measure of psychological flexibility within their association testing. Factor analysis also revealed two domains which they identified as; Transcending – the observed self, and Centring – “the ability to be able to find stability in the face on emotional turmoil”. The scale showed a high level of internal consistency ($\alpha = .83$). The paper describing the development process was not published in a peer-reviewed journal. In light of the lack of choice of measures, permission was obtained from the authors of the Self As Context Scale (SACS) enabling its use for the present study (Appendix 17). The results of the present study reflected this in the assessment of limitations.

3.4.6 Procedure

Participants were provided with access to an online survey hosted by Bristol Online Survey (BOS). The survey was presented in three sections. The first provided information regarding the nature of the survey content after which the participants provided informed consent (see for example Appendix 3). For the second section, participants provided demographic information followed by questions about the nature and level of physical activity, followed by the questions contained in the ACT

questionnaires. Finally, participants were presented with a debrief section (see for example Appendix 4).

3.4.7 Data Analysis

No data was collected from participants who started but then chose not to complete the survey. Physical activity levels were calculated using the International Physical Activity Questionnaire (IPAQ). Physical activity levels were used to report two sets of results using multiple linear regression analysis. The first analysis used the sum of the overall activity reported by the IPAQ. The second analysis used only the activity reported during leisure time. Independent variables for both analyses were self-report Likert-scale data obtained from each of the six ACT component questionnaires. Data were subjected to testing for assumptions prior to tests for association between levels of physical activity and the scores for each of the ACT process measures. All analyses were conducted in SPSS v24.

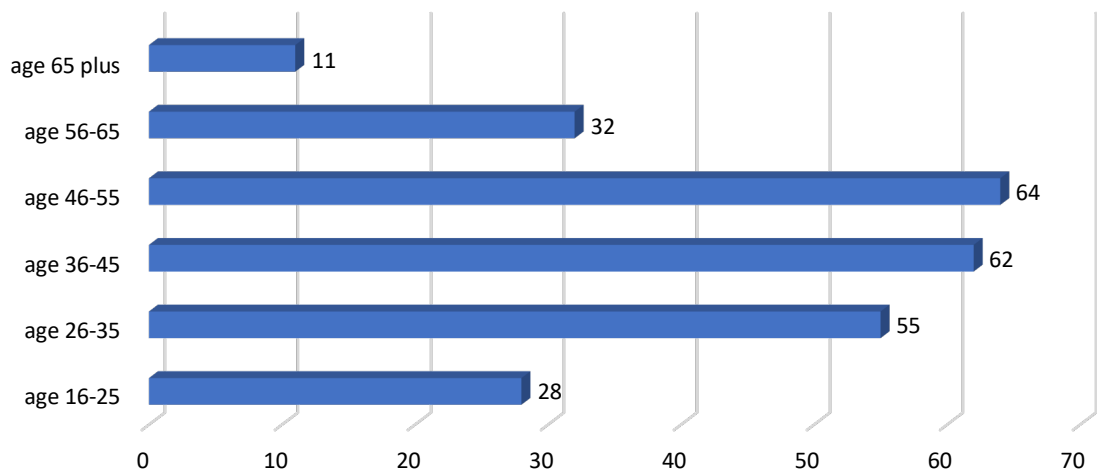
3.5 Results

3.5.1 Demographic Information

Two hundred and fifty-two participants completed the survey. Of this sample, 176 (69.8%) identified as female and 76 (30.2%) as male. Information on participant age-group and occupation are detailed in Figures 3.1 and 3.2.

Figure 3.1

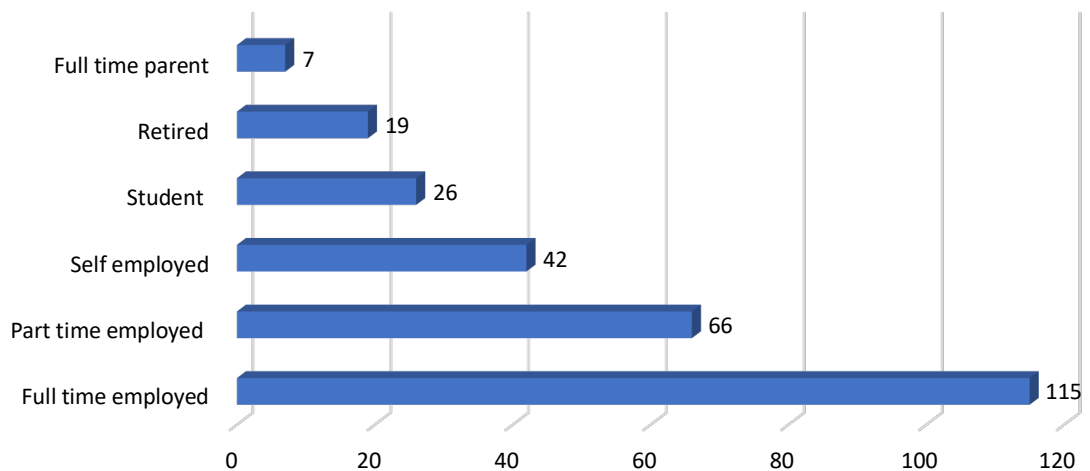
Participant Age Grouping



Note. Items shown are the number of participants per age grouping.

Figure 3.2

Participant Occupation



Note. The items show the number of participant responses to questions about their general occupation. Full time employment was considered to be work activity of more than 35 hours per week.

3.5.2 Data Cleaning

Data reported for levels of physical activity using the IPAQ were inspected for outliers and cleaned according to data processing rules published in the Guidelines for Data Processing and Analysis of the International Physical Activity Questionnaire (2005). Of the 252 participants 39 were considered outliers and thus not included in the analysis. Exploration of the data revealed that listwise exclusion further reduced the included cases to $N = 177$. Pairwise exclusion therefore was applied to data, in order to maintain a sufficiently powered analysis of the data as a result, $N = 202$ cases were included in the final analysis. This is discussed further in the limitations section of this chapter.

3.5.3 Assumptions Tests for Analysis of Overall Activity Level

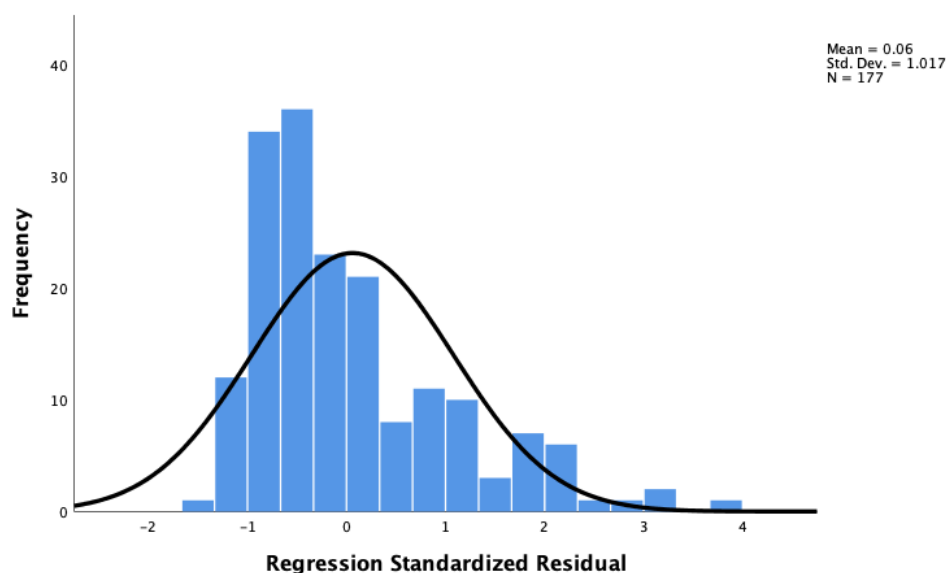
Multiple regression analysis was used to predict total overall METS for the week from scores on the ACT measures. There was independence of residuals as assessed by a Durbin-Watson statistic of 1.498. There was linearity as assessed by a regression plot of the studentized residuals versus the predicted score. There was homoscedasticity, as assessed by visual inspection of plots displaying studentized residuals and unstandardized predicted scores. The correlations matrix revealed a fairly strong correlation between scores on the AAQ-II and CFQ ($r = .86, p < .001$). However, there was no multicollinearity when data were assessed using tolerance values greater than 0.1. Three cases were identified with studentized residuals greater than 3 standard deviations for METS values. Inspection of the data revealed that, although high, the recorded values were within the boundaries one would expect for a very busy lifestyle. Thus, at this stage there was no justification to omit the two outliers from

the results. There were no leverage values above 0.2, and Cook's Distance values show all cases were below 1.0.

The histogram (Figure 3.3) suggested that the data for overall levels of physical activity was fairly well distributed with a small negative skew which falls within -1.0 standard deviations.

Figure 3.3

Distribution of Reported Overall Levels of Physical Activity



In light of the slight negative skew a statistical test of the distribution using Kolmogorov-Smirnov suggested that statistically, data were not normally distributed ($p < .05$). In view of this, square root transformation of the data was performed. This produced data with a strong positive skew and so Log-10 transformation was performed as an alternative, which also produced a strong positive skew. Finally, Inverse transformation provided a more appropriate visual change. However, each transformation failed to produce viable alternative data, when statistically examined

using Kolmogorov-Smirnov tests, all were statistically significant ($p < .05$). In light of this and because multiple regression is fairly robust to non-normal distribution (Habeck et al., 2014; Li et al., 2012), and visual inspection of the data via histogram suggested only minor negative skew, interpretation and prediction of data continued without data transformation.

3.5.4 Results for Overall Activity Level

The multiple correlation coefficient indicated a very low level of association between total reported METS per week and the predicted scores on the ACT process measures. R^2 value for the overall model was 9.0% and the R^2 proportion of variance in METS per week explained by the scores on the process measures was 5.9%. The model was statistically significant, $F(6,178) = 2.92$, $p = .010$. Three of the measures (VLQ, AAQ-II, CFQ) statistically significantly contributed to the model ($p < .05$). Regression coefficients are detailed in Table 3.1

Table 3.1

Regression Coefficients of ACT Process Measures on Physical Activity Levels

ACT process measure	Total METS			Leisure METS		
	<i>B</i>	β	<i>SE</i>	<i>B</i>	β	<i>SE</i>
Constant	-906.50		5231.46	427.82		1266.33
Values (VLQ)	70.70*	.18	28.49	29.48**	.31	6.90
Avoidance (AAQII)	233.17*	.36	91.76	32.18	.20	22.21
Committed Action (CAQ8)	112.50	.13	77.35	15.60	.071	18.72
Cognitive Fusion (CFQ)	-187.25*	-.30	93.48	-38.98	-.25	22.63
Mindful (MAAS)	410.86	.05	664.44	-190.58	-.10	160.83
Self as Context (SACS)	5.17	.01	62.99	6.87	.050	15.25

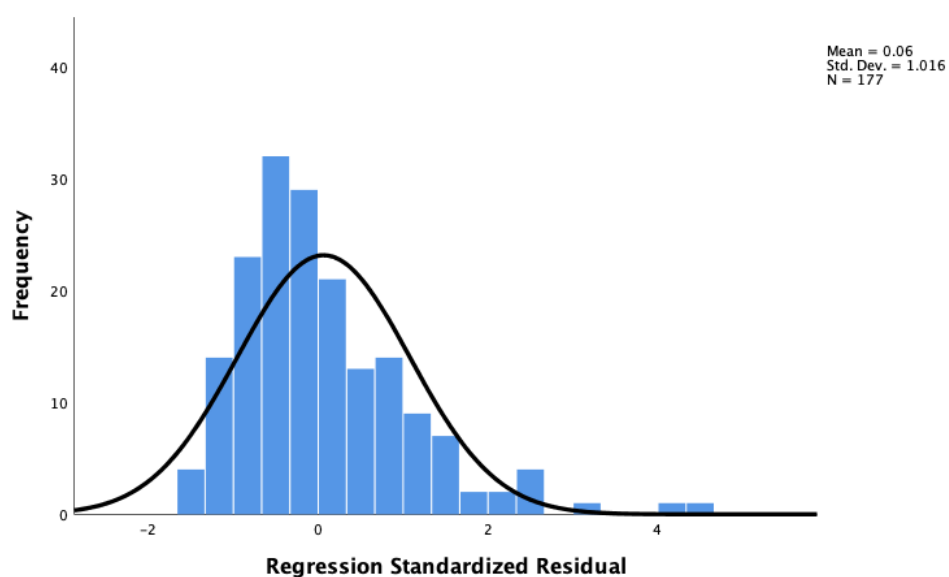
Note: Multiple linear regression was used to examine the impact of reported scores of ACT process measures on the usefulness as predictors of physical activity levels. Model 1 reported the impact of the same scores on total overall levels of activity. In model 2 regression analysis reported the impact on chosen leisure time levels of activity. * $p < .05$. ** $p < .001$

3.5.5 Assumptions Tests for Leisure Time Activity Level

A second multiple regression tested the total METS using leisure time activity for the week and scores for the ACT process measures. Independence of residuals was shown by a Durbin-Watson statistic of (Durbin-Watson = 1.79). There was linearity shown by visual inspection of partial regression plot and also a plot of studentized residuals versus the predicted scores. There was homoscedasticity, as assessed by visual inspection of plots displaying studentized residuals and unstandardized predicted scores. The association between AAQ-II and CFQ remained the only substantial correlation ($r = .86$). Once again there was no multicollinearity when data were assessed using tolerance values greater than 0.1 There were three identified outliers in the data set, however, as detailed in the testing for assumptions of the total METS above, there was no justification to remove the cases from the data set.

Figure 3.4

Distribution of Reported Leisure Time Physical Activity



Visual inspection of the data (Figure 3.4) revealed that the data was fairly normally distributed. However, Kolmogorov-Smirnov test for normality were statistically significant ($p < .05$) showing a non-normal distribution. Transformation of data using Log 10 and Square root methods failed to produce a normal distribution of the data. The violations of assumptions were noted, and the regression continued with no further adjustment (Habeck et al., 2014; Li et al., 2012).

3.5.6 Results for Leisure Time Activity Level

The multiple correlation coefficient indicated a modest level of association between Total reported METS attributed to leisure time per week and the predicted scores on the ACT process measures. R^2 for the overall model was 13.9% and the R^2 proportion of variance in METS per week explained by the scores on the process measures was 11.0%. The model was statistically significant, $F(6,178) = 4.782$, $p < .001$. The multiple regression model significantly predicted values (VLQ) scores ($p < .001$). However, none of the other independent variables contributed significantly to the model. Regression coefficients are detailed in Table 3.1

3.6 Discussion

The overarching aim of ACT is to increase psychological flexibility and promote the identification of life values with the purpose of helping people to live a more fulfilled life (Wilson & Murrell, 2004). ACT therefore suggests that a person's tendency to achieve this can be measured across a number of processes (Harris, 2019; Hayes et al., 1999/2003). For example, those people who score lower on a measure of avoidance, or that have the ability to defuse from uncomfortable thoughts (private-

events) and have a sense of commitment to change, are more psychologically flexible and therefore in a better position to live according to their true values (Hayes et al., 1999/2003). The aim of this study was to explore relationships between the six core components of ACT and levels of physical activity. To do this the study collected survey data which included self-report levels of recent physical activity from a range of domains including work, travel, domestic and leisure-time. These were compared with participant scores on self-report measures from each of the six ACT processes (values, acceptance, defusion, self-as-context, present-moment-awareness, and committed action). In turn, the current study was designed to inform further study on the development of intervention content focused on the most impactful elements of ACT specific to physical activity.

The exploratory nature of the analysis meant that hypotheses were generalised to two ideas. The first hypothesis was that overall levels of physical activity would be predicted by scores on measures of ACT processes. People can be physically active out of necessity, for example, by travelling from place to place, or through their employment. However, people can also be physically active through choice, for example, during a leisure-time activity such as sport and exercise. For this reason, a second hypothesis related directly to the choice of being physically active stated that levels of physical activity during leisure-time would be predicted by scores on measures of ACT processes. Sections 3.6.1 to 3.6.2 explain the results firstly in relation to overall levels of activity, then in relation to leisure-time activity. Following this, sections 3.6.3 to 3.6.5 explore the results for each of the ACT processes identified as significant predictors of levels of activity. This is followed by a general discussion of the findings as a whole.

3.6.1 Prediction of Overall Physical Activity Level

In line with the study hypothesis, results showed a significant model-fit for prediction of overall activity levels, although only three of the six measures contributed to the prediction of overall levels of physical activity. Findings indicated that not all ACT processes predicted overall levels of physical activity in the manner stipulated by the first hypothesis. Scores from the values questionnaire showed that participants who rated being physically active more strongly statistically predicted higher levels of physical activity overall.

Interestingly, higher scores of avoidance reported by the AAQ-II and also cognitive fusion reported by the CFQ, significantly predicted higher overall levels of physical activity. The results suggested that, higher levels of avoidance and fusion, both indicative of psychological inflexibility, predicted people would be more physically active overall. That is to say, when taking into account activity across work, travel, domestic chores and leisure-time domains.

3.6.2 Prediction of Leisure Time Physical Activity

The IPAQ domain of leisure-time defined as activity other than by domestic chores, travel, and employment commitments, provided a potential model of ACT related traits exhibited by those people who engage in regular exercise activity through choice. Scores from the values questionnaire showed that participants who rated being physically active more strongly, statistically predicted higher levels of physical activity during leisure time. However, none of the remaining five ACT processes significantly predicted levels of leisure- time-only activity.

3.6.3 Values Relationships

Activity levels calculated using overall activity and also calculated separately using only leisure-time levels of activity both showed that higher levels of physical activity were predicted by people who scored higher on values. This suggested that values are likely to be elements of ACT which could influence people's level of engagement in physical activity. There are however a number of interesting points of discussion to consider before making assumptions related to these results. Firstly, the values questionnaire asked about valued domains of living, and compared these with values about physical activity. Participants reported their level of agreement with statements in the questionnaire using a seven-point Likert scale which was rated between 1 = *strongly-disagree* to 7 = *strongly-agree*. One of the statements was, for example: "My spare time interests are of key importance". Participants then considered a second statement related to the first, and also to physical activity. The second statement was therefore, "Being physically active helps me with this value". As detailed in the section 3.4.5.1 the values questionnaire was adapted for the current study from the Valued Living Questionnaire (Wilson & Murrell, 2004) so as to be context specific to exercise/physical activity. As such, the results suggest that people who identify with life values that are consistent with their values on physical activity are likely to be more active. However, the results do not report how closely they live to values other than those related to physical activity.

3.6.4 Avoidance Relationships

Understanding how avoidance scores in the current study might impact on levels of physical activity can be drawn from the literature detailing the development of the AAQ-II by Bond et al. (2011). The measure was designed to address the dichotomous relationship between two fundamental concepts in the ACT model; acceptance and avoidance. In ACT terms, acceptance describes the willingness to experience uncomfortable private-events in order to pursue personal values, and experiential avoidance describes the attempt to avoid, or alter the form of private-events, even though the actions taken may contravene personal goals or values (Bond et al., 2011; Hayes et al., 1999/2003; Wilson et al., 2004) ACT maintains that psychological flexibility is an example of acceptance, whereas, inflexibility is described as the persistent dominance of actions taken in order to avoid uncomfortable private-events over personally valued alternatives (Hayes & Duckworth, 2006). As such, the AAQ-II is both a measure of acceptance and also avoidance, where higher scores represent greater tendency for inflexible and avoidant actions in the presence of uncomfortable private-events. Bond et al. (2011) suggested that avoidant strategies develop in a number of ways. Firstly, they can occur in a negative context, such as through the experience of physical pain. However, avoidance can also be routed in experiences such as competition. This kind of relationship might find someone avoiding competitive situations for fear of appearing inadequate. More complex are the avoidant actions established through pleasant private-events. Being a provider for a family is a common personal value (Wilson & Murrell, 2004) which could therefore power the belief of being a great provider by working excessive hours both in work and at home. Bond et al. (2011) suggest that such processes reduce the salience of

alternative valued contingencies and thus appetitive choices based on values that can provide motivation to change ongoing unhelpful behaviours. Thus, scoring highly in a measure of avoidance may suggest a tendency to subconsciously override the idea of working excessive hours in the face of equally, or even more important values. For example, a person may hold on to the belief that going to an exercise class isn't necessary because their job and home life is physical enough, despite evidence that they are gaining weight and that increasing their level of fitness would help them achieve their valued goals. Comparison of this interpretation with the finding from the current study provides a possible explanation as to how those reporting a higher tendency for avoidant ways of thinking predicted higher overall levels of physical activity.

3.6.5 Cognitive Fusion Relationships

Cognitive fusion was statistically significant only when examined in relation to overall physical activity level, and not for leisure-time activity. Interestingly, there was a fairly strong statistically significant correlation between scores on the AAQ-II and the CFQ ($r = .86, p < .001$). Hayes et al. (1999/2003) suggest that the processes of ACT are not completely independent of each other. This overlapping nature of ACT constructs was observed by the developers of the CFQ (Gillanders et al., 2014) who reported several overlying constructs including acceptance. Indeed, a relationship between the two questionnaires was also suggested by the developers of the AAQ-II (Bond et al., 2011). In line with the literature, the current study identified a relationship between cognitive fusion and experiential avoidance. Further, the similarity of these results suggested that people who choose to be more active during

their leisure-time were less likely to be psychologically inflexible and instead appeared to be motivated by their personal value of being active.

3.6.6 General Discussion

The small amount of research exploring ACT in terms of promoting physical activity has indicated that the skills learned through ACT could provide a useful way of understanding perceived private-events related to exercise (see for example Butryn et al., 2015). Barriers to physical activity can evolve from the physiological sensations generated during engagement brought about by feelings associated with exertion, that may be perceived as unpleasant, such as breathlessness, sweating or fatigue (Biddle & Mutrie, 2008). Ultimately, the sensations related to exertion manifest as discomfort; private-events, such as the urge to stop, or feelings of self-conscious or even thoughts about the exertion itself (Butryn et al., 2015; Joseph et al., 2019). The current study sought to uncover associations between levels of activity and naturalistic baseline personality traits measured as processes of ACT. The central hypothesis was driven by the idea that those people with a tendency for psychological flexibility would be associated with an ability to overcome such barriers. Tapper et al. (2009) for example, recruited participants onto an ACT-based weight-loss programme where physical activity and barriers to exercise were a key focus of the intervention content. Tapper reported that those assigned to the ACT-based protocol demonstrated significant increases in activity over a longer period than controls. Ivanova et al. (2015) focused on overcoming barriers of perceived boredom and effort during exercise and reported increases in exercise participation at six months post-intervention. Both studies indicated that increasing participant

knowledge and understanding of the ACT processes increased long-term exercise levels for people who previously avoided physical activity. This suggests that people with a naturally higher acceptance/psychological flexibility would be able to overcome barriers and so would show an association with higher levels of activity. Conversely those more inflexible would tend to engage in less physical exercise behaviours. The current study suggested that people who value being active, those who have a tendency to defuse from unpleasant private-events and also those high in avoidant traits may be predictors of activity levels. Whereas, the ACT constructs of present-moment-awareness and committed action were not significant predictors. This is interesting because some of the existing literature explored in Chapter 1, for example Tapper et al. (2009) included interventions that used all six of the ACT processes. Other reviewed studies for example the intervention content delivered by Ivanova et al. (2015) employed only acceptance and defusion processes. The results from the present study suggest that the processes of mindfulness and committed action are not significant predictors of activity levels and therefore it may be possible to omit training in these skills from intervention content. Interestingly, both Tapper et al. (2009) and Ivanova et al. (2015) reported increases in activity levels immediately post intervention, but only Tapper reported continued significant increases in exercise levels at 26 week follow-up. However, the results of the current study suggest that, when it comes to avoidant traits, being physically active may also be a result of complex relationships between experiential avoidance and the perception of choice.

One explanation as to why this occurs might be attributed to societal attitudes. The internalised experience of stigma, for example, related to body-

weight, serves to influence exercise engagement and is associated with avoidance of physical activity (Vartanian & Novak, 2011) and therefore may result in substituting alternative forms of activity that do not include the experiences associated with physical effort (Joseph et al., 2019). From the perspective of physical activity across domains including work, travel, and domestic chores, engagement in or avoidance of physical activity takes many forms. There are, for example, established links between poor lifestyle habits, such as alcohol use, and stress resulting from excessive workload (Nowack & Pentkowski, 1994; Schabracq, 2003). Common coping mechanisms of work-based stress can be physical activity related and so correlate with a healthy lifestyle that includes exercise. From an ACT perspective however, higher levels of psychological inflexibility correlate with the tendency for avoidant behaviours which can manifest as unhelpful coping strategies often associated with poor lifestyle habits (Cairney et al., 2014; Hayes et al., 1996). In such cases it could be said that the function of discomfort becomes avoidance.

Taking these points into consideration suggests that engagement in physical activity, may be derived from a true association of the value of being active, such as keeping fit and or to spend time with friends. Equally however, it could be derived from a sense of avoidance, such as the belief that to spend longer hours at work or at home doing chores somehow justifies not going to an exercise class. Dahl et al. (2009) describe such relationships as “values-traps”, situations where actions may seem to support long-term values but may be aimed at relieving symptoms or memories of stress, pain or anxiety which mask true valued related action. Often it is easier to relieve the symptoms by seeking fulfilment in outcomes, extrinsically focused conditioned reinforcement such as social status, employment progression

or even living up to the expectation of others. Whereas reinforcement of more intrinsic, process focused actions, would suggest a greater tendency for living in accordance with true values (Teixeira et al., 2019).

ACT seeks to identify when behaviours are unhelpful, avoidant and contrary to true values (Hayes et al., 1999/2003). In relation to physical activity, ACT interventions then teach skills such as defusion (the ability to observe one's own thoughts) which in turn serve to decrease fused and avoidant behaviours in relation to negative internalised private-events and therefore increase exercise engagement (Tapper et al., 2009). Teaching skills to increase understanding of the thoughts and feelings underlying sedentary behaviours are therefore just as important as skills that help people to identify personal values if recipients of interventions are to overcome unhelpful or entrenched behaviours which may be barriers to exercise. A problem with this interpretation, however, is that psychological interventions themselves may be perceived as a barrier because of, for example, stigma attached to psychological help and also issues such as body image (Brenner et al., 2020; Joseph et al., 2019). Should lack of engagement in such experiences be the product of a person's tendency for avoidance then it seems unlikely that they would seek or engage with an intervention to increase their levels of exercise. The audience for such interventions would be those who already see the value in being more physically active, but who struggle with the uncomfortable experiences due to the effort of exercise. This approach was adopted by Moffitt and Mohr (2014) who targeted participants according to their degree of intention for engagement with regular exercise. Ivanova et al. (2015) adopted a similar targeting strategy. Both studies made this differentiation using the transtheoretical model and included

participants in the contemplation stage of adopting an exercise regime (Prochaska et al., 2008; Reed et al., 1997). For this reason, the current study proposed that future development should focus on the identification of values as a motivation for continued engagement and also overcoming the private-events that promote disengagement from a physical exercise. As such, testing interventions that are both brief and exercise focused should concentrate on the ability to cognitively defuse from unhelpful thought and feelings, and the appetitive function of values.

3.6.7 Limitations

Several key limitations of the present study can be attributed to its design. Firstly, the cross-sectional nature meant that data were collected from participants that covered a single time point. A criticism of this approach is that data may not represent the typical weekly volume of activity of the previous week. A factor which could increase this misrepresentation rests with the actual sample composition. A proportion of the sample were students from the University, whilst their patterns may be typical of students, activity levels may be atypical when compared to the general population who due to employment may have limitations on physical activity time or for example, working parents (Maselli et al., 2018; Hamilton et al. 2012). Therefore, in future studies it is recommended that data is collected over several time points and analyses conducted to explore the impact of for example occupation through the use of covariance modelling.

A second limitation was attributed to the measure used to collect physical activity data. The International Physical Activity Questionnaire (IPAQ) asks that people recall their level of activity over the previous seven days, which therefore relies on

the ability of the participant to accurately recall activity. The Guidance for Data Processing and Analysis of the IPAQ (2005) reported that the participant recall of activity levels contribute to over-reporting of the level of activity and skewed data (Craig et al., 2003). The developers of the IPAQ (Craig et al., 2003) detail numerous methods that attempt to rectify the problem of participant overestimation of activity levels. Prior to analysis, overly high rates of activity are omitted as outliers and the remaining data are truncated in order to reduce the likelihood of non-normal distribution. This process led to a reduction in available data from 252 to 200 cases. Missing data from other measures included in the study further reduced the number of complete data sets to 177. Despite the uncertainty regarding the number of respondents required to sufficiently power the study, the number included in the final analysis was some way short of the original target, leaving the possibility that the study was underpowered. Analyses were conducted using a pairwise strategy in order to include as much of the available data as possible. Despite the extensive cleaning and manipulation of data prior to analysis data still violated tests of assumptions and so caution should be taken in drawing conclusions from the findings.

Further consideration as to alternative measures of physical activity level needed to be given not only to the feasibility but also the practicality of the measure used. Objective measures, such as accelerometers and fitness trackers offer an alternative method of measuring physical activity levels. However, such methods have their own methodological reliability problems. A meta-review conducted by Dowd et al. (2018) suggested that methodological effectiveness of measures varied widely for both self-report and objective measures. Self-report measures were prone to overestimation and variation of accuracy due to the perception of exercise

intensity. Whilst objective measures such as fitness trackers provided accurate data but were reliant on correct use by the wearer and the cost of equipment. Dowd stressed the importance of selecting measures appropriate to the study design. As a cross-sectional survey, the sample size required for the current study made the use of objective measures such as a fitness tracker costly. An alternative approach to data collection, such as a daily diary, may therefore have provided more reliable data and reduced the burden of recall for the participants.

3.7 Conclusions

Results showed that people who had personal values related to physical activity were more active not only during leisure time, but overall. Importantly, this suggests that values focused approaches are likely to impact favourably on intervention outcomes for physical activity, especially where a person finds value in being physically active. A source of avoidance with regard to physical exercise is likely to be due to barriers created via the unwillingness to experience private-events; thoughts, feelings or emotions, related to the discomfort of exertion during exercise. The skill of defusion, taught in ACT, offers a way of becoming aware of our own experiences and creating a psychological space between the sense of self and our thoughts. It therefore seems likely that protocols containing both defusion and values processes would be a suitable focus for development of brief intervention strategies. The results of the present study therefore suggested that being able to overcome unhelpful personal experiences related to physical exercise via defusion, value-orientated cues to action, and incorporation of a method of reinforcing those cues would inevitably result in less avoidance.

Phase II

Chapter 4

Testing a Hierarchically Framed Defusion Intervention for Increasing Tolerance to the Discomfort Experienced During a Stepping Exercise

4.1 Introduction

In ACT terms, experiential avoidance describes actions taken to evade thoughts, feelings or situations when engagement with them is perceived as difficult or uncomfortable, even if doing so is inconsistent with personal goals or values (Hayes et al., 1996). The psychological inflexibility (the unwillingness to deviate, accept or experience these private-events) that accompanies avoidance can also result in hypersensitivity to uncomfortable private-events and therefore a tendency to become fused with avoidant responses. As such, when opportunity to engage in valued activity occurs, the resulting action may be to avoid the potential enjoyment of engagement for fear of, for example, disappointment or embarrassment (Bond et al., 2011).

In relation to physical activity this suggests that avoidant behaviours may arise from work and homelife commitments, which in turn, can provide legitimate reasons for lack of engagement in exercise during leisure time. Whilst ACT can provide a means for a person to explore whether their beliefs about exercise correspond to their fundamental core values, the nature of situational avoidance suggests that interventions would need to address inflexible thinking. Paradoxically, this same

avoidance may hinder engagement in ACT, therefore reducing its ability to influence engagement in physical activity. In short, because the choice to engage in exercise is down to the individual, they would have to want to be more active and have the motivation and desire to change. Without this, engagement in any therapeutic process would be unsuccessful.

Often people intend to engage in physical activity but simply struggle to overcome difficult thoughts and sensations which can present a barrier to participation (Biddle & Mutrie, 2008; Ivanova et al., 2015; Joseph et al., 2019; Kangasniemi et al., 2015). This suggests that development of focused, achievable, and cost effective interventions should focus on specific barriers to exercise at the individual level for people that already identify positively with physical exercise (Biddle & Mutrie, 2008; Joseph et al., 2019), but who struggle with motivation and engagement because of thoughts and sensations related to the effort involved.

In relation to using ACT to increase exercise, Moffitt and Mohr (2014) examined the impact of ACT based interventions with participants who were contemplating changes in their exercise behaviour. The empirical studies reviewed in Chapter 2 presented a spectrum of ACT based training, with the aim of exploring how the multi-model training impacted on activity levels. However, the research lacked evaluation of whether increases in activity were due to the effect of specific elements of ACT or whether some combination of the ACT processes was responsible (Butryn et al., 2011; Ivanova et al., 2015; Moffitt & Mohr, 2014).

Results from the survey study (Chapter 3) suggested that personal values related to being physically active were a strong predictor of being more active during leisure-time. High experiential avoidance, while being associated with high levels of

physical activity was not a significant predictor of leisure-time activity. This suggests that focusing solely on experiential avoidance might not be the most effective ACT intervention strategy and that while increasing physical exercise should be the goal, the route to this should encompass multiple ACT processes. This also suggests that ACT interventions may be most suitable for those who are at the contemplative point of leisure-time exercise but who struggle with the uncomfortable personal experiences the exercise provides. In short, a focused intervention that acknowledges the value of physical activity, but which focuses on overcoming the thoughts, feelings and psychological sensations related to exertion, rather than attempting to overcome a tendency for avoidance in general.

A study by Luciano et al. (2011) trained participants in cognitive defusion and self-as-context as a way of overcoming uncomfortable thoughts, feelings, and sensations. The study focused primarily on two methods of presenting a defusion based intervention. The first protocol (which they called defusion I) used in ACT terms, training in defusion, to notice thoughts as they occurred and to internally observe a distinction between thoughts, feelings and the sense of self (I-HERE-THOUGHT-THERE). In RFT terms, this approach constitutes distinction relations. The second protocol (which they called defusion II) incorporated hierarchical relations, which translates to privately observing the process of defusion in relation to the contextual self (I-HERE-THOUGHT-THERE - I AM MORE THAN MY THOUGHTS). The aim was to promote the realisation that often discomfort is experienced as a personal event in the form of thoughts that perpetuate the experience of discomfort, and that defusion provides a means to explore the true nature of private-events. Ongoing behaviours, the result of the observed unpleasant private-events, are undermined by defusion and

can then be challenged using the third element of defusion II, the appetitive function of alternative responses to private-events based on values (Luciano et al., 2011).

The exact procedural and methodological content of defusion II are based in Relational Frame Theory (Hughes & Barnes-Holmes, 2016; Torneke et al., 2016). However, the developers of defusion II (Foody et al., 2013; Foody et al., 2014; Gil-Luciano et al., 2016; López-López et al., 2017) use terminology that is consistent with RFT and also use clinical practical process terms, known as “mid-level” (Hayes et al., 2013). This perhaps is a reflection that research in this area continues to develop, but it also makes teasing out nuanced approach to protocol development difficult (Barnes-Holmes, et al., 2016; McEnteggart, 2018). For this reason, and by way of introduction, this chapter briefly summarises the main research on the development of Defusion II prior to presentation of the empirical laboratory study.

4.1.1 Overview of Defusion II

Using mid-level terms, defusion, self-as-context, and values are viewed as discrete but interrelated processes (Hayes et al., 1999/2003). Barnes-Holmes et al. (2016) suggest that clinical practice of ACT is facilitated when the processes included in ACT are explained as a model (see Figure 1.1). The practical application of defusion and self-as-context provides the opportunity to substitute unhelpful behaviours (functions of learned avoidant strategies) with behaviours consistent with things that are personally important (values). A second more structured view focuses on the content of such interventions, the development of which requires the use of Relational Frame Theory (Hayes, et al., 2001; Törneke, 2017). RFT underpins ACT and can be used to help construct the verbal content of an intervention (see chapter 1 for

a more detailed description of RFT). Concentrating on this theoretical approach, three studies investigated the effects of deictic and hierarchical framing of interventions containing combinations of defusion, self-as-context and cues to action based on values for mitigating behaviours associated with a range of personally experienced discomfort (Foody et al., 2013; Foody et al., 2014; Luciano et al., 2011). The interventions also incorporated mental visualisation of thoughts and feelings and physically orientated written exercises. Findings suggested that teaching defusion in a way that promotes a hierarchy between thoughts, the sense of self, and subsequent behaviours, provides a superior method of promoting behaviour change in comparison to interventions presented using only deictic (sometimes known as distinction) relations.

Further similar work conducted by Gil-Luciano et al. (2016) focused on the effect of discriminative functions using defusion II protocols. In these experiments, Gil-Luciano incorporated physical discomfort as an aversive stimuli. Participants were exposed to two sources of induced discomfort. The first was by exposure to actual physical discomfort using a cold-pressor. The second was implied physical discomfort by observing a film showing limb amputation surgery. Duration of engagement and perceived level of discomfort were reported by participants pre-to-post intervention. There was no difference in the perceived level of discomfort experienced by the participants between the intervention groups. However, participants who received either defusion I or defusion II training significantly increased their duration of task engagement. Further, consistent with findings in the previously discussed literature (Foody et al., 2013, Foody et al., 2014; Luciano et al., 2011) a hierarchically structured defusion intervention (training in both defusion and self-as-context) was superior in

effect to interventions that framed defusion using only deictic relations (Luciano et al., 2011; Foody et al., 2013; Foody et al., 2014; Gil-Luciano et al., 2016). This suggests that ACT processes can be applied as a means of increasing tolerance to induced physical discomfort and also highlights a gap in the research literature. Specifically, the idea that tolerance to discomfort experienced as private-events as a result of physical exercise, such as being breathless, sweating, or feeling self-conscious may be increased by a defusion based protocol.

In practical terms, the active ingredients of Defusion II consist of a number of interrelated processes (Defusion, self-as-context, and value-related augmenters). It is therefore important to understand what effect each of the active ingredients exerts on behaviour change specific to physical exercise. Indeed, guidance on developing therapeutic interventions with multiple interacting components suggests that the modelling of process outcomes should be investigated by conducting a series of studies that allow understanding and refinement prior to any field-trials (Craig et al., 2013). With these points in mind, the present study was the first of a series of studies that investigated the effects of the different processes included in defusion II intervention protocols and for the first time in relation to tolerance of private-events experienced during physical exercise.

4.1.2 Aims and Objectives

The study reported in this chapter aimed to test the effectiveness of scripted defusion-based protocols in relation to tolerance of exercise related discomfort. There were three main objectives. Firstly, to develop a hierarchically framed defusion protocol incorporating generic ACT metaphors used to teach defusion in multiple

exemplar training. Secondly, to compare the effectiveness of the protocols when participants were given the opportunity to practice the learned techniques using either physical, or mental rehearsal. Finally, to compare the effects of the defusion protocols to a control condition (progressive muscle relaxation) that also used physical or mental rehearsal.

The broader aim was to explore whether, by limiting the ACT components to defusion and self-as-context, it would be possible to isolate their true effect on perception of discomfort and duration of exercise engagement. In order to achieve this the study measured the perception of discomfort generated during exercise, rather than the level of exertion. Results were expected to determine whether defusion of thoughts generated whilst being physically active would lead to changes in exercise duration and the perceived intensity of subjective private-events experienced during exercise.

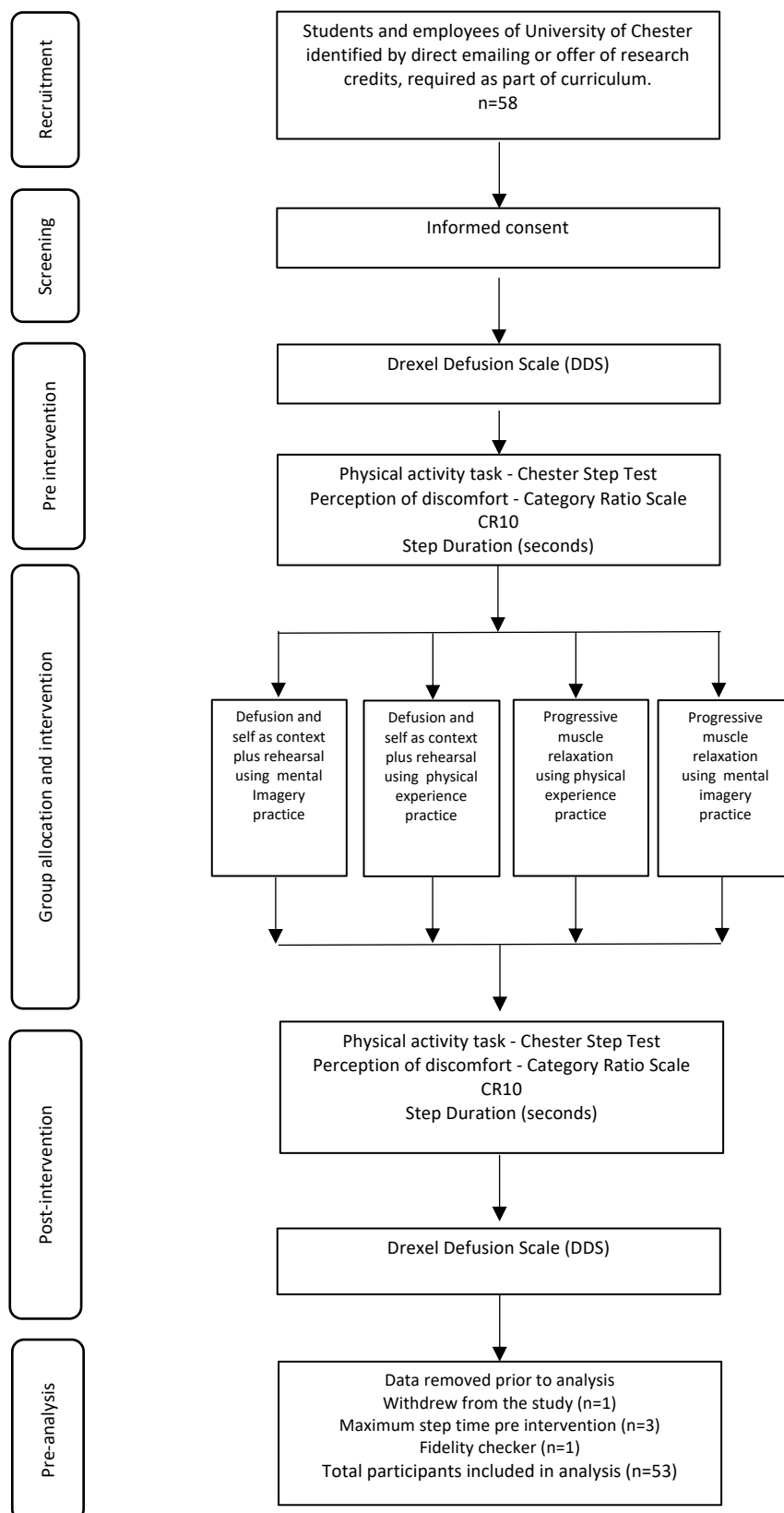
4.1.3 Hypotheses

1. There would be a difference in exercise duration from pre-to-post intervention for participants receiving training in hierarchically framed defusion.
2. There would be a difference in exercise duration in the post intervention condition between participants receiving training in progressive muscle relaxation and those receiving defusion training.
3. There would be a difference in the perceived level of discomfort from pre-to-post intervention for participants receiving training in hierarchically framed defusion.
4. There would be a difference in the perceived level of discomfort in the post intervention condition between participants receiving training in progressive muscle relaxation and those receiving defusion training.

4.2 Methods

Figure 4.1

Flow of participants through the study



4.2.1 Participants Characteristics

Participants were recruited via posters and social media postings within the University. This convenience sampling method meant that participants were limited to staff or students attending the University and all were over the age of 18 years. Prior to acceptance into the study, participants completed a health screening information sheet and self-declared their fitness to take part. Data collection took place between May and December 2016. There was no financial incentive, however students of the University of Chester School of Psychology were offered research participation credits. Ethical approval was obtained from University of Chester Department of Psychology Ethics Committee in May 2016, which operated in accordance with the British Psychological Society Code of Human Research Ethics (2014).

4.2.2 Sample Size and Power

There were very few comparable studies by which to gauge a suitable sample size. Studies highlighted in the introduction section of this chapter reported varied effect sizes. Foody et al. (2013) for example, reported a strong within subjects main effect of time (partial eta square = .47) but not for interaction effects (partial eta square = .05). Luciano et al. (2011) reported strong effect sizes for changes in behaviour post defusion II intervention (Cohen's $d = 1.26$). However, no studies measured precisely, the effect of physical discomfort during exercise. For this reason the calculated sample size for the current study was based on the assumption of analysis using mixed ANOVA and a moderate effect (Cohen's $d = .50$). A calculation

for statistical power using G-power software produced and estimated a sample size requirement of 38.

4.2.3 Development of Scripted Intervention Material

Metaphors are commonly used in ACT to promote client understanding of ACT processes. Therapists choose metaphors specific to the ACT process being explained, and many are commonly used in ACT practice and adapted from reliable published ACT resources (see for example Harris, 2019; Stoddard & Afari, 2014). The present study adapted metaphors for use in training participants in the defusion protocols and then constructed scripted protocols also adapted from work by Foody et al. (2013), Harris (2019), Ivanova et al. (2015), Luciano et al. (2011), and Stoddard and Afari (2014). Four specific metaphors were identified for teaching the concept of defusion for the present study. The first of these, entitled Ball in a Pool (Stoddard & Afari, 2014) is designed to emphasise the counter productiveness of trying to control thoughts. It describes the futility of struggling with distressing thoughts and feelings as like fighting to keep a ball submerged underwater. The second, entitled Kicking Soccer Balls (Stoddard & Afari, 2014) is designed to elucidate the concept of noticing thoughts as they occur and promoting distinction relations (I-HERE-THOUGHT-THERE). During this metaphorical exercise the participant is encouraged to notice thoughts, then objectify thoughts, and place words that describe the thoughts on a ball. Then kicking the ball away whilst visualizing the thought on the ball. The metaphor is detailed in Figure 4.2

Figure 4.2*Kicking Footballs Metaphor Exercise*

Imagine yourself at a football pitch. It can be a famous pitch, like Liverpool's Anfield, or maybe one that you enjoyed playing on when you were younger. As you're imagining yourself on the pitch, take a moment to notice the touchline, near the goal, facing the large open field, and there's a football on the ground next to you. As you bend down to pick it up you notice something written on it. As you begin to focus on it, you notice the words describe a thought that's distressing you. When you can see that thought clearly on the ball place the ball back on the ground, keeping your focus on the thought as you step back to kick it. Now run up to the ball and kick it off into the distance, watching it travel from where you are standing. As you watch the ball travel off into the distance take another deep breath. Now return to the touchline and do this with another ball and another thought. It might be the same thought popping back up again, or it might be a different thought. When you can see that thought clearly on the ball, place it on the ground, keeping you focus on the ball, Step back away from it, run up and kick it off into the distance. (Kicking footballs; Stoddard & Afari 2014).

The second example training distinction relations (I-HERE-THOUGHT-THERE) was a metaphor titled Hands as Thoughts (Harris, 2019). Once again, the metaphor is intended to encourage participants to visualise thoughts and feelings as distinct from each other and makes the differentiation between being fused with, and defusion from, thoughts and feelings. The Hands as Thoughts metaphor is detailed in Figure 4.3

Figure 4.3*Hands as Thoughts Metaphor*

Hold your hands together, palms open, as if they were pages of an open book. Then slowly and steadily raise your hands up toward your face. Keep going until you cover your eyes. Now take a few seconds to look at the world around you through the gaps in your fingers and notice how this affects your view of the world.- What would it be like going around all day with your hands covering your eyes in this way. How much would it limit you? How much would you miss out on? How much would it reduce your ability to respond to the world around you? This is like fusion: we become so caught up in our thoughts that we lose contact with many aspects of the here-and-now experience, and our thoughts have such an influence over what we do that our ability to act effectively is significantly reduced. Now once again cover your eyes with your hands, but this time lower them from your face very, very slowly. As your hands slowly descend beneath your eyes, notice how much easier it is to connect with the world around you. This is like defusion. As you lower your hands they don't disappear, but getting some separation allows you to engage more fully and flexibly, freeing you to choose to act in ways that are important to you. (Hands as Thoughts; Harris, 2009).

The final metaphor entitled Leaves on a Stream (Hayes, 2005), asked participants to envisage placing thoughts on leaves and placing them on the surface

of the water to float downstream. While this format remains deictic in structure, once participants had practiced this, an adapted version of the metaphor was introduced incorporating hierarchical relations (I-HERE-THOUGHT-THERE-I OBSERVE MYSELF HAVING THOUGHTS). This involved the participants mentally observing/noticing themselves engaged in the process of placing thoughts on leaves, letting them float down-stream, and was similar to the method used in existing defusion II literature (Luciano et al., 2011; Foody et al., 2013). The Leaves on a Stream metaphor is detailed in Figure 4.4.

Figure 4.4

Leaves on a Stream Metaphor

If you can, I'd like you to imagine a beautiful, slowly floating stream. - pause 2 seconds. The water flows over the rocks and around the trees, descends down-hill, and travels through a valley. Once in a while, a big leaf drops into the water and floats down-stream. See if you can look down on yourself sitting beside the that stream on a warm sunny day, watching the leaves float by. Now become conscious of your thoughts. Each time an unwanted thought pops into your head, notice the thought, can you notice yourself noticing that thought? Now, imagine that the thought is on one of those leaves. If you think in words, put those words onto the leaf. If you think in images, put them on the leaf as images. Don't try to make the stream go faster or slower. Don't try to change what shows up on the leaves in any way. If the leaves disappear, if you mentally go somewhere else, or if you find that you're in the stream on a leaf, just stop and notice that this has happened. Let it be, and then once again return to the stream. Notice yourself watching a thought come into your mind, place it on a leaf, and let the leaf float down-stream. So, notice the thought, put it on the leaf and let it float. Notice yourself doing this. Continue for the next few moments, just watching your thoughts float by. Visualize yourself doing this. Can you see that you are now noticing yourself noticing your thoughts? (Leaves on a stream; Hayes, 2005).

All of the metaphors were compiled into scripted intervention material designed to be narrated by the researcher in order to guide the participant through the learning process. The opportunity to practice the defusion techniques within the context of physical activity was written into the scripted intervention training. The practice involved a series of simple seated chair exercises. For example, lifting both arms out to the side until they were parallel to the floor and holding the position.

Hierarchical relations were incorporated into the practice session by prompts to observe the process of defusion. An extract is shown below in Figure 4.5.

Figure 4.5

Extract of Scripted Hierarchically Framed Practice Exercises

Take a moment to become aware of how your arms and shoulders feel now, whether they feel relaxed or tense. Just feel your back in contact with the chair you're sitting on. Now I'd like you to slowly lift your arms out to the sides, until they are parallel to the floor. As you hold your arms there, I'd like you to be aware of the muscles in your shoulders and back working to keep your arms extended. How do they feel? Perhaps you can feel your arms becoming heavier, I'd like you to try to become aware of the physical sensations and notice the thoughts you have about those sensations. Each time a thought about perhaps any heaviness you feel in your arms pops into your head, just watch it for a moment. Perhaps you feel the muscles in your shoulders become warm or start to feel fatigued. Each time a you notice your muscles becoming tired, notice that it is you that is watching those thoughts. Each time you notice an unwanted thought try to notice that you are apart from that thought. Notice yourself, noticing the thoughts. You may perceive your arms becoming too heavy to hold any more. When you do I'd like you to slowly lower your arms and place your hands gently by your side.

All four metaphors and physical practice exercises were incorporated into scripted interventions to ensure each participant received the required intervention and to ensure consistency and reproducibility. Fidelity checking (see Carroll et al., 2007 as an example) was carried out by an independent observer, who sat in on a single intervention session of their choosing. The researcher was monitored on procedural and script consistency. The participant was blind to the purpose of the observer and the results from the relevant session were removed from the dataset prior to analysis.

Control conditions consisted of a progressive muscle relaxation exercise (PMR) based on the work of Jacobson (1925/1987) and now widely used as a method of relaxation and reduction of physical tension (Bernstein et al., 2000; Carlson & Hoyle, 1993). The PMR exercises were scripted and focused on tensing and then relaxing major muscle around the body. In PMR participants are asked to notice the difference in sensation between tension and relaxation in muscles during the process. The script

for the exercise was based on a widely used format such as that sourced from Guy's and St Thomas' NHS Foundation Trust (2019) The scripted guidance used by the researcher for each of the experimental conditions is available in Appendix 5.

4.2.4 Measures

4.2.4.1 Measure of Discomfort

Borg's Categorical Ratio Scale – 10 ([CR-10]; Borg, 1998) enables an individual to subjectively rate their perception of intensity of experiences such as pain, noise or brightness (see Appendix 7). The scale can also be used to rate more specific experiences such as the level of discomfort in an area of the body, for example, the legs, during a step exercise. When used in relation to an overriding sensation such as pain or fatigue, re-test and parallel testing for reliability within both clinical and healthy populations using visual analogue scales (VAS), suggested even inexperienced users of the CR10 scale reported high ($r = .79$) correlations (Borg, 1998; Harms-Ringdahl et al., 1986).

4.2.4.2 Measure of Defusion

The Drexel Defusion Scale ([DDS]; Forman et al., 2012) is a 10 item Likert scale questionnaire with anchors of scale from 0 = *not at all* to 5 = *very much*, designed to measure people's ability to psychologically distance themselves (defuse) from internally experienced thoughts and feelings (Appendix 14). The questionnaire covers a range of domains representing daily life stressors such as anger, fear, and pain. The developers of the DDS reported high levels of reliability (Cronbach's alpha = .83) and modest validity ($r = 2.5$, $p < .01$) when compared with the Acceptance and Action Questionnaire ([AAQ-II]; Bond et al. 2011) Forman et al. (2012) also reported a strong

association between gym attendance and changes in DDS scores over a five week period ($r = .45, p = .03$).

4.2.5 Setting and Equipment

4.2.5.1 The Physical Exercise Task

The Chester Step Test (Sykes & Roberts, 2004) is easy to use in a non-clinical setting, primarily for testing aerobic capacity, and is both validated and inexpensive. The task involves stepping on and off a 30cm tall fibreglass box-shaped step at a rate set by a beat in a recording. The stepping rate starts at 15 steps per minute and increases by five steps at two-minute intervals. Instructions accompanying the step test, played via a CD recording, ask that participants continue until they feel that they have worked “moderately hard” or until they reach 80% of their maximum age predicted heart rate. The maximum duration of the test is 10 minutes. The stepping duration is measured by the researcher using a stopwatch.

4.2.5.2.Heart Rate

Heart rate was measured using a Polar FT1 Heart Rate Monitor, which included a wrist watch and a chest-strap type heart rate monitor, both worn by the participant.

4.2.6 Pre-Intervention Procedure

Participants provided informed consent (see Appendix 3) prior to being allocated a participant number. Each number was randomly assigned to one of four experimental groups using the random number generator function in Microsoft Excel. This involved fitting a Polar FT1 sports heart monitor, which remained in place for the

remaining duration of the session. The researcher clarified the definition of discomfort in relation to the step test and the use of the CR-10 scale (Borg, 1998). Base-line measurements were recorded for defusion using the Drexel Defusion Scale, level of discomfort using the CR-10, and heart rate in beat per minute. Maximum heart rate for each participant was calculated using the formula $220 - \text{age} \times 80 / 100$.

All participants were asked to perform the Chester Step Test (Sykes & Roberts, 2004). Values for heart rate and levels of discomfort were recorded on an answer sheet (for example see Appendix 6) before the start of the test, at two-minute intervals during the test and again at the point of retirement from the test. Measurement of heart rate in the Chester Step Test was recorded to ensure that participant exercised within a safe working limit. As such, participant heart rate was not included in the analysis. The maximum duration of the task was 10 minutes.

4.2.7 Intervention Procedure

Immediately after completion of the step task participants were exposed to the intervention, depending on their randomly assigned group. Group A, received multiple exemplar training using hierarchically framed defusion by means of metaphors and defusion exercises as detailed in section 4.2.3. Participants in Group A then practiced what they had learned using mental imagery of physical exercise. For this, participants were asked to visualize themselves performing simple chair based exercises and imagine the associated physical sensations. Group B, received multiple exemplar training using hierarchically framed defusion using metaphors and defusion exercises identical to Group A. However, participants in Group B then practiced what they had learned by engaging in actual physical exercises. For this, each participant

was asked to perform simple chair-based exercises and pay attention to the associated physical sensations. The researcher used the scripted intervention material to guide participants from both groups through the exercises, as detailed in section.

Participants in the control conditions (C and D) received no training in defusion but instead received progressive muscle relaxation training. The PMR exercises involved participants sitting in a chair, listening to instructions that directed their attention to various muscle groups around the body, and noticing the sensations they experience when asked to tense and relax the muscles. Group C were instructed to engage in the PMR exercises by mentally visualising tension and relaxation of muscles and noticing differences in sensation between the states. Group D were instructed to engage in the PMR exercises by physically tensing and relaxing of muscles and noticing differences in sensations between the states.

4.2.8 Post-Intervention Procedure

After completing their assigned intervention, each participant was asked to perform the step test for a second time. Measurements of heart rate, level of discomfort and stepping duration were recorded using the same method as for pre-intervention testing. Following the step test, the participants were asked to complete the DDS measure of defusion for a second time. Participants were not permitted access to their previous DDS results. Debriefing information was provided (for example see Appendix 4) upon completion.

4.2.9 Data Analysis

Results were compiled using Microsoft Excel and incorporated into SPSS v23 for statistical analysis.

The design of the present study was an experimental 4(Group) by 2(pre-post) repeated measure intervention. The dependent variables were participant stepping duration in seconds and the score of perceived discomfort using the CR-10 scale. Each of the dependent variable had two levels, pre and post intervention. Participant trait ability to be able to defuse from internal experiences, measured pre-intervention, using the Drexel Defusion Scale (DDS) were included in the analysis as a covariate. The independent variables were each of the intervention groups. Repeated measures ANOVA was used to investigate interaction effect within and between groups, and to test if trait levels of defusion influenced participant stepping duration and or perception of discomfort.

4.3 Results

4.3.1 Participant Demographics

In all 58 participants were allocated to one of the four possible intervention groups. A total of five participants were removed from the dataset prior to analysis; three participants reached the maximum permitted stepping time during the pre-test phase, one participant withdrew from the study, and one agreed to be a fidelity checker. A total of 40 female and 13 male participants (N=53) were included in the final analysis. Descriptive statistics are shown in Table 4.1

Table 4.1
Summary of Participant Details

Group	N	Age		Sex	
		<i>M</i>	<i>SD</i>	Male	Female
Defusion with mental rehearsal	15	29.5	13.0	1	14
Defusion with physical rehearsal	15	29.6	13.7	3	12
PMR with physical rehearsal	9	22.2	4.1	2	7
PMR with mental rehearsal	14	23.80	6.0	7	7
Total	53	26.8	10.9	13	40

4.3.2 Tests of Assumptions

There were a number of outliers in the data as determined by inspection of box plots. Shapiro-Wilk test for normality show that reported levels of perceived discomfort were not normally distributed ($p < .001$). Although, as the sample size is relatively small, skew and kurtosis statistics for levels of discomfort were within acceptable limits (Field, 2009). Tests for sphericity were not applicable as the dependent variable only had two levels (pre- and post-intervention). There was homogeneity of variance for both pre- and post-intervention levels of discomfort ($p = .138$ and $p = .194$ respectively), but not for pre- and post-intervention stepping duration ($p = .008$ and $p = .005$ respectively) as reported by Levene's test of equality of variance. It is acknowledged that data were non-normally distributed when assessed by Shapiro Wilk's test. There was no clear rationale for excluding outliers, and so in light of the relatively small sample size and because ANOVA is a robust method of assessing group differences (Feng et al., 2014; Schmider et al., 2010), a repeated measures ANOVA was used to test for interaction effects both within and between the intervention groups over time.

Table 4.2

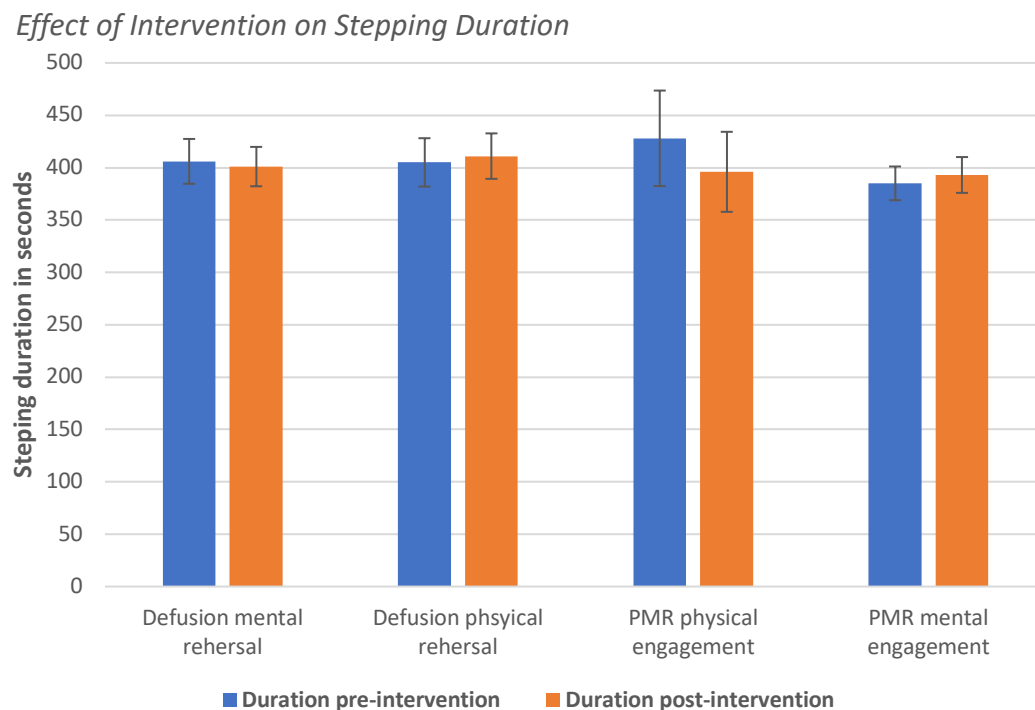
Descriptive Statistics for Baseline Defusion, Pre- and Post-Intervention Discomfort Level and Stepping Duration

Group	DDS Baseline scores		T1 CR-10 rating		T2 CR-10 rating		T1 Step duration seconds		T2 Step duration seconds	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Defusion and mental rehearsal	26.0	7.84	4.43	1.88	4.33	1.95	406	82.8	401	72.2
Defusion and Physical rehearsal	26.6	7.03	3.98	1.56	3.61	1.48	405	89.6	411	84.0
PMR and physical rehearsal	27.7	7.42	4.56	1.81	3.94	2.01	428	137.0	396	115.0
PMR and mental rehearsal	24.3	7.87	3.39	0.96	3.21	1.01	385	60.8	393	64.1

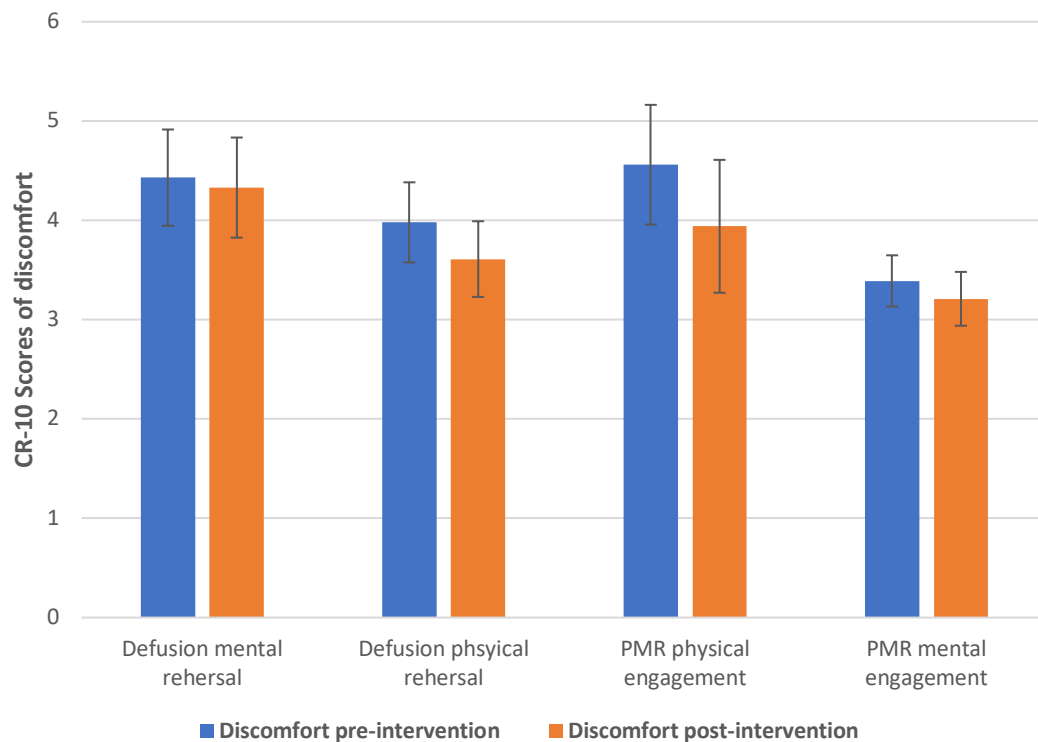
4.3.3 Tests for Interaction Effects

A repeated measures ANOVA compared the effects of each intervention, on the pre-post outcome measure scores (step duration and perception of discomfort) taking into consideration participant existing trait scores of defusion, as a covariate. The main effect of time showed that there was no statistically significant interaction between step duration, level of discomfort and intervention group, $F(3, 48) = 1.40$, $p = .254$, $\eta^2_p = .081$. Tests for within subject effects for step duration were not statistically significant, $F(3, 48) = .0785$, $p = .971$, $\eta^2_p = .005$ and participant trait levels of defusion did not significantly influence step duration, $F(1, 48) = 2.3589$, $p = .131$, partial $\eta^2_p = .047$.

Figure 4.6



Tests for within subjects effects for the perception of discomfort were not statistically significant, $F(3, 48) = 1.4108$, $p = .251$, $\eta^2_p = .081$ and participant reported scores of trait defusion did not significantly influence the perception of discomfort. The main effect of group showed that there was no significant difference in stepping duration or perception of discomfort between the intervention groups, $F(3, 48) = .0970$, $p = .961$, $\eta^2_p = .006$. These results are collated in Table 4.3.

Figure 4.7*Effect of Intervention on Level of Discomfort***Table 4.3***Summary of Results*

Effect	ANOVA
Step duration x Intervention Group	$F(3, 48) = .0785, p = .971, \eta^2_p = .005$
Step duration x Trait defusion (DDS)	$F(1, 48) = 2.3589, p = .131, \eta^2_p = .047$
Discomfort x Intervention Group	$F(3, 48) = .0785, p = .971, \eta^2_p = .005$
Discomfort x Trait defusion (DDS)	$F(1, 48) = 2.3384, p = .133, \eta^2_p = .046$
Main effect of Group	$F(3, 48) = .0970, p = .961, \eta^2_p = .006$

4.4 Discussion

This was the first in a series of lab-based studies designed to explore whether a brief intervention utilising ACT processes could influence tolerance to discomfort experienced during an exercise task. Intervention content was similar in design to existing empirical research that developed the process known as defusion II (Foody et al., 2013; Foody et al., 2014 Luciano et al., 2011). In line with established research, the present study focused specifically on training in defusion and self-as-context using hierarchical relations and incorporated multiple exemplar training using physical components and mental visualisation. An important distinction, however, was that for the present study, the augmental function of values-based situational cues, used by Luciano et al. (2011) to elicit behaviour change, were omitted from the intervention.

The present study therefore assessed the impact of hierarchically structured training in defusion and self-as-context alone on the function of exercise related discomfort. In short, whether noticing one's own thoughts in the context of private-events experienced during exercise could alter perception of those events, and manifest in longer exercise engagement. This approach, aimed at better understanding the effect of the intervention components, would allow further experimental work to continue and corresponds with the approach to development of complex interventions detailed by General Medical Council guidance (Craig et al., 2013). The present study, the first in a series of three studies, which aim to split what is understood as defusion II (Luciano et al., 2011) into its constituent parts in order to investigate, whether defusion or values-based augmental functions or the combination of these processes (defusion II) could be useful in terms of future

development of interventions designed to help increase engagement with physical activity.

Contrary to the study hypothesis results showed that participants who received a defusion intervention using hierarchical relations did not significantly change their exercise duration from pre-to-post intervention or compared to controls that received a relaxation exercise, regardless of whether participants utilised physical or mental rehearsal. Participants who received relaxation training, did not vary in their stepping duration from pre-to post intervention, regardless of whether their intervention training incorporated either physical or mental visualisation techniques compared to participants in the defusion conditions. The same pattern emerged in regard to the perception of the level of discomfort. Again, contrary to the predicted outcomes, participants who received training using hierarchically framed defusion did not report a significant difference in the level of discomfort pre-to-post intervention either within or between groups.

In essence the present study aimed to establish whether multiple exemplar training using a hierarchically framed defusion protocol was sufficient to change the perceived intensity of discomfort and promote increased exercise duration. The results suggest that a hierarchically framed protocol based solely on defusion and without the incorporation of a value-orientated cue, was ineffective at helping participants overcome the ongoing avoidance of discomfort associated with physical exercise.

When exploring the results of the present study with respect to the established research an obvious difference was the incorporation of value-orientated cues, which were omitted from the present study. However, differences in sample population may

serve to offer an alternative reason for the lack of effect. Luciano et al. (2011) for example, targeted a clinical population experiencing difficulty in ongoing behavioural regulation, whereas, the present study sought to induce the experience of discomfort in the opportunistic, non-clinical population. By contrast, studies by Foody et al. (2013; 2014) did focus on induced discomfort, but the nature of these private-events were based on internal emotional generated discomfort via, for example, self-criticism. Similar to the present study, Gil-Luciano et al. (2016) included a non-clinical sample population and also focused on physically induced discomfort. Gil-Luciano reported an increase in tolerance to a cold-pressor task, however, they, in contrast to the present study included value-orientated cues that serve to change the ongoing stimulus function (the urge to avoid discomfort). This suggests that, because Gil-Luciano et al. (2016) incorporated the augmental cues omitted by the present study, that not only is a purely defusion based protocol insufficient to elicit change in relation to physical discomfort, but also that the situational values based-augmental functions are likely to be key in the effectiveness of such interventions.

A further complication is the subjective interpretation of the dependent variables. Studies report tolerance to physical discomfort objectively by measuring the duration of engagement (Gil-Luciano et al. (2016). This method was employed for the present study and so stepping duration recorded in seconds was an objective measure designed to gauge whether participants overcame the urge to stop stepping in the post intervention condition. The intention was to contrast the duration with the more subjective results for the perception of discomfort reported using the CR-10 questionnaire (Borg, 1998). Participants in the present study were asked to label whatever thought or sensation they were conscious of experiencing that presented

itself as a barrier to further participation in the exercise task. Some examples used to describe the types of experiences were breathlessness, boredom, sensations of tiredness or feeling self-conscious. The intention of the repeated measures design of the present study was to control for the subjective nature of discomfort. However, the study did not control for the possibility that the nature the discomfort may have changed as a result of the intervention.

Additionally, the CR-10 scale consists of an incremental scale which is displayed in whole numbers from 0 to 11, with the option of including higher values at the discretion of the participant. Alongside the scale are descriptions of intensity of the chosen sensation. Instructions dictated that the scale should be used by looking at the verbal expression and matching it to a corresponding value (see Appendix 6). The values provided could be increments of whole or decimal fractions of whole numbers at the participants' discretion. During the step test, the CR10 scale was attached to the wall directly in front of the participant, and they verbally relayed their selections when prompted by the researcher at regular 2-minute intervals. There is general criticism of Visual Analogue Scales (VAS) that measure subjective perceptions because they can be influenced by people's tendency to think logarithmically when making comparisons between attributes of stimuli (Gregory & Colman, 1995). Borg (2007) suggests the CR-10 scale combats this by anchoring the scale with an existing reference point. For example, when reporting levels of pain, the reference point is *the most pain ever experienced*. Additionally, the scale then recognises the possibility of higher levels of discomfort. By contrast the existing studies that developed defusion II interventions reported discomfort without using Borg's method (Foody et al., 2013; Foody et al., 2014; Gil-Luciano et al., 2016). The present study reported perception of

discomfort at the moment when the participant chose to stop stepping. Interestingly, despite the ability to rate levels using the open-ended scale in whole and decimal fractional increments only two participants chose to use decimal increments, and all reported results were within the 0-11 range. It is therefore possible that on this occasion the results using the Borg CR10 scale lacked sufficient sensitivity to report subtle differences in discomfort.

Although the development process of intervention necessitates an understanding of the function of the elements incorporated relative to the problem there are nevertheless questions with regard to the external validity of any future protocol. One of the key assumptions of ACT, for example, is that the fundamental processes require people to understand and work with thoughts and behaviours. The process of defusion, for example, requires that the individual grasp a clear idea of the abstract concept, and also has the opportunity to practice the skills (Hayes et al., 1999/2003). True understanding occurs over a period of time, during which people identify with daily experiences and start to develop some of the skills learned (Harris 2019). Subjective application of skills such as defusion and self-as-context then help to reinforce behaviour change. Additionally, ACT is a third wave, inherently humanistic approach to behaviour change (Hayes et al., 1999/2003). Introducing an element of conscious experience in the form of psychological discomfort in a laboratory setting lacks the worldly experiences associated with “real life” choices to engage in physical exercise. It also lacks any account of intrinsic or extrinsic motivational or personal emotional content that can impact on behaviour and physical and emotionally influenced perceptions.

4.4.1 Limitations

The self-report measure used to test the utility of the developed protocol was the Drexel Defusion Scale (Forman et al., 2012), used pre-post intervention training. The DDS requires respondents to rate their level of response to daily life situations. For example; Imagine that you bang your knee on a table leg. To what extent would you normally be able to defuse from physical pain? (Forman et al., 2012). As such, the DDS is a measure of trait responses and so is perhaps unsuited to record short-term intervention effects. On reflection the DDS would be better suited to longer term follow-up analysis.

The maximum duration of the Chester Step Test is 10 minutes. This potentially limiting factor resulted in four participants reaching the maximum permitted stepping time. Interestingly three of the participants (5% of the total sample) completed 10 minutes of stepping in both pre-intervention and post intervention phases. This suggests several potentially limiting factors for design of the present study. Firstly, the present study did not control for the level of physical fitness of the participant group. Secondly, data obtained from participants who reached the maximum stepping duration lacked validity for comparison with other data. Thirdly, removal of the unreliable data may result in an underpowered study.

4.4.2 Conclusions

Despite its methodological limitations, and lack of statistically significant findings the study reported in this chapter informs further study. For example, when taught using multiple exemplars and commonly used ACT metaphors it is unlikely that defusion and self-as-contexts will increase tolerance to exercise induced discomfort,

regardless of whether rehearsal is physical or mental. Further, the current study utilised hierarchically framed defusion-based processes. However, without the timely incorporation of the values-based statements designed to augment an alternative stimulus function, protocols are unlikely to illicit changes in exercise behaviour. The findings permit the formulation of an experimental hypothesis that the inclusion of values-based statements designed to augment an alternative stimulus function, within hierarchically framed defusion interventions, are more likely to increase tolerance to exercise induced discomfort than interventions using only defusion.

Chapter 5

Testing the Effect of a Defusion II Intervention on the Tolerance to Discomfort

Experienced During a Cold Pressor Task or During a Stepping Exercise

5.1 Introduction

The second empirical study built on the findings of the previous chapter, but also continued to explore established research which has suggested that defusion-based interventions are more effective when they are based on hierarchical rather than distinction relations. As such, development of intervention protocols that use cognitive defusion and self-as-context processes for changing the function of thoughts (unpleasant private-events) associated with anxiety, stress and discomfort have focused on the efficacy of, in RFT terms, hierarchical relations (see for example Foody et al., 2013; Foody et al., 2014; Luciano et al., 2010; Luciano et al., 2011 reviewed in chapters 1 and 4). In a study conducted on a clinical level, Luciano et al. (2011) recruited fifteen adolescent participants, who were prone to impulsive problematic behaviours, to take part in a defusion training intervention. One group learned a distinction relationship between thoughts and the sense of self (I- HERE THOUGHT-THERE). Another group trained to view the relationships between thoughts, and the sense of self, framed hierarchically therefore promoting the realisation of the self-in-context with their thoughts and private-events (I HERE - THOUGHT THERE - I AM MORE THAN THOUGHTS). At this juncture, the training promotes the observation of the self within the context of the private-events, which is more than merely observing thoughts as separate from the self, it is Harris (2019) suggests, the internal observation of that process. Luciano et al. (2011) compared the

efficacy of both styles of training and reported that the hierarchically structured intervention was more effective at alleviating impulsive and problematic behaviours at 4-month follow up.

By contrast, Foody et al. (2014) investigated the relational framing of a protocol on distress reduction. Arguably ACT based interventions were not designed for use on induced distress (Hayes et al., 1999/2003). However, Foody et al. (2014) for the first time suggested that, given robust experimental conditions, emotional responding to induced distress stimuli was also influenced according to the framing of the intervention content. Specifically, stress experienced by the participants was reduced more when the intervention was hierarchically framed as opposed to being framed using deictic or distinct relations.

Building on the finding of these studies (Luciano et al., 2011; Foody et al., 2014), and also the idea that distress could be understood from the perspective of experiential avoidance, Gil-Luciano et al. (2016) focused on the controlled introduction of aversive private-events in the form of both physical and observed pain. Gil-Luciano exposed participants to two sources of pain stimuli, one actual, the other observed. In the first task, participants immersed their hand in water, cooled to 4°C, the observed pain task involved participants viewing a film of surgical amputation. These stimuli were presented to participants in pre-post intervention conditions. Gil-Luciano developed interventions that included scripted multiple exemplar training designed, in RFT terms, to alter the discriminative function of aversive private-events. In practical terms, they aimed to weaken the link between an unhelpful thought (for example, "I cannot do this") and the unhelpful, or avoidant behaviours that may follow such a thought. Gil-Luciano measured the effect of three

multiple exemplar training protocols: a. Defusion I (using distinction relations); b. Defusion II (using hierarchical relations and values based augmental cues); c. Control (“general interview”). Those people in the defusion II condition reported significantly increased duration of task engagement (tolerance) for both cold pressor and aversive film tasks, compared to Defusion I, which was in turn significantly higher than the control condition. Analysis of the perception of pain/discomfort showed no significant differences in pre-post training for any condition.

The controlled lab-based studies by Foody et al. (2014) and Gil-Luciano et al. (2016) suggest that hierarchically framed defusion focused protocols that included augmental cues based on values, could impact positively on induced discomfort. This provides support for the idea that private-events experienced during physical activity are a suitable candidate for further investigation. By contrast, the hierarchically framed defusion intervention reported in Chapter 4 of the current thesis suggested that merely educating participants in the processes of defusion and self-as-context and without such augmental cues is insufficient for increasing tolerance to exercise discomfort. Interestingly, this suggests that not only are augmental cues key to such interventions but also that further investigation of interventions to increase tolerance to exercise related discomfort should include the structured combination of defusion, self-as-context and value related augmental functions (collectively known as defusion II).

There is however a boarder issue to consider in that development of defusion II interventions are in the early stages (see Foody et al., 2014; López-López et al., 2017 as examples). Notwithstanding this infancy, they are designed within the context of relational frame theory, and as such seek to further develop the theoretical basis on

which existing ACT practice stands. There are relatively few studies, and although methods originally explored by Luciano et al (2011) have been partially replicated and empirically scrutinised (for example, Foody et al., 2013; López-López et al., 2017; Food et al., 2014) there is a considerable overlap of authors with published work on the concept of defusion II. In addition, those who teach ACT in practical terms maintain that the whole purpose of ACT is to enable engagement with valued behaviour (Hayes et al., 1999/2003; Harris, 2019). Arguably therefore, to use values as a motivation for change has more in common with behaviour change techniques such as motivational interviewing (Miller & Rollnick, 2013). In light of the current replication crisis in psychology research (Open Science Collaboration, 2015; Wiggins & Christopherson, 2019) and also because the aim of the current thesis is to further extend the research on a robust and replicable footing, the present study sought to adhere closely to the procedures of Gil-Luciano et al. (2016) but also, where possible, to make methodological improvements in order that findings of the present study be replicable.

5.1.1 Aims and Objectives

The study reported in this chapter aimed to test the utility of a defusion-based training protocol similar to that used by Gil-Luciano et al. (2016). The objective of the protocol was to alter the discriminative function of discomfort experienced during a cold pressor task. Additionally, the current study aimed to compare the results with a similar protocol adapted for a physical exercise task.

5.1.2 Hypotheses

1. For the cold-pressor task there would be a difference in duration of task engagement for participants between the groups in the post-intervention condition.
2. For the cold-pressor task there would be a difference in the scores for perception of discomfort for participants between the groups in the post-intervention condition.
3. For the exercise task there would be a difference in duration of task engagement for participants between the groups in the post-intervention condition.
4. For the exercise task there would be a difference in the perception of discomfort for participants between the groups in the post-intervention condition.

5.2 Method

5.2.1 Development of Intervention Material

The primary focus of the present study was to explore the role of defusion II in altering discriminative functions of private-events during the cold pressor task and also a physical activity task. The shift in comparison between a cold-pressor task and an exercise task, rather than an aversive film used by Gil-Luciano et al. (2016) enabled the continued development of work toward an ACT-based intervention and extended the literature concerning the aims of this thesis. Limitations highlighted by Gil-Luciano et al. (2016) were addressed for the present study in a series of methodological adaptations. These are addressed in the following section.

5.2.1.1 General Methodological Development

As with Gil-Luciano's study, the dependent variables were duration of engagement in the task and perception of the discomfort experienced. A change for the present study was to the cold-water task, which used a purpose-made standardized cold-pressor equipment. The present study also used a validated scale for the reporting of perceived intensity of discomfort, Borg's Categorical Ratio Scale – 10 (CR-10; Borg, 1998) replaced the 0-100 visual analogue scale employed by Gil-Luciano et al. (2016).

5.2.1.2 Scripted Material Development

A strength of Gil-Luciano's paper was the detailed account of the defusion protocols for each phase of the study. A detailed account of the text used in their intervention made a clear differentiation between the multiple exemplar training using neutral and aversive private-events, and both the defusion I and defusion II protocols. This provided an opportunity to adapt the protocol for use with an exercise task.

Gill-Luciano's intervention content was delivered by a trained therapist during a two-way interaction, with the opportunity for the participant to answer simple questions posed by the researcher during the session. The training was delivered in phases, first using neutral private-events, for example, the experience of breathing. Each phase built the participants understanding of the defusion strategy. The final phase involved participants remembering the specific thoughts and sensations they had experienced during the aversive tasks (the cold pressor and the aversive film), and via their training, apply the strategy to the private-events they had experienced.

Once this training was complete participants were asked to engage in the tasks again (Gil-Luciano et al., 2016).

By contrast, the current study provided the training using a scripted protocol. The scripts were adapted for the present study and similar in design and structure to work in the established literature (Foody et al., 2013; 2014; Gil-Luciano et al., 2016; Ivanova et al., 2015; Luciano et al., 2011). For this, text detailed in Gil-Luciano et al. (2016) was adapted to be contextually specific to the two experimental tasks (Figure 5.1 provides an example of an adaptation). The scripts were then transferred to audio recordings as the method of delivering the interventions to address two specific issues. Firstly, audio recordings provided a consistent method of training for each participant. Secondly, interventions delivered using audio recordings reduced the potential for bias by the researcher. The audio recordings were presented via speakers and participants were prompted to vocalise answers to questions.

An audio recording was also used for participants in the control condition. This replaced the "general interview" conducted by Gil-Luciano et al. (2016) during which participants were asked questions about their work-life and plans for their future. Instead, the present study used a relaxation exercise, also presented to participants via an audio recording. The recording was developed (see the scripted material in Appendix 9) for the study and was based on a progressive muscle relaxation (PMR) first developed by Jacobson (1925/1987). In PMR, participants are asked to focus on tensing and relaxing various muscle groups around the body and to notice the difference in sensation between the tensed and relaxed muscle. A hard copy of the audio transcripts for the defusion conditions are provided (Appendix 8).

Figure 5.1

An Example of How Text from Gil-Luciano et al. (2016) was Adapted for Inclusion in the Current Study.

The researcher: “Now, I would like you to go back to the moment before you **started to stepping on and off the box** (placed your hand and forearm in the water container). Try to go back to that moment. See if you recall **the instructions saying 3,2,1, Go** (my voice saying ‘Now’) and then see yourself **stepping up onto the box** (placing your hand and forearm in the water). **Try to think of the thoughts and sensations you had when you stepped up onto the box** (What did you feel just at that moment? What sensation did you have in your hand?). **Now I’d like you to say out loud just one of the thoughts you had as a direct result of the sensations you had**. Imagine that you can feel that kind of **heaviness in your thighs and calves** (pin-pricks all over your hand and forearm, *can you?*) *Now, ask yourself who is its having those sensations?* Imagine you can take a picture of that pain discomfort in your **legs** (hand) take a picture and place it in front of you. *Who is contemplating that picture of **discomfort in the legs** (pain in the hand)?* *Now, imagine yourself letting that **discomfort** (pain) be in charge of what you do. See yourself doing whatever you would do if the **discomfort** (pain) were in charge. **I’d like you to say out loud what you would do** (What would you do, then?) *Now, imagine that you allow yourself to be in charge of the situation. Ask yourself what would you do if you were in charge. **Now say out loud what you would do if you were in charge.** Would you be bigger than your pain discomfort in that case? Imagine that you give yourself the chance to place yourself over your **discomfort** (pain). See that you can apply this to any sort of situation in your daily life, when you feel something you don’t want to feel.”**

Note. The above extract is taken from the multiple-exemplar training using aversive private-events. For this, participants were specifically asked to remember thoughts and feeling they experienced during the exercise task. Text adaptations for the present study are in bold text, which replaced text is in parentheses. Italicised text is included in the defusion II condition only.

5.2.2 Participants Characteristics

Participants (N=55) were a convenience sample of students and staff attending the university and members of the general public living locally to the university campus. The minimum age requirement for participation was 18 years. There was a maximum age restriction of 60 years, based on findings by Zhang et al. (2013) and stipulated by the guidance for the use of the cold-pressor, reviewed by the Department of Psychology Ethics Committee in December 2016. The study was approved by the University of Chester Department of Psychology Ethics Committee

(DOPEC). Participants were offered an incentive of £7.50 for taking part. Students from the Department of Psychology were awarded a total of five research credits.

5.2.3 Setting and Equipment

The testing took place within the Department of Psychology at the University of Chester. A room was equipped with a cold-pressor filled with water, two chairs, desktop computer running Windows 10 Enterprise 2016 LTSB software, a 300mm high step designed specifically for the Chester Step Test, a Fastime Zero one stopwatch, a Polar FT1 watch and chest-strap heart rate monitor. Paper towel, fresh drinking water and some disposable cups were available for participants. A desktop computer equipped with Logitech Z120 PC speakers was available to present the audio components of the intervention.

5.2.3.1 Physical Activity Equipment

The Chester Step Test (Sykes & Roberts, 2004) described in detail in chapter 4, was the physical activity task performed by all taking part in the present study. This physical exercise test is validated, inexpensive and easily used in a non-clinical setting, primarily for testing aerobic capacity. In the task, participants are asked to step on and off a 30cm tall fibreglass box-shaped step at a rate set by a beat in the recording. The stepping rate started at 15 steps per minute. The stepping rate increased by five steps at two-minute intervals. The maximum duration of the task is 10 minutes.

5.2.3.2 Cold Pressor Equipment

The cold-pressor task was conducted using a purpose-made refrigerating bath circulator, Model RW-2025G, manufactured by Lab Companion. The 20ltr capacity bath has a working temperature capacity of -25°C to $150^{\circ}\text{C} \pm 0.05^{\circ}\text{C}$. Fluid, in this case water, is placed into the stainless steel tank and the required temperature set using a digital display. Both current temperature and desired temperature are displayed. For the purpose of the current study the water in the cold-pressor was cooled and maintained at $+3^{\circ}\text{C}$ during the experiment. This test is a widely used method of inducing discomfort under experimental conditions and is used extensively in psychological evaluation research of pain (Mitchell et al., 2004).

5.2.4 Measures

5.2.4.1 Acceptance/Avoidance

Acceptance and Action Questionnaire II ([AAQ-II]; Bond et al., 2011) This seven-item Likert scale questionnaire (7 = *always true* to 1 = *never true*) is a general measure of psychological flexibility (Appendix 13). Gil-Luciano et al. (2016) used the Spanish version of this questionnaire by Ruiz et al. (2013) which showed a high level of agreement (Cronbach's $\alpha = .88$) with the English language version. The English version of the AAQ-II reported by Bond et al. (2011) showed test-retest reliability ($\alpha = .81$).

5.2.4.2 Cognitive Fusion/Defusion

Cognitive Fusion Questionnaire ([CFQ]; Gillanders et al., 2014) uses a seven-point Likert type scale (7 = *always true* to 1 = *never true*) which assesses instances of cognitive fusion and can be reverse scored as a measure of defusion (Appendix 15).

Gil-Luciano et al. (2016) employed the Spanish language version of the CFQ (Ruiz et al., 2017) showed similar psychometric properties to the English language version (Cronbach's alpha = .89).

5.2.4.3 Perception of Discomfort

Borg's Categorical Ratio Scale – 10 ([CR-10]; Borg, 1998). The CR-10 scale is used as a measure of individual perception of intensity, where personal experiences like noise, brightness, pain or discomfort experienced in an area of the body, such as the legs, during a step exercise (Appendix 7). When used concerning an overriding sensation such as pain or fatigue, reliability testing within both clinical and healthy populations suggested that using Visual Analogue Scales (VAS) was challenging for inexperienced users. In contrast, the CR10 scale reported high correlations from $r = 0.79$ (Harms-Ringdahl et al., 1986). The scale is presented to the participant in two stages. The first stage involves participants reading a set of instructions and completing a short comprehension exercise. Once completed, the participant may then provide self-report data using the scale as necessary.

5.2.5 Procedure

5.2.5.1 Stage 1 – Participant Screening

Upon providing informed consent (see for example Appendix 3) participants completed the AAQ-II and CFQ questionnaires (see Appendix 13 and 15 respectively), and comprehension exercise for the CR-10 questionnaire (see Appendix 7).

5.2.5.2 Stage 2 – Pre-Test Condition Tasks

All participants were provided with instruction on how to fit the Polar FT1 heart rate monitor and watch. The chest monitor was worn next to the skin. The researcher checked the monitor's functionality prior to the tasks. All participants then took part in the first round of experimental tasks. Exposure to the Cold Pressor and Chester Step Test was counterbalanced so as participants took part in the Cold Pressor task or the Chester Step Test first dependent on their number allocated prior to the randomisation process. Participants allocated odd ID numbers took the Cold Pressor task first, while those with even ID numbers took the Chester Step Test first. Participants were invited to sit on a chair for a short break of approximately 3 minutes following each task to allow for recovery.

5.2.5.2.1 Cold Pressor Task

Immediately before initial testing, the researcher told participants that the water was cooled to $+3^{\circ}\text{C}$ and that experiment involved them immersing their non-dominant hand and wrist into the water. Participants were told that they were free to take their hand out of the water at any time and the experiment was concerned with how long they chose to keep their hand in the water, and the level of discomfort they experienced. The researcher explained that talking during such tasks could mean that they were distracting themselves from their experiences and so talking during the tasks was not permitted. Participants were then invited to sit in a chair so as that they could easily place their non-dominant hand into the water tank. The participant was supplied with a paper towel to dry their hand after the task. After a count-down of three, participants then placed their hand into the water. The duration was

recorded by the researcher using a stopwatch from the time the participant's hand entered the water to the time they withdrew their hand. The duration was written on the results sheet (see for example Appendix 6) by the researcher. Participants were then immediately presented with a copy of Borg's Category Ratio Scale - 10 printed on a piece of paper so as they could see the scale (Appendix 6) and asked to verbally express the level of discomfort experienced at the moment they withdrew their hand from the water. The researcher then recorded the score on the data-sheet.

5.2.5.2.2 The Stepping Task

Immediately before initial testing, the researcher told participants that the exercise task was stepping onto and off of a 30cm box at a rate set by a beat played as an audio file through speakers. Participants were told that they were free to stop stepping at any time. The researcher explained that even though the Chester Step Test was developed as a test of aerobic fitness the study was not concerned with fitness but how long they chose to step and about how they felt at the moment they decided to stop. The researcher explained that talking during such tasks could mean that they were distracting themselves from their experiences and so talking was not permitted. Participants were told that their heartrate would be monitored via the wristwatch during the task and that if their heart rate reached or exceeded 80% of its maximum calculated level for their age, they would be asked to stop. The audio instructions for the step test then started, and after a count-down of three, the participants commenced stepping. The duration was recorded by the researcher using a stopwatch from the time the participants started stepping to the time they stopped. The duration was written on the data-sheet (Appendix 6) by the researcher.

Participants were then immediately presented with a copy of Borg's Category Ratio Scale - 10 printed on a piece of paper and held up by the researcher so as they could see the scale (Appendix 6) and asked to verbally express the level of discomfort experienced at the moment they chose to stop. The researcher then recorded the score on the data-sheet.

5.2.5.3 Stage 3 - Interventions

Following the pre-intervention task, participants were seated at a desktop PC to proceed with their assigned intervention; Defusion I, Defusion II, or Progressive Muscle Relaxation. The interventions were delivered as audio MP3 files via the PC. The researcher selected the appropriate file for each participant determined during the randomisation process. The researcher explained that they were blind as to which intervention the participant was allocated, but that all the files asked for some participant engagement, for instance saying words aloud or closing their eyes. Participants were shown how to use the audio controls, and the researcher left the room for the duration of the intervention.

5.2.5.3 Stage 4 – Post-intervention Tasks

The post-test tasks identical to those performed in stage 2, were performed by all participants.

5.2.6 Design

The present study design was an experimental 3(group) by 2(pre-post) repeated measures intervention. Participants were allocated to one of the three conditions before beginning the experiment. Random allocation to one of three groups was by random number allocation via Microsoft excel. The participants were blind to the other group conditions. The researcher knew participants were allocated to a group number but were blind as to which intervention corresponded to which group number. The dependent variables were the perception of discomfort scores measured using Borg's CR-10 scale, and the time on task measured in seconds. All were reported for the cold pressor and step test tasks pre- and post-intervention.

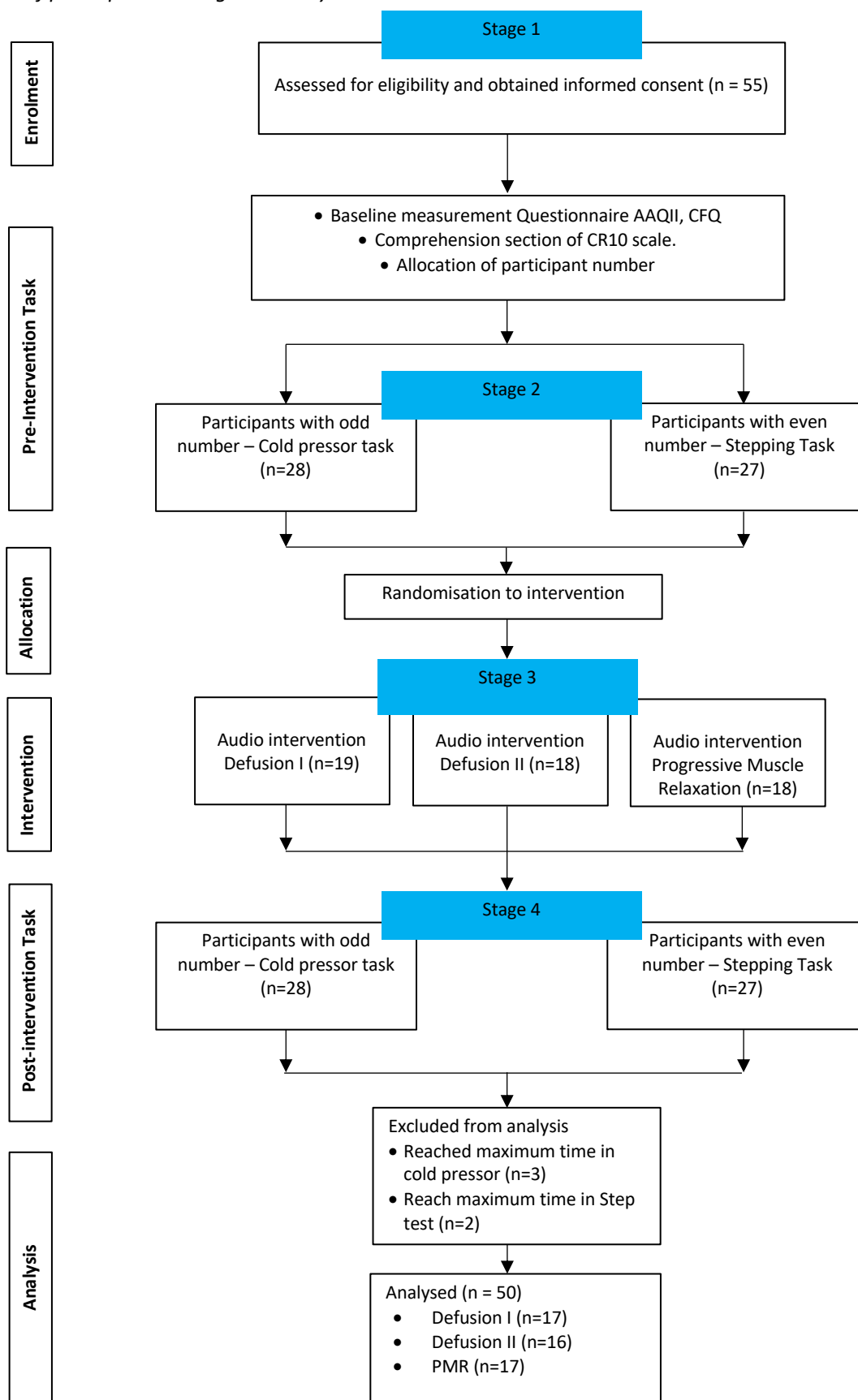
Three Independent variables, each of the three independently tested interventions; Defusion I, Defusion II and Progressive muscle relaxation tested between subjects.

5.2.6.1 Statistical analysis

A series of repeated measures ANOVA were used to investigate interaction effects within and between groups. Follow up analysis of significant pre-post differences in duration or perception of discomfort tested moderation effects of cognitive defusion and psychological flexibility, measured by the CFQ and AAQ-II, respectively.

Figure 5.2

Flow of participants through the study



5.3 Results

5.3.1 Participant Demographics

Of the initial sample, three were excluded because they reached the maximum safe time limit for the cold pressor task during the first round. Two were excluded because they reached the maximum time for the Chester step test during the first round. The final sample (N=50) consisted of nine males (18%) and 41 females (82%), aged 19 to 59 years (M age=31.06, SD =12.88). Analysis of variance (ANOVA) for between-group differences at baseline for age, Cognitive fusion (CFQ), Psychological Flexibility (AAQ II), perception of discomfort and duration in seconds for the pre-test experimental conditions were not statistically significant. A summary is detailed in Table 5.1.

Table 5.1

Descriptive Statistics and Between Group Differences at Baseline

	Defusion I	Defusion II	Control	F (<i>df</i>)	<i>p</i>
Age	30.29 (13.42)	30.75 (12.55)	32.12 (13.37)	.089 (2,47)	.917
CFQ	21.88 (8.66)	18.87 (8.20)	21.82 (6.95)	.761 (2,47)	.473
AAQII	18.76 (7.60)	15.57 (9.46)	19.19 (6.41)	.963 (2,44)	.400
Discomfort in cold pressor	7.32 (1.82)	7.69 (1.59)	7.23 (2.12)	.271 (2,47)	.764
Duration in cold pressor	55.00 (64.63)	45.63 (39.13)	57.12 (75.84)	.158 (2,47)	.854
Discomfort in step test	5.65 (2.32)	5.22 (1.61)	5.97 (1.78)	.626 (2,47)	.539
Duration in step test	383.00 (87.68)	421.56 (109.49)	397.47 (105.03)	.611 (2,47)	.547

5.3.2 Tests of assumptions

5.3.2.1 Tests of Assumption for Duration in the Cold Pressor Task

Time by group tests for assumptions for the cold pressor duration in seconds was conducted. Outliers assess by box plots showed 11 extreme outlier values. Shapiro-Wilk's test for normality showed data were non-normally distributed ($p < .05$). Skewness and kurtosis fell outside the acceptable limits of ± 2 in two out of the three independent variables (Field 2009). There was no homogeneity of covariance as assessed by Box's test ($p < .05$) Although assessments of homogeneity of variance assessed by Leven's test were not significant ($p > .05$) Bonferroni correction was then applied during the final interpretation of the 2-way mixed ANOVA.

5.3.2.2 Tests of Assumptions for Discomfort in Cold Pressor Task

Time by group tests for assumptions for the cold pressor perception of discomfort was conducted. Outliers assess by box plots showed three outlier values. Shapiro-Wilk's test for normality showed data were normally distributed ($p > .05$) in five of six cases; that of the post-intervention perception of discomfort for group 2, which was non-normally distributed Shapiro Wilk's test ($p < .05$). Skew and Kurtosis were all within ± 2 . There was homogeneity of covariance assessed by Box's test ($p > .05$) and assessment by Levene's tests for homogeneity of variance were also not significant ($p > .05$)

Table 5.2
Tests of Assumptions for the Cold Pressor Task

	Group	T1 Cold duration	T2 Cold duration	T1Cold discomfort	T2 Cold discomfort
<i>n</i>	Defusion I	17	17	17	17
	Defusion II	16	16	16	16
	PMR	17	17	17	17
Skewness	Defusion I	2.33	2.26	0.216	-0.0932
	Defusion II	2.90	2.78	-0.349	-0.897
	PMR	2.69	1.76	0.151	-0.793
Std. Error Skewness	Defusion I	0.550	0.550	0.550	0.550
	Defusion II	0.564	0.564	0.564	0.564
	PMR	0.550	0.550	0.550	0.550
Kurtosis	Defusion I	5.01	4.37	1.40	2.80
	Defusion II	9.87	9.42	1.57	-0.475
	PMR	6.82	1.45	-0.388	1.16
Std. Error Kurtosis	Defusion I	1.06	1.06	1.06	1.06
	Defusion II	1.09	1.09	1.09	1.09
	PMR	1.06	1.06	1.06	1.06
Shapiro-Wilk p	Defusion I	<.001	<.001	0.275	0.057
	Defusion II	<.001	<.001	0.307	0.020
	PMR	<.001	<.001	0.715	0.436

5.3.2.3 Test of Assumptions for Duration in the Stepping Task

The time by group tests for assumptions for the step test duration in seconds were conducted. Outliers assessed by box plots revealed five outliers, all of which were less than 1.5 times the median value. Assessment of distribution by Shapiro Wilk's test showed data were normally distributed ($p > .05$) in five of six cases. The post-intervention step duration for group 2, which was non-normally distributed ($p < .05$). Skew and Kurtosis were all within ± 2 . There was homogeneity of covariance assessed by Box's test ($p > .05$) and assessment by Levene's tests for homogeneity of variance were also not significant ($p > .05$).

Table 5.3
Test of Assumptions for the Step Task

	Group	T1 Step duration	T2 Step duration	T1Step discomfort	T2 Step discomfort
N	Defusion I	17	17	17	17
	Defusion II	16	16	16	16
	PMR	17	17	17	17
Skewness	Defusion I	-0.912	0.857	0.407	0.100
	Defusion II	-0.928	-1.49	-0.466	-0.345
	PMR	-0.402	-0.213	-0.341	-0.0813
Std. Error Skewness	Defusion I	0.550	0.550	0.550	0.550
	Defusion II	0.564	0.564	0.564	0.564
	PMR	0.550	0.550	0.550	0.550
Kurtosis	Defusion I	1.78	0.323	-0.791	-1.35
	Defusion II	0.916	1.86	0.574	-0.257
	PMR	-0.381	-1.18	-0.408	-0.373
Std. Error Kurtosis	Defusion I	1.06	1.06	1.06	1.06
	Defusion II	1.09	1.09	1.09	1.09
	PMR	1.06	1.06	1.06	1.06
Shapiro-Wilk p	Defusion I	0.392	0.120	0.454	0.128
	Defusion II	0.185	0.012	0.722	0.318
	PMR	0.726	0.467	0.534	0.941

5.3.2.4 Test of Assumptions for discomfort in the stepping task

The time by group tests for assumptions for the step test perception of discomfort were conducted. Outliers assessed by box plots showed just one outlier, which was within 1.5 times the median value. Normal distribution assessed by Shapiro Wilk's test show data were normally distributed ($p > .05$). Skew and Kurtosis were all within ± 2 . There was homogeneity of covariance assessed by Box's test ($p > .05$) and assessment by Levene's tests for homogeneity of variance were also not significant ($p > .05$).

It is acknowledged that data in a small number of cases were not normally distributed when assessed by Shapiro Wilk's test. However, skew and kurtosis were within the acceptable norms and as ANOVA is an extremely robust method of assessing group differences (Feng et al., 2014; Schmider et al., 2010) there was no clear rationale for excluding outliers, and so it was assumed these were actual results. A series of 2-way repeated-measures ANOVA's were conducted to assess interaction effects. Moderation analyses to estimate the effects of people's trait levels of psychological flexibility and cognitive defusion were performed using PROCESS (Hayes, 2018) in conjunction with SPSS.

Table 5.4*Results Summary for the Level of Perceived Discomfort and Time on Task for Cold Pressor and Step Tasks*

Test	Def I		Def II		PMR		Main effect of time	Time by group interaction
	Pre-int	Post-int	Pre-int	Post-int	Pre-int	Post-int		
Cold Pressor Duration	55.00 (64.63)	69.40 (83.80)	45.63 (39.13)	74.60 (66.20)	57.12 (75.84)	79.40 (107.00)	$F(1,47) = 12.746, p = .001,$ $\eta^2_p = .213$	$F(2,47) = .470, p = .628,$ $\eta^2_p = .020$
Cold Pressor Discomfort	7.42 (1.82)	7.00 (1.66)	7.69 (1.59)	7.22 (2.32)	7.24 (2.12)	6.82 (2.56)	$F(1,47) = 4.19,$ $p = .048, \eta^2_p = .081$	$F(2,47) = .045, p = .956,$ $\eta^2_p = .002$
Step Test Duration	383.00 (87.70)	408.00 (89.80)	422.00 (109.00)	481.00 (107.00)	397.00 (105.00)	408.00 (112.00)	$F(1,47) = 20.718, p < .001,$ $\eta^2_p = .306$	$F(2,47) = 4.410,$ $p = .018, \eta^2_p = .158$
Step Test Discomfort	5.65 (2.32)	5.57 (2.23)	5.22 (1.61)	5.57 (1.76)	5.97 (1.78)	5.21 (2.13)	$F(1,47) = 1.073, p = .306,$ $\eta^2_p = .022$	$F(2,47) = 4.202, p = .021,$ $\eta^2_p = .152$

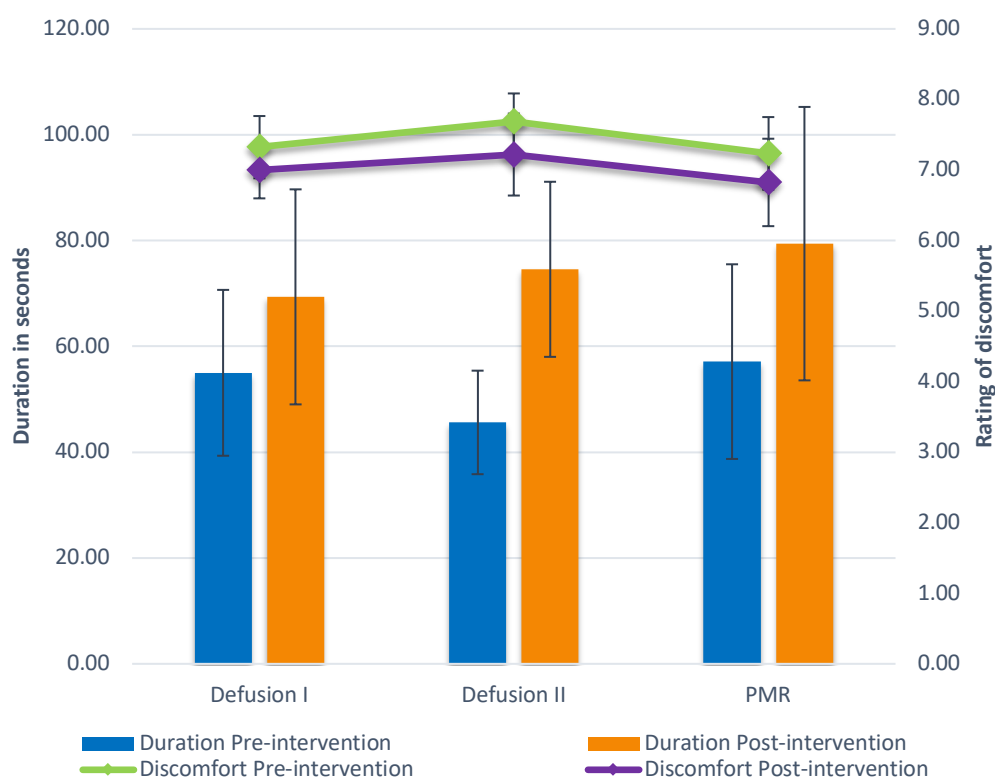
Note. Standard deviation in parentheses.

5.3.3 Tests for Interaction Effects in the Cold Pressor Condition

Test of within-subjects effects for the cold-pressor task showed that there was a statistically significant difference between pre- and post-training for the duration that participants spent with their hand submerged in the water, $F(2,47) = 12.746$, $p < .001$, $\eta^2_p = .213$. There was no statistically significant time by group interaction for cold-pressor duration, $F(2,47) = .470$, $p = .628$, $\eta^2_p = .020$. Likewise, test of within-subjects effects for the level of perceived discomfort in the cold-pressor task also showed a statistically significant difference between pre- and post-training, $F(1,47) = 4.19$, $p = .048$, $\eta^2_p = .081$. However, there was no statistically significant time by group interaction for the perception of discomfort for the cold pressor task, $F(2,47) = .045$, $p = .956$, $\eta^2_p = .002$, see (Figure 5.3).

Figure 5.3

Pre-post Intervention Mean (SE) Scores for Cold Pressor Task



5.3.4 Tests for Interaction Effects for Stepping Task Condition

Tests of within-subjects effects for the Chester Step Test showed there was a statistically significant difference between pre and post-training for the duration that participants spent stepping, $F(1,47) = 20.718$, $p < .001$, $\eta^2_p = .306$. Time by group interaction effects for the step task were also statistically significant, $F(2,47) = 4.410$, $p = .018$, $\eta^2_p = .158$. Post-hoc comparisons showed that pre-post intervention, participants in defusion II group significantly increased their stepping duration, $t(47) = -4.8689$, $p < .001$, and there were no significant interaction effects between the other groups over time. Test for within-subjects effects for the level of discomfort showed there were no statistically significant differences between pre and post-training for the level of perceived discomfort in the stepping task, $F(1,47) = 1.073$, $p = .306$, $\eta^2_p = .022$. However, the time by group interaction was significant, $F(2,47) = 4.202$, $p = .021$, $\eta^2_p = .152$. Post-hoc comparisons failed to show significant interaction effects between the groups over time. Follow up post hoc Tukey test analysis using change scores for the level of perceived discomfort in the step task revealed that there was a statistically significant pre-post change in the level of perceived discomfort between participants in the defusion II group compared to participants in the PMR group, $t(47) = 2.86$, $p = .017$, see (Figure 5.4).

There were no statistically significant moderation effects for psychological flexibility or cognitive defusion (measured by the AAQ-II and the CFQ respectively) on participants duration of stepping or perception of discomfort between the groups in the stepping task. (Table 5.5)

Table 5.5

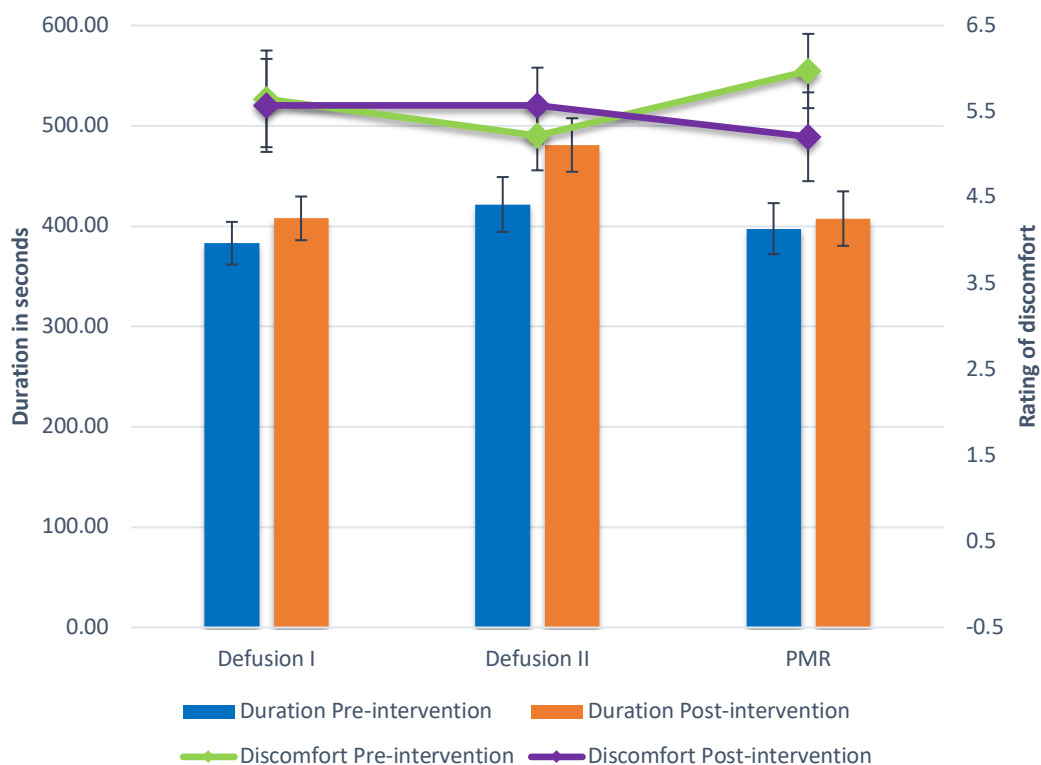
Moderation Analysis Results Showing No Significant Moderating Effects of Cognitive Defusion or Psychological Flexibility on Task Duration and Perception of Discomfort

Outcome variable	Mean	CFQ	AAQ-II
Change in seconds for duration of cold pressor task	21.72 (42.81)	$R^2 = .0567, F(5,44) = .529, p = .753$	$R^2 = .1073, F(5,41) = .986, p = .438$
Change in level of discomfort for cold pressor task	-.400 (1.37)	$R^2 = .0225, F(5,44) = .203, p = .958$	$R^2 = .0094, F(5,41) = .078, p = .995$
Change in seconds for duration of stepping task	30.82 (52.01)	$R^2 = .1642, F(5,44) = 1.728, p = .148$	$R^2 = .1610, F(5,41) = 1.574, p = .189$
Change in level of discomfort for stepping task	-.174 (1.19)	$R^2 = .1676, F(5,44) = 1.772, p = .138$	$R^2 = .1675, F(5,41) = 1.650, p = .168$

Note. Standard deviations in parentheses.

Figure 5.4

Pre-post Intervention Mean (SE) Scores for the Chester Step Test



5.6 Discussion

Interventions using defusion II have been shown to be a superior method of increasing tolerance to induced experiential discomfort (Foody et al., 2014; Gil-Luciano et al., 2016). The current study sought to replicate these findings and also add to the existing evidence base by the extending of the established methodology and tested the efficacy of the hierarchically framed strategy specific to the discomfort induced during physical activity.

The objectives of the present study were two-fold. Firstly, it investigated the utility of a protocol incorporating defusion, self-as-context and values-based augmenters of behaviour, and so formed the second of three experimental studies exploring experimental protocols designed to alter ongoing behaviours in the face of discomfort experienced during physical activity. Secondly, it aimed to replicate the complex framing of the language used by Gil-Luciano et al. (2016) to present the training of ACT processes. The intention was to build upon Gil-Luciano's findings by incorporating further robust methodology and extend the research by adapting the training for use with an exercise task. The principal hypotheses suggested that the present study would show a pre-post change in the duration of engagement in each of the tasks and also a pre-post change in the perception of intensity of the discomfort experienced during the tasks relative to the intervention content.

5.4.1 Baseline Characteristics

The participants reported no difference in psychological flexibility or tendency to defuse from unpleasant thoughts and sensations across the sample of 50

participants included in the study. Tolerance to discomfort and the perceived intensity of their discomfort relative to the task suggested that participants experiences of discomfort were also broadly similar before the intervention. Over half (56%) of the sample consisted of students, although with a mean age of 25 compared with a mean age of 40 for the non-student portion of the sample. Unsurprisingly, 41 of the 50 participants identified as female, which is consistent with other empirical work on ACT identified in the systematic review chapter of this thesis.

5.4.2 Evaluation of Cold Pressor Task Duration and Discomfort

The first hypothesis related to the cold pressor task was that there would be a difference in duration of task engagement for participants between the groups in the post-intervention condition. However, in spite of the significant main effect of time, the difference between the groups was not statistically significant. A trend in the mean values (Table 5.4) suggested that participants in the defusion II group showed the highest increase of task duration over time. Participants receiving relaxation training increased their duration to more than those receiving the defusion I training. A similar, pattern was observed in results for the perception of discomfort. Again, participants reported a significant main effect which suggested a reduction in the level of discomfort experienced at the moment the participant withdrew their hand from the water. However, the mean differences between the groups were insufficient to suggest that neither of the defusion conditions or mindfulness changed the perception of discomfort. This is interesting, because overall the results show that the participants were prepared to engage in the task for longer at post-test, regardless of the unchanged level of discomfort.

Several possibilities could explain the lack of interaction effects. There is uncertainty in the literature as to the most appropriate water temperature during a cold pressor test. Myers et al. (2001) for example used temperatures between +1 °C and +3°C in tests that included hand immersion, while Enggaard et al. (2001) cooled water to +4°C, and Rainville et al. (1992) to +5°C. The debate lies in findings by Mitchell et al. (2004) who suggest that even small variations in temperature between +1°C and +5°C can have significant effects on tolerance. They also identify that the circulation of water is critical, as without this, the water immediately next to the skin is warmed slightly, making tolerance more possible. Based on these assertions, the present study circulated the cooled the water to a temperature of +3°C. This contrasts with the uncirculated water, cooled to +4°C utilised by Gil-Luciano et al. (2016). Additionally, for the current study, all participants were asked to report the maximum level of perceived discomfort they experienced during the task. This allows for the possibility of experiential avoidance from private-events other than physical pain, such as boredom or feeling self-conscious.

An influence on the results may also have stemmed from the subjective measurement of discomfort itself. There has been criticism of VAS scales for use in such circumstances, as there is a tendency to overestimate levels of stimuli (Gregory & Colman, 1995). However, as discussed in chapter 4, the CR-10 scale makes use of reference points during a short explanatory exercise which is completed by participants before using the scale. The empirical study, detailed in chapter 3, discusses the failure of participants to use fractional increments in their assessment of levels of discomfort. Interestingly, for the current study, despite explicit instruction of ability to rate levels of discomfort using the open ended scale in whole and decimal

fractional increments only 16% of the total data points recorded for the level of discomfort in the cold pressor task, were fractional scores. It therefore remains a possibility that on this occasion the Borg CR10 scale lacked enough sensitivity to report subtle differences in perception of discomfort of such subjectivity.

5.4.3 Evaluation of Stepping Task Duration and Discomfort

Mirroring the study expectations for the cold pressor task, the hypotheses for the exercise task suggested that there would be significant differences in both duration of engagement and also in the perception of the level of discomfort experienced during the task. The mean values show that participants in all three groups increased their duration of stepping pre-to-post-training. Indeed, the main effect of time was statistically significant and there was a significant between group difference in stepping duration from pre-to-post-training. Post-hoc tests showed that the significant interaction effects were confined to participants in the defusion II group, who significantly increased their stepping duration from pre-to-post-training. While participants in the defusion I group, and those in the PMR group reported increased stepping duration over time, the increases were not statistically significant.

The main effect of time for the levels of discomfort reported in the stepping task was not significant. There was a significant time by group interaction, although follow up post-hoc comparisons failed to show significant interaction effects between the groups over time. Inspection of the mean values for the perception of discomfort suggested a decrease in perceived discomfort for participants in the PMR group pre-to-post intervention compared to slightly increased levels of discomfort pre-to-post intervention for participants in the Defusion I and defusion II groups. To

investigate this relationship further, change scores were calculated by subtracting pre-training scores from post-training scores for the reported levels of discomfort. The resulting analysis showed a statistically significant difference in the level of perceived discomfort between participants in the defusion II group compared to participants in the PMR group (see Figure 5.3). The results of stepping duration and the associated level of discomfort showed that participants in the PMR group did not significantly increase their step duration pre-to-post intervention, but they did experience less discomfort. By comparison, participants in the defusion II group exercised for longer after training although it would appear, they significantly extended their stepping duration despite the increasing discomfort. Interestingly this suggested that progressive muscle relaxation, which in the present study was intended to act as a control condition, had a significant effect on the outcome of the results. Although on the surface this data appears encouraging, it should be noted that the reported effects sizes are modest, the partial eta square value for the step duration interaction effect for example was $\eta^2_p = .158$.

5.4.4 Defusion and Psychological Flexibility as Moderators

Moderator analysis was employed to investigate further whether trait levels of cognitive defusion or psychological flexibility were related to the task results. As described in section 5.2.6, current data used repeated measures ANOVA's to report both within and between subject effects which allowed a judgment of the main effect of engagement in the tasks. In contrast, results published by Gil-Luciano et al. (2016) reported significant between-group differences using pre-post change scores for tolerance and also for levels of discomfort in the cold pressor task. This method

provided only the significance of interaction effects, and so any main effects require separate analysis. However, using change scores permits the use of moderation analysis because the pre-post scores are replaced by a single variable. As a secondary analysis, the current study explored the possible impact of participants' trait tendency to simply observe one's own thoughts as separate from the sense of self (cognitive defusion) and their level of psychological flexibility to act as a moderator by comparing base-line scores from the AAQ-II and the CFQ questionnaires to change scores for stepping duration and the level of perceived discomfort during the exercise task. In order to check the validity of this method, change scores were calculated, and factorial ANOVA's were run to cross-check the effects of making calculations based on change scores compared to computations using the repeated measures method. The time by group effects were identical, suggesting that the use of change scores did not impact negatively on the results. The results can be compared in Table 5.4. Follow-up moderator analysis (see Table 5.5) conducted on the significant interactions reported for the step test condition showed that neither people's trait cognitive defusion or level of reported psychological flexibility significantly moderated the duration of engagement or the level of perceived discomfort in the exercise task, regardless of which training they received. This suggests that the interventions were responsible for the changes observed during the study. It was interesting that only the defusion II protocol resulted in participants significantly increasing their stepping duration, but the lack of significant moderation reported by the CDQ suggests that defusion alone is not sufficient to alter the discriminate function of exercise. As discussed in chapter 4, Defusion I protocols involve teaching only deictically framed defusion and defusion II protocols train defusion, self-as-

context and values-based augmental functions. The results, therefore, suggest that the process responsible for altering the discriminative function of the discomfort experienced during exercise was either the combination of the three processes or the appetitive functions of the values-based augmenters.

5.4.5 Limitations

The control condition may have been responsible for the lack of between-group differences. In the current study, the intention of using progressive muscle relaxation was to provide an alternative, period of relaxation to act as a control to the experimental components of the study. Progressive muscle relaxation was originally conceived by Jacobson (1925/1987) and is used in sport and exercise to elevate the effects of stress and anxiety and most commonly to promote relaxation (Kellmann, Pelka & Beckmann, 2018; Pelka, 2017). Its efficacy is strongly linked to dosage and effects are greatest when PMR is used as a regular method of relaxation (Carlson & Hoyle, 1993). Although Rausch et al. (2006) showed that PMR could be highly effective as a stress reduction technique after just one brief session. It should be noted that findings in the present study showed a real effect of time for each of the three interventions and that the PMR may have an effect on the perception of discomfort.

The length of time between the first and second bouts of stepping was limited to the duration of the intervention. A three-minute rest period was permitted to each participant after the first bout, before commencing the training specific to their group allocation. However, the duration of each training session was not equal. The training in the defusion II group was 22 minutes, after which the participant was asked to

engage in the exercise task for the second time. Participant training in the defusion I and the PMR groups was slightly shorter in duration (14 minutes, and 10 minutes respectively). For the balance of time, participants were asked to sit quietly in their chair and relax. It is, therefore, possible that this arrangement had a bearing on the results as not only had participants in the defusion II group received training over a longer period, there was also minimal time lag between the end of the training and commencement of the second bout of stepping.

The Chester Step (Sykes & Roberts, 2004) was designed principally as a test of aerobic fitness. As such the test lasts a maximum time of 10 minutes. It was unfortunate that data from two participants was excluded from the analysis because they completed the test to the maximum duration in the pre-training condition. A further two participants completed the test during the post-training condition but were included in the analysis. The Chester Step test is limited in its capacity to take into consideration participant ability. Given that future development of an intervention to promote physical activity would need to consider people with poor levels of fitness and mobility, a more inclusive exercise task may have been more appropriate.

As discussed in section 5.3.2, data violated assumptions testing for Analysis of Variance. Although ANOVA is robust to uneven distribution of data, caution should be taken when drawing conclusions from the study findings.

5.4.6 Conclusions

Participants in the defusion II training protocol significantly increased their stepping duration compared to defusion I and PMR. Although there remains some

uncertainty as to which combination of ACT processes was responsible for the change. The focus of the following final study should therefore isolate the values-based augmental functions present in a protocol. Timing of interventions should be broadly similar without the opportunity for participants to become distracted from their tasks. The exercise task should be less limited by duration, less dependent on personal ability and therefore more inclusive.

Chapter 6

Testing a Values Focused Intervention to Increase Tolerance to Unhelpful Private-Events Experienced During a Cycling Task

6.1 Introduction

The first of the three experimental studies detailed in chapter 4, concluded that training in cognitive defusion and self-as-context, using a combination of deictic and hierarchical relations and without incorporation of augmental value-orientated cues, had no significant effect on tolerance to private-events experienced during a physical exercise task. However, when hierarchical relations were applied in a defusion, self-as-context protocol which did include value-orientated cues (defusion II) during the second experimental study (see chapter 5) a small but significant increase in tolerance to discomfort was evident. This suggests that the functional component of such an intervention could be appetitive value-based augmental cues and that defusion acts as a facilitator for this function. However, because the objective of defusion II interventions is to augment a change from an ongoing avoidant strategy, there remains the question of whether the identification of thoughts (via defusion) is necessary. In other words, can the values-based augmental cues remain an effective intervention strategy without training in defusion.

Studies involved in the development of defusion II interventions helped the participants to identify their own augmental cues (Luciano et al., 2011). However, there is little reference made in the defusion II literature as to the specific clarification of values. Further, although hierarchical relations were used in teaching defusion and self-as-context, there was no exploration of whether using the same hierarchical approach might be useful within the context of values clarification or whether

hierarchical relations could be used to establish augmental cues between values and private-events experienced as a result of exercise exertion. For example, the intervention reported by Luciano et al. (2011) included a values-orientated exercise. This was composed of a series of questions allowing participants to evaluate their ongoing behaviours, the consequences of both continued or alternative actions (outcome-based deictic relations) and provided the opportunity for participants to make a choice of alternative action. This conditional, outcome-based approach is similar to a method adopted in motivational interviewing (MI) (Rollnick et al., 2008; Bricker & Tillison, 2011), the values-based approach used to facilitate change or decision making. MI provides a platform through which clients can explore their own thoughts and feelings about uncomfortable or difficult decisions and help clarify a valued direction. Both MI and defusion II establish conditional relations between participant identified behaviours and their outcomes. By contrast hierarchical relations can be viewed as more process-focused thus framing the consequences of changing ongoing actions with alternative behaviours (Eswara-Murthy et al., 2020; Torneke et al., 2016). From an RFT perspective, networks of hierarchical relations allow for reinforcement of desired outcomes on an ongoing basis. For example a participant might engage in a task (for example, regular exercise) because they recognise that participation is serving a goal (for example, losing weight) which can be linked to independent desirable consequences (for example, being able to socialise with friends that cycle). Such networks are reinforced by positive feelings which serve overarching values such as a fulfilment or sense of social acceptance. Thus, defusion II promotes the potential for a long-term dynamic strategy for change (Ewarsa-Murthy et al., 2019). Whereas, MI, conditional or outcome framed

approaches primarily focus on overcoming immediate obstacles (Brodie & Inoue, 2004; Chair et al., 2013).

ACT places great emphasis on the clarification of values (Hayes et al., 2012). They form part of the foundation on which the ACT model is built which in turn aims to promote the mindful, values-consistent action, indicative of psychological flexibility (Harris, 2019). The use of values within ACT are multifaceted, in that they can serve as deeply held personal principles, and also as mediators; inspiration, motivation and purpose, to ongoing actions and quality of those actions (Harris, 2019; Wilson et al., 2010). Hence, values are both subjective and complex, so for the individual, they may require considered clarification.

In practical terms ACT utilises both conversational scenarios and more formalised psychometric style questionnaires to aid clarification. A conversational scenario might include, for example, the participant describing what they would like to hear in their own eulogy, or exploring what strengths and weaknesses they have, how they would develop them and what they would like to achieve (Harris, 2019; Strosahl et al., 2005). Other methods include psychometric style questionnaires which attempt not only to identify values but also whether individuals behave according to those values. The Common Core Values Guide (Forsyth & Eifert, 2016) simply lists values such as joy, family and health which serve to aid clarification of what is truly important to an individual. However, the Bull's-Eye Values Survey (Lungdren et al., 2012) is a formal psychometric approach for which participants group their values into domains such as health, personal relationships and leisure, and then describe how closely they fulfil each value. Similarly, the widely used Valued Living Questionnaire ([VLQ]; Wilson et al., 2010), also divides values into domains,

but uses a Likert scale on which participants rate both the importance of each domain, and how closely their behaviours correspond to those domains. However, these more formal approaches necessitate that participants readily identify with what is important to them, and as discussed in chapter 2, people may be blind to their true values. Indeed, as Dhal et al. (2009) describe, people may live unaware of their values because they find it easier, simpler and more comfortable to engage in an alternative action which offers less than their heartfelt values. The presence of such avoidance arguably makes a verbal style of clarification more useful, although clarification based on conversation has the potential to make experimental research more difficult to reproduce empirically. In previously developed defusion II protocols (see for example, Foody et al., 2013; Gil-Luciano et al., 2014; Luciano et al., 2011) hierarchical relations were used in relation to defusion and self-as-context. However, there was no exploration of whether using the same hierarchical approach is useful within the context of values clarification or whether hierarchical relations could be used to establish augmental cues between values and private-events experienced as a result of exercise exertion.

A further consideration, once values have been identified, is how they should be incorporated into an intervention protocol, and more importantly how participants should learn and use a values-based strategy as an appetitive cue. As discussed, defusion II does this by drawing attention to the nature of thoughts and feelings, and privately observing that process. Separate ACT research has used other methods to operationalise ACT processes. Ivanova et al. (2016) for example, increased participant tolerance to exercise discomfort using acceptance and defusion by incorporating IF-THEN strategies, a technique used widely in cognitive therapies,

based on implementation theory (see Gollwitzer & Sheeran, 2006; Koestner et al., 2002). In their ACT intervention aimed at increasing exercise tolerance, Ivanova et al. (2016) trained participants to notice thoughts, and IF they noticed a thought to stop exercising THEN they should notice that it was just a thought, and that if they wished to they could keep exercising. IF-THEN strategies may offer an alternative method of augmenting appetitive cues by, for example, IF you feel the urge to stop, based on whatever stimulus (pain, discomfort, boredom) THEN you should remember what is important to you. There are however some potential problems with the IF-THEN strategy in relation to the current series of studies, meaning that they may be unsuitable.

Firstly, in RFT terms IF-THEN strategies represent deictic relations, however, the literature underpinning this thesis suggests that interventions incorporating hierarchical relations are potentially superior in nature (see for example, Foody et al., 2014; Gil-Luciano et al., 2016; Luciano et al., 2011). Second, the present study aimed to isolate the use of values, to investigate the potential for co-dependence between defusion, self-as-context and values so as to inform future interventions. Finally, people may not always readily identify with their values and even when they do there is no guarantee that they may be relatable as a potential cue. For example, being a good parent is commonly identified as being a key personal value. However, if the value is not relatable to overcoming exercise discomfort then the augmental function of the cue is lost. Hierarchical relations provide the opportunity to transform the deictic identification of a value with a behaviour into a network of alternative behaviours that might satisfy the same value.

The content of Defusion II interventions, like other ACT interventions, also rely on metaphor and visualization within the training protocol. For example, Luciano et al. (2011) asked participant to visualise thoughts and sensations as like moles and freckles, in order to establish context. Gil-Luciano et al. (2016) asked that participants contemplate their thoughts written on a balloon. A study by Criollo et al. (2018) explored the use of ACT metaphors in relation to chronic pain. They suggested that metaphors where more effective when they were structured to be directly relatable to the nature of the pain experienced. Similarly, Sierra et al. (2016) showed the additional use of appetitive augmental functions, included in such metaphors further increased tolerance of pain.

The combination of the findings from established empirical research and results from the studies in preceding chapters suggest that the present study should address three main issues. Firstly, to allow continued comparison with previous thesis findings a values-based intervention protocol would need to address both clarification of values and also establish a relationship between the identified values and participant desire to overcome unhelpful private-events experienced during physical exercise. Secondly, a combination of both hierarchical and deictic relations, observed as a superior method of training defusion and self-as-context (Foody et al., 2013; Gil-Luciano et al., 2016; Luciano et al., 2011; Sierra et al., 2016), should be used for the elucidation of values related to exercise. Thirdly, the use of metaphors should be contextually similar to the task and utilise appetitive augmental functions specific to the task and to participant values.

6.1.1 Aims and Objectives

The study reported in this chapter aimed to test the effectiveness of a scripted values-based intervention in relation to exercise related discomfort. There were two main objectives. The first, to develop a values-based clarification exercise that incorporated hierarchical relations between values and their relationship with discomfort. The second was to develop a values-based intervention using metaphors designed to provide participants with augmental cues to persist in the engagement of an exercise task. The aims were to compare the effectiveness of three intervention protocols in relation to private-events experienced during an exercise task. One protocol utilised the values clarification exercise in combination with a metaphor containing augmental cues. The second protocol utilised metaphor training in augmental cues with no values clarification, and instead incorporated a short relaxation task. The third protocol, used only an extended version of the relaxation task. The groups were used to generate a series of study hypotheses.

6.1.2 Hypotheses

1. Participants in the metaphor and a values clarification group would increase their exercise duration pre-to-post training.
2. Participants in the metaphor and a relaxation task group would increase their exercise duration pre-to-post training.
3. Post intervention exercise duration would be statistically different between intervention groups.
4. There would be a difference in the level of perceived discomfort pre-to-post intervention for participants in the metaphor and a values clarification group.

5. There would be a difference in the level of perceived discomfort pre-to-post intervention for participants in the metaphor and relaxation task group.
6. There would be a difference in the post intervention levels of perceived discomfort between the groups.

6.2 Method

6.2.1 Participants

Participants were recruited using posters and social media postings from within the University. As such, participants were a convenience sample of staff and students attending the University and all were aged over 18 years. Potential participants read a screening information sheet and were accepted onto the study after declaring themselves fit to take part. Data were collected between April and October 2019, in the University of Chester School of Psychology laboratories. There was a financial incentive of £5 cash for taking part. Students of psychology within the University were offered the choice of the cash incentive or six research credits. Ethical approval was obtained from University of Chester Department of Psychology Ethics Committee (DOPEC) in March 2019, which operated in accordance with the British Psychological Society Code of Human Research Ethics (2nd edition, 2014).

6.2.2 Sample Size and Power

Research underpinning the present study tested for main effects of independent variables in relation to controls and reported moderate effects sizes (Criollo et al., 2018; Gil-Luciano et al., 2016; Sierra et al., 2016). A study by Sierra et al. (2016), for example, reported main effect sizes for the independent variables;

common physical properties, $F(1) = 6.135$, $p = .016$, $\eta^2 = .093$ and specification of augmental functions, $F(1) = 6.024$, $p = .017$, $\eta^2 = .091$. As such, medium effect sizes were used to estimate an appropriate sample size for the present study. Estimated sample size was calculated a-priori using G-Power v3.1 to provide α , power and effect sizes based on repeated measures between factors ANOVA. Given a calculated effect size ($f .3202$) an α level of 0.05 and power $1-\beta$ of 0.8 the required total sample size would be 75 to adequately power the study. However, because some elements of the intervention differ from the methods presented in similar research by, for example, Gil-Luciano et al. (2016) the present study aimed to recruit a slightly larger sample consisting of three groups of 27, giving a total of 81 participants.

6.2.3 Development of Intervention Material

The current study explored the relationship between methods of values clarification by developing a novel values clarification task and comparing the effect with a common ACT metaphor. For the present study both methods were used as a way of exploring value-based actions in relation to a static bike physical exercise task (Varra et al., 2008; Stoddard & Alfari, 2014). A diagram of participant flow through the study is presented in Figure 6.2.

Three intervention protocols were developed for the current study, each supported by scripted material which aided the researcher to guide participants through the intervention. The scripts developed for group one incorporated deictic and hierarchical relations, in a metaphor which explored values as an appetitive cue to alternative stimulus functions to private-events during an exercise task. In addition to the metaphor, group one also took part in hierarchically structured values

clarification training also developed specifically for the present study. The script developed for group two included the same metaphor as group one, but without values clarification training. Instead, scripted material for group two included a short relaxation exercise. The script developed for group three detailed an extended version of the relaxation exercise, but no metaphor or values clarification exercise. A short explanation of the scripted intervention development is provided below in sections 6.3.4 and 6.3.5.

6.2.3.1 Development of a Contextually Specific Metaphor

Scripts for groups 1 and 2 focused on exploring values as cues for alternative responses to private-events and incorporated both deictic and hierarchical relations. The protocol for groups 1 and 2 included an adaptation of a commonly used ACT metaphor called, The Swamp Metaphor (e.g., Gutierrez et al., 2004; Hayes et al., 1999/2003, p. 247; Sierra et al., 2016). The metaphor is designed to highlight that people will often overcome unpleasant obstacles in order to obtain what is important to them. In practical terms the swamp metaphor asks people to imagine that the only way to reach something of particular importance is to cross a muddy swamp. Attention is drawn to the unpleasant thoughts and sensations they experience as they progress through the swamp. People are introduced to notion that they have a choice of whether to proceed across the swamp and that their actions depend on the value they place on the outcome. The metaphor says, “We don’t choose to enter the swamp because it is unpleasant, but because it stands between us and where we are going” (Stoddard & Alfari, 2014).

Considering recent work by Criollo et al. (2018) which showed the effect of using contextually similar properties within ACT metaphors increased their effectiveness, the swamp metaphor was adapted for the current study so as to incorporate the contextually similar example of riding a bike across rough overgrown ground. Additionally, the adapted metaphor incorporated the specification of augmental functions, similar to those used by Sierra et al. (2016), which ask people to be mindful of something that is important to them as a goal, should they choose to continue. The metaphor and an extract of an accompanying script used by the researcher is detailed in Figure 6.1. Full scripts are detailed in Appendix 9.

Figure 6.1

Extract of Scripted Metaphor Including Specification of Augmental Cues

Introduction to the metaphor

People often experience unpleasant thoughts and feelings about physical exercise. Often they can present a reason not to be more active, what we call a psychological barrier. It's these barriers that can prevent people from taking part in an activity that they value. People can overcome these barriers by giving themselves a reason to push past unhelpful thoughts in order to achieve what's important to them. Like training to do a marathon in aid of Cancer research. People run for a cause, but what if that cause was related to one of your deepest personal values. I'd like you to try to think about things that are important to you and see if you can use just one of them as a reason to push past unhelpful thoughts and feelings you experience during exercise.

The Metaphor

Suppose you are on your pushbike beginning a ride to a beautiful mountain you can see clearly in the distance. No sooner than you start your ride, the road becomes a rough and overgrown muddy track that extends for as far as you can see. You say to yourself, "Blimey, I didn't realise that I was going to have to go cross country. It's bumpy and the mud is making it slippery. It's hard to peddle through the ruts. I'm hot and tired. Why didn't anyone tell me about this track?" Exercise is like that. Life is like that. We go down the track not because we want to get muddy, but because it stands between us and where we are going. At this point you have a choice you can either stop and go back, or you can carry on because the value of the getting to the mountain is worth the discomfort. Please, let yourself imagine the feeling you'd have riding toward something you value. What would you choose to do? Would you stop at the start of the track? Would you power on through and peddle on despite the discomfort of the fatigue? What would you choose to do?

6.2.3.2 Development of a Values Clarification Task.

The present study developed a hierarchically structured novel values clarification intervention, designed to help participants identify personal values, gain an understanding of how they relate feelings to their values and finally allow the opportunity to relate values to physical exercise behaviours. Scripted material presented by the researcher introduced a values clarification task and guided participants into the first section of the protocol, which was composed of three interrelated worksheets. The worksheets, completed by participants, were arranged sequentially, each worksheet exploring values in a more focused way than the last. The first worksheet asked people to use a Likert scale to rate general aspects of life that they identify as being of fundamental importance, such as family, physical well-being, or recreation. This portion of the task was adapted from an existing self-report values measure: The Valued Living Questionnaire ([VLQ]; Wilson et al., 2010). The second worksheet asked that people isolate three top scoring aspects of life identified in the previous section and explore reasons why the values are important by writing a short statement explaining their choices. Following this, people again use a Likert scale to rate the level to which being able to act in accordance with those values would impact on how they feel. The final section of the protocol, supported by scripted material presented by the researcher, asked that people explored framing a value in the context of the physical exercise task (See figure 6.1). A copy of the values clarification worksheets and the accompanying scripts are available in Appendix 9.

6.2.4 Setting and Equipment

Testing took place within the University School of Psychology laboratory. The lab was furnished with two comfortable desk chairs, a PC with speakers and a set of headphones and a static exercise bike. Heart rate was monitored using a Polar FT1 chest worn heartrate monitor and watch. Duration of exercise engagement was recorded using a stopwatch. Scripted material and participant information were printed on A4 paper and laminated. Bottled water, and paper towel were available as necessary. Randomised group allocation was achieved using a random number generator using Microsoft excel 2016. Results were recorded in Microsoft Excel and then transferred to Jamovi V1.0 for statistical analysis.

6.2.4.1 Physical Exercise Task.

A Technogym Bike Forma static exercise bike was used for the exercise task. Participant details of maximum heart rate and body weight in kg and peddling duration can be inputted into the “Constant Heart Rate Workout” programme using the bikes digital display. Upon starting in this mode, the rider is provided a three-minute warmup period when the bike offers minimal peddling resistance. Following this the effort required to peddle is adjusted automatically in order that the rider maintains the pre-selected heart rate throughout the entire exercise period. For the present study participant were asked to maintain a peddling rate of between 60 and 70 rpm, indicated by the display on the bike.

6.2.5 Measures

6.2.5.1 Acceptance and Action Questionnaire II.

The Acceptance and Action Questionnaire II ([AAQ-II]; Bond et al., 2011) is a well-established measure of both psychological flexibility and the ACT process of experiential avoidance (Appendix 13). The AAQ-II is a seven item Likert scale questionnaire (7 = *always true* to 1 = *never true*). Its developers used data from 2816 cases and reported the AAQ-II as having good test retest reliability and validity, with a mean alpha coefficient of .84 (Bond et al., 2011). In the current study, the AAQ-II provided a baseline measure of experiential avoidance.

6.2.5.2 Cognitive Defusion/Fusion.

Defusion, was measured using the Cognitive Fusion Questionnaire ([CFQ]; Gillanders et al., 2014). The CFQ provides a brief self-report measure of cognitive fusion using a seven-point Likert-type scale with anchors of 7 (*always true*) to 1 (*never true*). Through reverse scoring fusion becomes a measure of defusion. Gilanders et al. (2014) reported high test-retest reliability ($r = .81, p < .001$) over a four-week period. The CFQ has also been found a consistent measure in relation to studies in pain management ($\alpha = .87$; McCracken et al., 2014).

6.2.5.3 Perception of Discomfort.

Borg's Categorical Ratio Scale – 10 ([CR-10]; Borg, 1998) was used to report the intensity of the urge to stop peddling and also the perceived effectiveness of strategies learned by the participants (Appendix 7). The CR-10 scale is recognised as

a measure of individual perception of intensity, where the source can be experiences such as pain, noise or brightness as well as personal experiences including the discomfort experienced in an area of the body, such as the legs, during physical exercise. When used in relation to an overriding sensation such as pain or fatigue, re-test and parallel testing for reliability within both clinical and healthy populations using visual analogue scales (VAS), suggested even inexperienced users of the CR-10 scale reported high correlations $r = 0.79$ (Borg, 1998; Harms-Ringdahl et al., 1986).

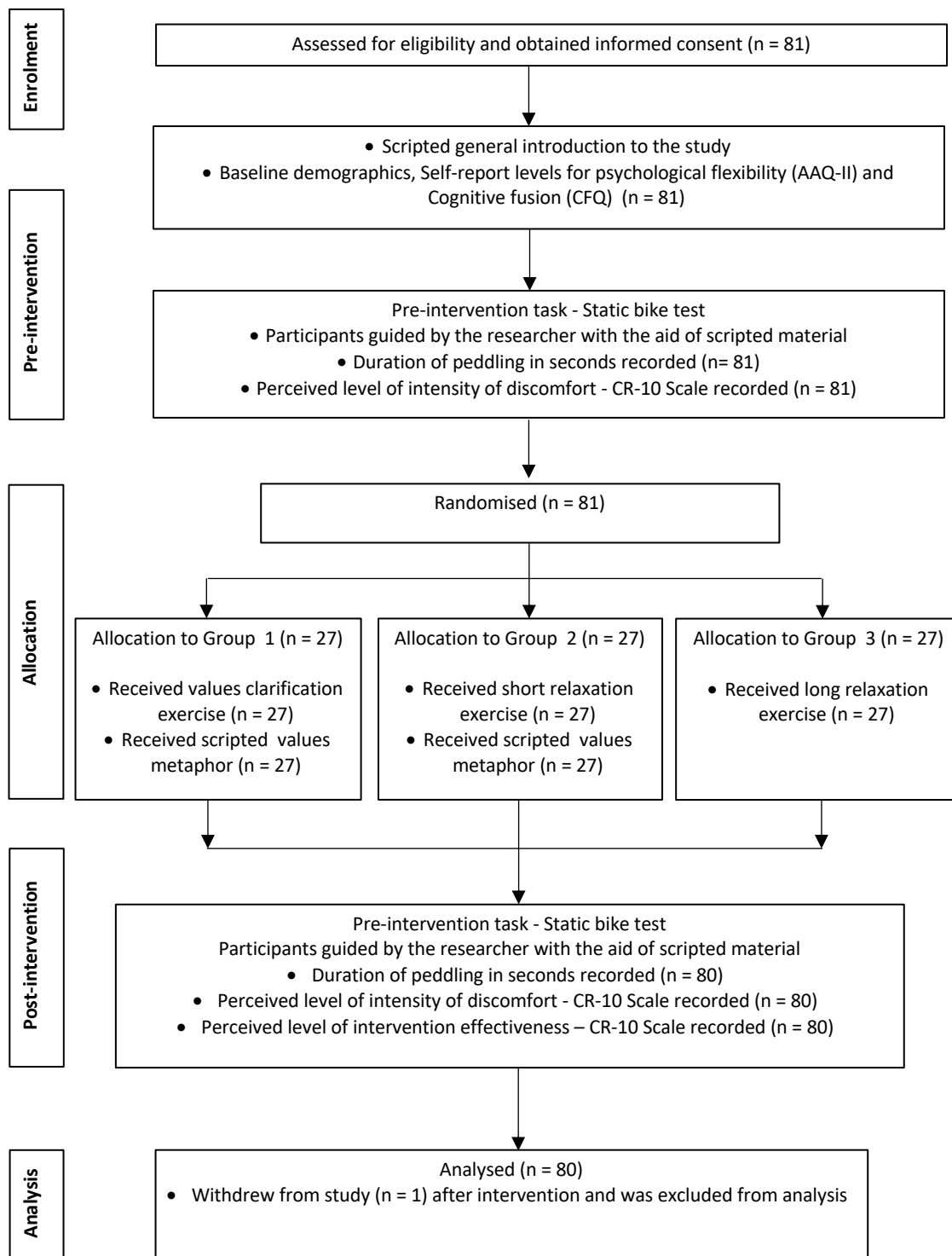
6.2.5.4 Heart Rate.

Heart rate was monitored using two methods. Firstly, The Technogym Bike Forma was programmed to adjust the resistance through the peddles based on participant heart rate. This was calculated individually for each participant as 70% of their maximum age-related heart rate. Participants were permitted to continue peddling for a maximum of 30 minutes. Heart rate was also monitored by the researcher at two-minute intervals during the exercise task in order to ensure participants were within safe working heart rate limits. Participants were asked to stop if they exceeded 80% of their maximum age-related heart rate. All participants underwent a planned three-minute warm-up and cool down period. These limits fall within sub-maximal fitness assessment and general principles of exercise testing detailed in empirical literature (Ekkekakis et al., 2011; Hayward, 2006).

6.2.6 Procedure

Figure 6.2

Flow of Participants Through the Study



6.2.6.1 Introduction Phase.

Prior to beginning the intervention participants were briefed as to the nature of the study. They received a copy of the participant information sheet, were provided an opportunity to ask questions and, if they were happy to do so, sign an informed consent sheet (Appendix 3). Participants were then given the baseline questionnaire package and provided with as much time as needed to complete it. Upon completion, it was necessary for participants to engaged in administrative tasks prior to participating in the cycling task. These included:

- Reporting of maximum participant heart rate for the task, calculated as 70% of the maximum heart rate for the participants age.
- Measuring of participant body weight in kg.
- Adjusting of the bike saddle to the appropriate height for the participant.
- Instruction on how to correctly fit the polar chest strap heart rate monitor.

The watch, used in conjunction with the chest worn monitor, was mounted on the handlebar of the exercise bike in order that it could be checked by the researcher and not observed by the participant. All information on the bike display screen was obscured to the participant with the exception of the peddle revolutions per minute.

6.2.6.2 Pre-intervention Task Phase.

All participants took part in the pre-intervention task phase. Instructions for the cycling task were provided, guided by scripted material. Participant age and calculated value for 70% of participant maximum heart rate was entered into the “Constant heart rate workout” programme using the bikes’ digital display. In this

mode, the effort required to peddle is adjusted automatically in order to maintain the preselected heart rate throughout the entire exercise. The participants were blind to the maximum duration of the exercise (30 minutes). Participants peddled with the minimum resistance offered by the bike for a warm up period of three minutes at a peddle rate between 60 and 70 rpm, as dictated by the digital read out on the exercise bike. There was no verbal communication during the task and participants were blind to all other feedback from the display. Heart rate was monitored by the researcher at two-minute intervals by checking the watch on the handlebar of the bike. Participants continued until they decided to stop peddling or until the researcher asked the participant to stop because they had reached the maximum time of 30 minutes or if they exceeded 80% of their maximum heart rate. When the participant stopped peddling the participants were reminded that for the purpose of the present study discomfort was defined as any thought, feeling or sensation which related to the exercise which resulted an urge to stop peddling. Examples included, feeling self-conscious, bored or the sensation of sweating. Participants were then asked to rate their level of discomfort at the point they stopped peddling using the CR-10 scale (Appendix 6). The finishing heart rate, and peddling duration in seconds were recorded by the researcher, but the results were withheld from the participant. Participants were provided a brief recovery period of approximately three minutes during which water and paper towel were provided as necessary and the participants were asked to be seated on a comfortable chair at a desk.

6.2.6.3 Intervention Phase.

Following the pre-intervention task participants were randomly assigned to one of three experimental conditions. A diagram of participant flow through the different phases of the study is shown in figure 6.2. Each group received an intervention that lasted approximately 15 – 18 min.

6.2.6.3.1 Group 1. Values Clarification Plus Metaphor.

Guided by the scripted material, the researcher provided a brief introduction to personal values within the context of the study and instruction on how to complete the values clarification exercise. Participants were told that the values exercise was for their personal information only and would not be seen by the researcher. The participants were provided approximately 10 minutes to complete the exercise. Once the values clarification exercise was completed the researcher, aided by the scripted material, provided a brief introduction to the use of metaphors within ACT, followed by the values-based metaphor, and an explanation of how they might incorporate this training into the cycling task.

6.2.6.3.2 Group 2. Short Relaxation Plus Metaphor.

Guided by the scripted material, the researcher provided a brief introduction to personal values within the context of the study and an introduction to the relaxation exercise. The relaxation exercise lasted approximately eight minutes, during which time the participant sat alone in a comfortable chair and listened to an audio recording, instructing them in a progressive muscle relaxation process. During the exercise the participant imagines tensing major muscle groups for a short period

followed by a short period of no tension. The script for the exercise was adapted from published work by Jacobson (1925/1987) and, as detailed in previous chapters, is widely used as a method of relaxation and reduction of physical tension (Borkovec & Hezlett-Stevens, 2000; Carlson & Hoyle, 1993). Following the relaxation exercise the researcher, aided by the scripted material, provided a brief introduction to the use of metaphors within ACT, followed by the values-based metaphor, and a brief explanation of how they might incorporate values into the cycling task.

6.2.6.3.3 Group 3. Long Relaxation Only.

Guided by the scripted material, the researcher provided a brief introduction to the relaxation exercise. For the exercise participants sat alone in a comfortable chair and were asked to listen to an audio recording, instructing them in a progressive muscle relaxation exercise lasting approximately 15 minutes. This exercise was based on the same principles as detailed previously but included an increased number of muscle groups and therefore was longer in duration. This provided an equivalent intervention duration to that of the other two groups. Once the relaxation exercise was complete participants were invited to engage in the cycling task.

6.2.6.4 Post - intervention Task Phase.

Immediately following their assigned intervention, participants took part in the post-intervention cycling task. The procedure for task engagement was identical to pre-intervention task phase. When the participant stopped peddling the researcher showed the participant the CR-10 scale and asked them to rate their level of discomfort at the point they stopped peddling. This was recorded on the results sheet

by the researcher together with the participant finishing heart rate, and peddling duration. Following the final testing phase, the participant was shown the CR-10 scale again and asked to rate the level of effectiveness of the strategy they had learned and its ability to help them overcome the urges to stop peddling.

6.2.7 Data Analysis

Repeated-measures ANOVA was used to investigate interaction effects within and between groups. A separate ANOVA analysis was conducted post-intervention results to test for between group differences of the effectiveness of the intervention as perceived by the participants.

6.3 Results

6.3.1 Participant Demographics

A total of 81 adults aged between 19 and 59 years were recruited, with a mean age of 31 years. Participants were randomly assigned to one of the three experimental groups. 66 participants were female and 15 were male. One participant withdrew from the study and so their data were not included in the analysis

6.3.2 Baseline Characteristics

There were no statistically significant between group differences at baseline for age, $F(2, 77) = .377, p = .715$ for self-report level of psychological inflexibility (AAQII), $F(2, 77) = .876, p = .420$, or cognitive fusion (CFQ), $F(2, 77) = .438, p = .647$.

Table 6.1*Between Group Means at Baseline for Age, Avoidance and Cognitive Fusion*

Group	n	Age	AAQ II	CFQ
Values clarification task and metaphor	27	31.40 (13.86)	19.90 (5.80)	23.20 (7.05)
Short relaxation task and Metaphor	27	31.00 (12.67)	21.90 (9.62)	25.30 (8.81)
Long relaxation task	27	28.60 (11.49)	21.10 (9.64)	24.80 (9.77)

Note. Standard deviations in parentheses.

Table 6.1 shows the mean scores for both AAQII and CFQ measures. For the AAQII higher scores are indicative of higher levels of psychological inflexibility, the maximum possible score is 49. For the CFQ, higher scores are indicative of higher levels of cognitive fusion, the maximum possible score is 49.

6.3.3 Tests of Assumptions

Visual assessment using box plots showed the presence of outliers and Shapiro-Wilks test of normality revealed that peddling duration data was not normally distributed ($p < .05$). Data for perceived level of discomfort were normally distributed in all but two conditions, that of the pre-intervention metaphor + values condition and the pre-intervention PMR condition ($p = .017$ and $p = .035$ respectively). Data for strategy rating were normally distributed ($p > .05$). In light of this data were transformed using log10 prior to performing ANOVA and the results were compared to ANOVA using unaltered data. The measure of skew for transformed data remained in violation of assumptions testing. However, the statistically significant results for duration of cycling and level of reported discomfort remained unchanged as a result

of the transformation. Therefore, because the sample size for the present study was sufficient powered to make ANOVA robust to non-normally distributed data, and transforming data can increase the risk of error (Feng et al., 2014; Schmider et al., 2010), the non-transformed data were used in analysis for the present study.

Table 6.2

Descriptive Statistics for Peddling Duration, Perception of Discomfort and Perception of Intervention Effectiveness

Group	Peddling Duration	Peddling Duration	Intensity of Discomfort	Intensity of Discomfort	Perceived Level of Intervention Effectiveness
	Pre-Intervention	Post-Intervention	Pre-Intervention	Post-Intervention	
	<i>M</i>	<i>M</i>	<i>M</i>	<i>M</i>	<i>M</i>
Values clarification task and metaphor	408 (352)	691 (378)	6.07 (1.66)	5.72 (2.39)	7.13 (2.28)
Short relaxation task and Metaphor	491 (480)	589 (471)	5.88 (1.80)	5.96 (2.28)	6.42 (1.66)
Long relaxation task	357 (298)	435 (310)	6.08 (1.81)	5.38 (2.13)	3.63 (1.77)

Note. Standard deviations in parentheses.

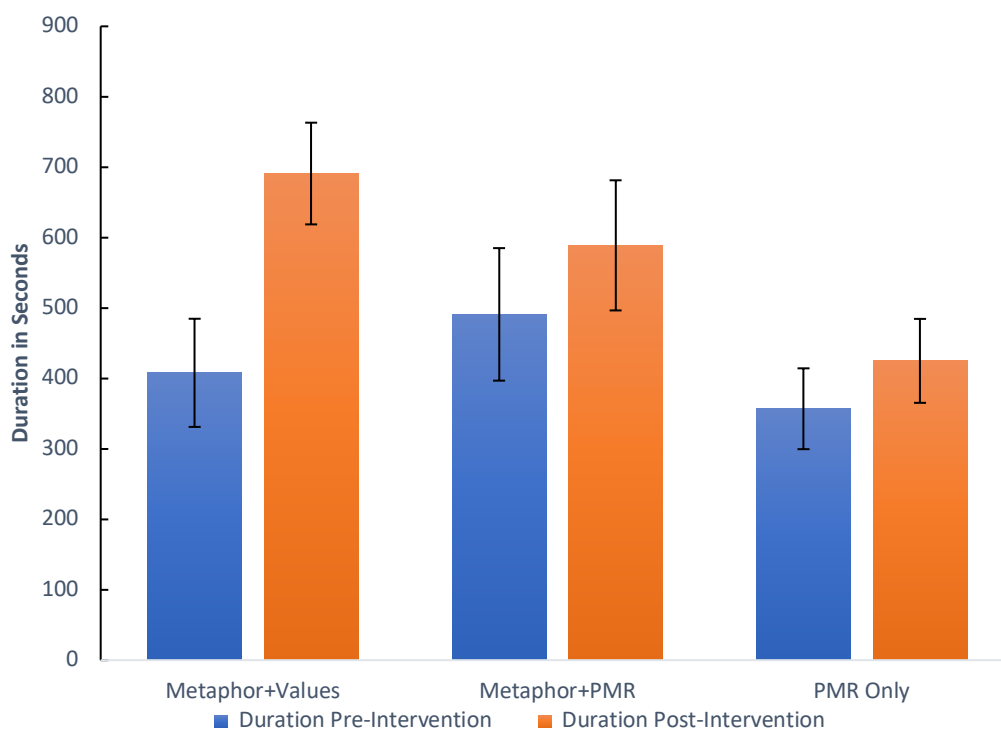
6.3.4 Tests for Interaction Effects for Peddling Duration

The assumption for homogeneity of variance assessed by Levene's test was violated for peddling duration both pre ($p = .044$) and post ($p = .010$) intervention. Initial test for within subjects effects using repeated measures ANOVA showed a main effect of time for pre-to-post peddling duration, $F(1, 77) = 22.64, p < .001, \eta_p^2 = .227$. There was a significant time by group interaction effect for peddling duration, $F(2, 77) = 4.16, p = .019, \eta_p^2 = .097$. However, the main effect of group was not significant, $F(2, 77) = 1.54, p = .222, \eta_p^2 = .038$.

Post hoc Tukey tests show that participants in receiving the metaphor and values clarification intervention (Group 1) significantly increased their peddling duration from pre-to-post intervention, $t(77) = -5.114, p < .001$. Inspection of mean values showed that whilst participants receiving the metaphor and relaxation intervention (Group 2) and also participants receiving the relaxation only intervention (Group 3) peddled for longer in the post intervention condition, the increases were not significant.

Figure 6.3

Mean Peddling Duration Pre- and Post-Intervention



Note: Error bars show standard errors

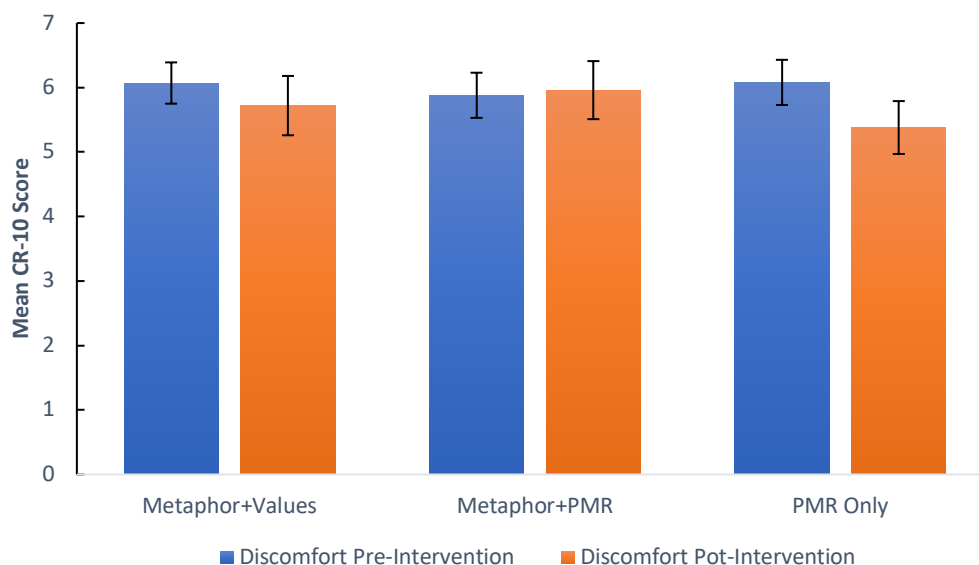
There results showed a trend between the groups whereby the participants receiving the metaphor and values clarification intervention (Group 1) increased their peddling duration compared to participants receiving the metaphor and relaxation intervention (Group 2) but this difference was not significant. However, there was a statistically significant interaction effect for peddling duration where participants receiving the metaphor and values clarification intervention showed a greater increase in peddling duration compared to participants receiving relaxation only, $t(101) = 2.180, p = .024$

6.3.5 Tests for Interaction Effects for the Perception of Discomfort

Levene's test showed that there was homogeneity of variance ($p > .05$). However, the main effect of time for perception of discomfort was not significant, $F(1, 77) = 2.13, p = .149$. Time by group interactions were also not significant, $F(1, 77) = 1.01, p = .370$. Visual inspection of the means suggest that participants in the PMR only condition reported a drop in the perception of discomfort from pre ($M = 6.08, SE = .392$) to post intervention ($M = 5.38, SE = .39$).

Figure 6.4

Mean Scores for the Perceived Level of Discomfort Pre- and Post-Intervention



Note: Error bars show standard errors.

6.3.6 Tests for the Perception of Intervention Effectiveness

There was homogeneity of variance as assessed using Levene's test ($p < .05$). The main effect of group on the perception of intervention effectiveness was significant, $F(2, 77) = 24.4, p < .001, \eta_p^2 = .392$. Post-hoc tests showed that there was no statistically significant difference between the perceived effectiveness of the metaphor + values group and the metaphor + PMR group. However, both the metaphor + values, and the metaphor + PMR interventions, were perceived significantly more effective at overcoming the urge to stop exercising than PMR only, $t(77) = 6.67, p < .001$ and, $t(77) = 5.28, p < .001$ respectively. A summary is provided in Table 6.3. Follow-up analysis showed a small to moderate significant positive correlation between strategy rating and the percentage increase in in cycling

duration, $r(79) = .445, p < .001$. There was no significant association between strategy rating and the level of post intervention discomfort.

Table 6.3

Estimated Marginal Means for the Perception of Intervention Effectiveness

Group (IV)	Mean	SE	95% Confidence Interval	
			Lower	Upper
Metaphor + values	7.13	0.371	6.39	7.87
Metaphor + PMR	6.42	0.378	5.67	7.18
PMR only	3.63	0.371	2.89	4.37

6.4 Discussion

Chapter 4 concluded that an intervention protocol containing hierarchically framed defusion processes had no effect on tolerance to exercise discomfort. Subsequently the second study, detailed in chapter 5, extended a hierarchically framed defusion protocol by the addition of value-orientated appetitive augmental cues (a so-called defusion II protocol). The study evaluated the defusion II processes and suggested that the addition of the augmental cues to the protocol helped participants to overcome uncomfortable experiences during exercise and therefore promoted an increase in exercise duration. The present, third experimental study in the thesis, explored whether a purely values-based intervention was sufficient to help people overcome private-events in relation to a physical activity task. The study

employed hierarchical relations, similar to those used with defusion in previous studies, but instead applied to a values-based intervention protocol with no training in defusion. Three independent protocols were compared, the first employed hierarchical relations and involved values clarification task in combination with a values metaphor. The second protocol also used hierarchical relations and involved a metaphor and a short relaxation task. The third, in keeping with studies detailed in chapters 4 and 5, used progressive muscle relaxation for comparison with the effects of ACT processes.

6.4.1 Evaluation of Duration of Task Engagement

With regard to the duration of task engagement, the results supported hypothesis 1 that participants in the intervention condition consisting of the values clarification task and a values-based metaphor (group 1) would increase their cycling duration pre-to-post intervention.

However, the results did not support hypothesis 2 that participants receiving the values-based metaphor and a relaxation intervention (Group 2) would significantly increase their exercise duration pre-to-post intervention. Hypothesis 3 which stated that there would be a significant difference in exercise duration between participants in group one, participants in group two and participants receiving only relaxation training (Group 3) was not supported. The results suggest that the values-based training required the inclusion of a values-clarification component in order to significantly increase cycling duration compared to training that used a values-metaphor or relaxation strategy.

6.4.2 Evaluation of the Perception of Discomfort

Results for the perception of the level discomfort were not consistent with the study hypotheses. Specifically, the results did not support Hypothesis 4 that there would be difference in the level of perceived discomfort for participants receiving the values clarification and values-based metaphor from pre-to-post intervention (Group 1). Hypothesis 5 which stated that there would be a pre-to-post difference in the level of perceived discomfort for participants receiving the metaphor and relaxation intervention (Group 2) was not supported by the results. There was no support for Hypothesis 6 which stated there would be a difference in the pre-to-post level of perceived discomfort between the groups.

The results suggest that, pre-to-post intervention, participants did not vary in their rating of the intensity of whatever feelings contributed to the urge to stop exercising. These findings broadly concur with the existing literature (Gil-Luciano et al., 2016). However, the present study had some key differences in the definition of discomfort and also in the scale of measurement for intensity. In the present study, participants were provided with a definition of discomfort as whatever thoughts and sensations, personal to them, contributed to the urge to stop. They were asked to rate the intensity of such personal experiences. In this way the study attempted to capture the subjective experience of the uncomfortable experiences which create a barrier to ongoing engagement as discussed in chapter 3 (Biddle & Mutrie, 2008; Joseph et al., 2019). This is quite different from the experience of acute induced physical discomfort produced by a cold pressor test, as was the case for Gil-Luciano et al. (2016). Such differences suggest that direct comparisons of these experiences

between existing literature and the present study are tentative. Importantly, the significant increase in exercise duration combined with the lack of change in perception suggested that people continued to exercise despite the uncomfortable experiences. Interestingly, the mean values for the level of discomfort in the present study reveal a small decrease in the level of post-intervention discomfort for participants receiving only relaxation training relative to the other intervention groups. A similar trend was also observed in the previous study, reported in chapter 5 and suggested that progressive muscle relaxation training may be more suited to changing the way in which they perceive the intensity of discomfort rather than defusion and values processes. As discussed in chapter 3, this is reflected by well-established evidence that mindfulness based practice is useful for helping people suffering from chronic pain (McCracken & Vowles 2014).

6.4.3 Evaluation of the Perceived Effectiveness of Strategy

Literature on the development of healthcare interventions stresses the importance of assessment of acceptability when evaluating new intervention constructs (Craig et al., 2013; Sekhon et al., 2017). An initial assessment of perceived effectiveness of the intervention was therefore conducted by asking participants to rate the level of effectiveness of their strategy, immediately following the post-intervention cycling task, participants used the CR-10 scale to report the level to which they felt the training they had received was effective at helping them to overcome the discomfort. There were some notable differences in perception of how effective participants felt their training was. In particular, participants reported that the values-based interventions were more effective than the relaxation exercise at

helping them overcome private-events manifesting in the urge to stop exercising. This at first seems counterintuitive, because the trend in mean scores for the intensity of discomfort suggest that PMR reduced the intensity of discomfort relative to the values training. One explanation could be that participants associated success of the strategy with the process of overcoming the urges to stop rather than their perception of the outcome of peddling duration. Further, this suggests that participants were content to continue to engage in the cycling task regardless of the intensity of discomfort. In RFT terms, the hierarchically framed values, in particular, those including the clarification exercise did not necessary alter the perception of discomfort but did alter the discriminative functions of tolerance to the resultant urges. This is in agreement with similar findings reported by Sierra et al. (2016) who used a combination of metaphors incorporating appetitive cues to increase tolerance to pain induced in a cold pressor task.

Consistent with RFT theory (Thorneke et al., 2016) and similar to work by Sierra et al. (2016) the present study incorporated both deictic and hierarchical relations within a contextually tailored metaphor and scripted intervention designed to promote value orientated augmental processes. Similar hierarchical relations were adopted by other researchers to facilitate participant learning, understanding and use of defusion and self-as-context in order to facilitate value orientated actions (Foody et al., 2013; Gil-Luciano et al., 2016; Luciano et al., 2011). However, to my knowledge the present study is the first work to apply both deictic and hierarchical relationships to a values clarification exercise when incorporated into an intervention using a contextually tailored metaphor designed to increase tolerance to unhelpful private-events during an exercise task. The present study revealed that interventions

employing both deictic and hierarchical framing that allows for contextual relations to be established between values and private-events related to exercise can encourage both outcome related and process related changes to discriminative function of discomfort (Dahl et al., 2009; Deci & Ryan, 1985). In practical terms interventions aimed at someone struggling with the goal of being physically fitter, may be more effective if the intervention encourages them to identify with any intrinsic value they may have for exercise engagement. For example, with cycling, the sense of freedom that cycling brings to them, or the thrill of shared experience with fellow cyclists.

6.4.4 Limitations

The current study, as with those detailed in chapter 4 and 5 was laboratory based and therefore requires ecologically valid testing to be carried out for further development. The nature of the cycling test was such that the resistance through the peddles was increased by the programme on the bike at regular intervals, until the participant reached their ceiling heart rate calculated as 70% of their maximum heart rate for their age. Once achieved, the bike programme reduces and increases the resistance in order to keep the ceiling heart work rate constant. Participants reaching their ceiling limit experience reduced peddling resistance while their heart rate reduces to a level approximately 10% lower than their ceiling rate. It is therefore arguable that the effects of the intervention might permit participants to overcome an initial discomfort which made them stop the first time, and so are then able to carry on peddling with reduced effort. No account was made of participant fitness, which would have a direct effect on the efficiency and power output relative to their

heart rate. This would explain why participants do not differ in their perception of the intensity of urges to stop but are, after overcoming the comparative more difficult stage of reaching the desired heart rate, able to carry on exercising for longer.

6.4.5 Conclusions and Implications

The empirical research discussed in this chapter provided some evidence to suggest that training in the use of personal values using metaphors with a contextually similar narrative to the source of private-events can be used to encourage individuals to overcome unpleasant subjective experiences associated with physical activity. The findings provide further support for existing research which suggests that some ACT processes are superior in effect when framed hierarchically. Further, the present study showed that clarification of personal values using a combination of deictic and hierarchical framing appeared to result in a change in the discriminative functions induced by the physical exercise task. The present study also provided some evidence to suggest that, in ACT terms, an intervention using values only can increase tolerance to exercise induced discomfort without the need to incorporate the processes of defusion and self-as-context.

The research discussed in the present chapter has a number of important implications for physical activity focused intervention development and also more generally for the further development of defusion II protocols. Firstly, in line with the aims and objectives of the current thesis the current study suggested it was possible to use a brief, values focused approach to elicit changes in tolerance to the private-events due to exercise. However, combining the approaches tested in both the

present study and those explored in chapters 4 and 5 have yet to be tested in relation to long term change require further testing in terms of longitudinal effects. Implications for further development of defusion II interventions, such as those reported by Luciano et al. (2001) might also focus on the impact of the addition of hierarchical relations and therefore process driven approaches to values clarification to complement hierarchically focused defusion protocols.

Chapter 7

General Discussion, Conclusions and Recommendations

7.1 Overview

The programme of work in this thesis has sought to extend the evidence-base related to brief ACT interventions to promote engagement in physical exercise at the general population level. Evaluation of the existing empirical knowledge highlighted that intervention development in relation to physical activity required better understanding of the impact of the individual ACT components, and a greater consideration of the theories on which ACT is based. In response, a primary consideration of the programme of work were the key elements for the development and evaluation of health related interventions (see for example Craig et al., 2013). Specifically, the programme of work was concerned with the identification, testing and modelling of ACT theories and processes in relation to the outcome of interventions designed to promote engagement in physical exercise. The evidence presented within this thesis addressed two broad aims, which were:

1. To explore the practical and theoretical understanding of ACT process in relation to increasing levels of physical activity.
2. To empirically develop and model interventions in order to establish an evidence base for efficient and effective brief intervention content that were less demanding on resources.

Therefore, the thesis design divided the programme of work into two distinct

phases. The first phase of work, in response to Aim 1 was comprised of two studies, which gathered and evaluated evidence to support the development of both the practical and theoretical application of ACT processes to promote engagement in physical activity. This was achieved by addressing a series of research objectives:

1. To systematically identify and evaluate the nature and quality of the existing evidence base concerning the use of ACT to promote engagement with physical activity.
2. To highlight gaps in the literature and so provide an anchor point for the thesis.
3. To identify ACT processes likely to have the greatest potential to influence physical activity behaviours.
4. To identify relevant theoretical approaches likely to influence ACT based protocols used to increase physical activity behaviours.

The second phase of this thesis was concerned with empirical investigation of the findings established by successful completion of Objectives 1, 2, 3, and 4. In response to Aim 2, a series of empirical experiments were conducted to explore the effects of differing combinations of the identified ACT and RFT processes within an intervention context. This was achieved by addressing further objectives:

5. To develop and empirically evaluate the use of hierarchical framing techniques for intervention strategies focused on overcoming exercise induced discomfort.
6. To evaluate the efficacy of a defusion II intervention protocol in relation to exercise induced discomfort.

7. To explore the validity of the practical and theoretical components of defusion II in relation to exercise induced discomfort.
8. To make recommendations as to the content and structure of intervention programmes likely to be most effective for continued development.

7.1.1 Phase 1

The following sections describe how the thesis aims were met in relation to each study in turn and highlight how the objectives were achieved through the programme of research in a sequential manner.

7.1.1.1 Systematic Review

A review of current empirical literature was conducted to investigate the extent to which research has explored the use of ACT in the promotion of increased physical activity, in line with Aim 1. The rationale for exploration of the evidence, as noted by Objective 1 was to establish a clear understanding of current knowledge by employing a formal systematic approach to reviewing the existing empirical evidence (Petticrew & Roberts, 2006).

In line with Objectives 1, and 3 the review assessed outcome methods used in relation to physical activity and collated information as to the nature, duration, setting, and targeted population of the ACT interventions. There was also systematic evaluation of the quality of the evidence in terms of bias, validity, and likely efficacy of studies. Finally, in line with Objective 4 the review included assessment of how the identified studies related to the theories that underpin ACT. Findings of the review showed that empirical research to date has been both limited and exploratory in

nature and that studies varied both in population and methodological approach. A systematic narrative synthesis of the data, such as that detailed in guidance by Petticrew and Roberts (2006), was therefore employed to explore the nature and quality of these studies in accordance with Objective 2.

There was common support for short-term increases in physical activity, which tended to focus on outcome related goals. However, there was less evidence to suggest significant longer-term maintenance of exercise. The review identified that studies tended not to detail the theoretical constructs that underpin ACT when explaining the results and findings. Furthermore, there were inconsistencies in the use of ACT process measures to explore intervention efficacy, and limited availability of the finer details of interactions between researchers and participants. These findings suggest that the research to-date might not be reproducible and there could be increased potential for bias. Identifying these points highlighted gaps in the available literature in line with objective 2 which in turn informed the research programme.

7.1.1.2 Survey Study

In view of the need for more robust development of potential interventions as identified in the systematic review, and to align with Aim 2, a survey study was conducted. Specifically designed to provide further evidence for Objectives 2 and 3, the survey explored the nature and volume of people's physical activity in relation to reported scores on the six ACT processes. Three ACT processes were significantly associated with levels of physical activity. With respect to values, those who valued being physically active were predictive of higher levels of physical activity in work, at

home and during leisure time. In contrast, people who reported a tendency for avoidant behaviours and those who found it difficult to cognitively defuse from uncomfortable thoughts and experiences, were predictive of being more physically active during work or homelife, but not during leisure time. Importantly, being physically active during work and home life is not likely to be the kind of physical activity normally associated with physical exercise. Further, psychological inflexibility assumes a tendency for avoidance of uncomfortable private-events, which suggests that people with a tendency for avoidant behaviours adopt unhelpful coping strategies often associated with poor lifestyle (Cairney et al., 2014; Hayes et al., 1996). In ACT, the process of defusion is adopted in combination with personal values in order to combat avoidance, because the suggestion is that dealing with the thoughts and experiences of discomfort will result in less avoidance. Indeed, ACT therapists help clients to explore avoidance which manifest as unhelpful barriers to a values orientated life by using ACT processes such as defusion. The findings from the survey study suggested that protocols containing defusion and values processes would be a suitable focus for the development of brief intervention strategies to enhance physical activity.

7.1.2 Phase 2

Emerging from the first phase of the thesis, it became apparent that there was a need to explore the utility of ACT processes included in defusion II, both individually and in combination. In line with Objectives 5, 6 and 7, phase 2 focused on both the theoretical and practical approaches to delivering the ACT processes of defusion, self-as-context and values. In order to explore and develop this idea in a robust and

sequential way, the programme of work included a series of empirical laboratory-based experiments. Each measured changes in exercise duration and the intensity of private-events. To enhance reproducibility each study utilised scripted material. Metaphors were used to guide participant comprehension, and relaxation exercises were employed as comparison conditions. Importantly, the studies were performed consecutively in order that the limitations from each study be considered prior to the development of successive empirical work.

7.1.2.1 Empirical Study 1

Despite being a critical component of ACT theory hierarchical framing was found to be an omission in the research reviewed in chapter 2. In response to these findings and in line with Aim 2, study 3 (see chapter 4) was the first of the three studies that included the use of hierarchically based framing techniques. The study explored the effects of a brief defusion intervention on the tolerance to, and the perceived intensity of discomfort, experienced during the Chester Step Test exercise task (Sykes & Roberts, 2004). Practical differences in the effectiveness of training in defusion were also explored using multiple exemplar training that included either a physical experiential or a mental visualisation element.

The results from this controlled laboratory study showed clearly that defusion and self-as-context taught using hierarchal relations had no statistically significant pre-to-post intervention effect on the duration of participant exercise engagement or the perception of personal experiences during exercise. This was true regardless of whether the intervention was taught using either physical or mental rehearsal. Importantly, comparison of the findings with existing RFT literature (for example

Luciano et al., 2011) highlighted that not only was there a need for participants to firstly identify with thoughts and feelings associated with barriers to participation, but also they required a cue to change the function of the ongoing urge to disengage with the exercise task. This suggested that both defusion, framed using hierarchal relations, and an appetitive value-orientated cue to change were required.

7.1.2.2 Empirical Study 2

Aligned with objective 5, 6 and 7 and building on the emergent findings from the first lab-based study, the second empirical study employed a combination of both defusion, and appetitive values orientated cues. In order to build on current research evidence, study 4 (see chapter 5) was a partial replication of existing empirical work by Gil-Luciano et al. (2016) which combined defusion and values orientated cues designed to augment behaviour change in relation to physical discomfort. The fourth study used scripted intervention material very similar to that of Gil-Luciano, and both studies trained participants in defusion techniques and compared the effect of using either deictic relations (known as defusion I) or hierarchical relations (defusion II). Both studies measured the duration of task engagement and the perception of the intensity of aversive stimuli. The aversive tasks presented by Gil-Luciano's study involved a cold pressor task and viewing a film of limb amputation. In contrast, given the focus of this research was on physical activity, study 4 used a cold pressor task followed by The Chester Step Test exercise and included a progressive muscle relaxation task as a control condition.

The interventions had no significant impact on either duration of engagement or the perception of discomfort in the cold pressor task. Participants in the defusion

II training protocol significantly increased the duration of physical exercise compared to participants receiving defusion I and PMR. Interestingly, only PMR was significantly associated with a decrease in the perceived level of discomfort experienced during the exercise task. The study concluded that a question remained as to whether defusion, values orientated augmental cues or a combination of the two processes was responsible for the change in exercise duration.

7.1.2.3 Empirical Study 3

Emergent findings from studies 3 and 4 suggested that there was a need to explore the process of values in relation to exercise duration and the perceived intensity of the resultant personal experiences. Aligned with Aim 2 and Objective 5, 6 and 7, Study 5 (see chapter 6) used a scripted approach to deliver values-based interventions in relation to an exercise task to evaluate the effect of hierarchal relations applied to appetitive values-orientated cues to behaviour change. The study compared the effectiveness of three intervention protocols in relation to private-events experienced during an exercise task. One condition utilised the values clarification exercise in combination with a metaphor containing augmental cues. The second condition utilised metaphor training with augmental cues but no values clarification. The third, a comparison group, used a relaxation exercise.

The results showed that the values focused intervention, when presented using a mixture of both deictic and hierarchical relations was responsible for an increase in exercise duration only when supported by the values clarification task. Consistent with previous studies there was no effect on the perceived intensity of the private-events experienced during the exercise task, which suggested that people exercised

for longer despite their discomfort. Interestingly, the effect of PMR although not statistically significant followed a similar trend to that of study detailed in Chapter 5, suggesting a relationship between PMR and a reduction in the perceived intensity of discomfort.

7.2 General Discussion

The following subsections bring together the key findings of the programme of research and highlight the valuable and original contribution to knowledge in relation to the thesis aims and objectives.

The objectives achieved through the systematic review presented in Chapter 2, provided a reference point for the body of work within the thesis and therefore no further formal searches were conducted after the initial investigation. Nevertheless, given the time span over which the current thesis was conducted, informal searches revealed an advance in the literature. Pears and Sutton (2020) published a systematic review, remarkably similar to the review presented in chapter 2, both reviews focused on the effectiveness of ACT interventions for promoting physical activity. There was a considerable overlapping of studies included in both reviews (see Table 7.1). Indeed, six of the seven studies identified by Pears and Sutton were also identified in the thesis review. Similar to the review conducted for this thesis, Pears and Sutton concluded that there was insufficient account made by the reviewed literature as to the specific use of core ACT processes within interventions.

Table 7.1*Comparison Between the Thesis Review and that of Pears and Sutton (2020)*

Comparator	Review Chapter 2	Review Pears and Sutton (2020)
Included studies	Butyrn et al. (2011) Ivanova et al. (2016) Kangasniemi et al. (2015) Moffitt & Mohr (2014) Fletcher (2011) Tapper et al. (2009) Katterman et al. (2014) Goodwin et al. (2012) Van Buskirk (2014)	Butyrn et al. (2011) Ivanova et al. (2016) Kangasniemi et al. (2015) Moffitt & Mohr (2014) Fletcher (2011) Martin et al. (2015) Stevens et al. (2017)
Cross-referenced difference	Martin et al. (2015)-Identified but not included Stevens et al. (2017) – not within search date	Tapper et al. (2009) – not reviewed Katterman et al. (2014) – not reviewed Goodwin et al. (2012) – not reviewed Van Buskirk (2014) – not reviewed
Search Terms	Acceptance and commitment therapy AND Physical activity OR exercise – exploded terms related to the terms were dependent of the database. After 1980 and Jan 2016; then hand searches.	Acceptance and commitment therapy AND Physical activity – exploded terms related to the terms were dependent of the database After 1980 and until may 2019
Source of articles	Digital searches CINHAL Cochrane Library MEDLINE PsycINFO Psychology and Behavioural Sciences Collection (PBSC) Hand Searches Association for Contextual Behavioural Science Journal of Contextual Behavioural Science Research Gate	Digital searches MEDLINE EMBASE PsycINFO Web of Science, Scopus CINAHL Cochrane Hand searches Association for Contextual Behavioural Science Journal of Contextual Behavioural Science

There was however a fundamental difference between the two reviews. Pears and Sutton, selected six of the seven reviewed works and conducted a meta-analysis to show that ACT produced a statistically significant, small to moderate effect on physical activity behaviour. Whereas, the thesis review identified that, the small number of studies, the varied nature of the study populations and methodologies

used by intervention studies all call into question the robustness of such an analysis (Popay et al., 2006). The thesis review therefore assessed the quality of the reviewed studies and conducted a narrative synthesis of research findings. A strength of this narrative approach was the finding that RFT was omitted from the intervention development research literature. Interestingly, Pears and Sutton suggest that developers of ACT interventions may leave out complex processes, such as self-as-context, because they are thought to be more difficult concepts to teach. However, as reported in chapters 4 and 5, teaching self-as-context is benefited by using the RFT approach of hierarchical framing (Luciano et al., 2011; Foody et al., 2014). Although, both reviews concluded the need for high quality research to identify the finer characteristics and relevance of the processes included in the intervention content. Pears and Sutton did not identify the lack of RFT approaches to behaviour change as a weakness in the reviewed work, and this thesis review therefore challenges the newly published work.

There is a general lack of reference to RFT across the practice-based ACT research. This has resulted in repeated calls from the developers of ACT for researchers to relate empirical finding to the theories which underpin ACT (Barnes-Holmes & Hayes, 2003). There remains an apparent reluctance to incorporate RFT into studies regarding ACT practice because of its complexity (Tonneau, 2002). Nevertheless, numerous researchers identified throughout this thesis have reported the potential benefits of using RFT in the construction of ACT interventions (Esawra-Murthy et al., 2020; Foody et al., 2013; Luciano et al., 2011). Indeed, recommendations for the advancement of ACT research by Gaudio (2011) called directly for research to better establish the relationships between core ACT processes

and RFT. In light of this, and in spite of the complexity of incorporating both practice-based and theoretical terminology, it remains important that development of ACT in newly emerging fields, such as the current programme of work, should explore the potential benefits. In doing so the current thesis offers a valuable contribution to empirical knowledge in regard to the use of hierarchical framing for ACT processes in relation to physical activity promotion.

The survey study presented in chapter 3 also contributed to the first phase of the thesis. The study provided a significant and important contribution to the literature through the thesis objectives by the identification of three ACT processes likely to impact on engagement in physical activity. In spite of the limitations of the survey study, addressed in chapter 3, the study results suggested that defusion and values were associated with engagement in exercise. This was of pivotal importance to the programme of work for two reasons. Firstly, it provided an avenue of investigation that corresponded with Aim 2 of the thesis. Secondly, it presented the opportunity to explore these two ACT processes using an existing approach to overcoming psychological discomfort which, unlike the studies included in the thesis review, presented an ACT-based intervention from an RFT perspective (see Luciano et al., 2011 as an example). There were however some important differences between this existing research and the programme of work in this thesis. Principally, the existing Defusion II protocols suggested that a mixture of deictic and hierarchal relations applied to the teaching strategy of defusion was more effective than using deictic relations alone. This relationship had been studied independently within a clinical population that focused on psychological distress (Luciano et al., 2011) and also within a general population using physically induced discomfort (Gil-Luciano et

al., 2014). However, there had been no studies reporting the effects of a defusion focused strategy targeting physical exercise. Further, because physical exercise has the potential to produce both psychological and physical discomfort the present programme of work needed to incorporate testing of both a new outcome variable (exercise) and two potential sources of discomfort (psychological and physical). Exploring physical exercise related discomfort in this way challenged the methods employed by the work reviewed in chapter two and also extended the existing defusion II literature.

In line with Aim 2, Phase 2 of the programme of work was a systematic evaluation of specific ACT processes, taught as skills using an RFT approach for increasing tolerance to private-events experienced during physical exercise. In order to achieve this the programme of work conducted three empirical experiments, described in chapters 3, 4 and 5. Through the programme of work the series of studies examined the relationship between defusion, self-as-context and values to better understand their relationship in the context of tolerance to physical exercise in a way not previously explored in the research literature.

A strength of the empirical studies undertaken for phase two of this thesis was that they considered the framework for the development of complex health-related interventions (Craig et al., 2013). The guidance suggests that protocol development should be an evolving process that iteratively evaluates evidence, develops theory, and tests processes prior to conducting feasibility trials or piloting studies. The reviewed literature evaluated in chapter 2, suggested that greater methodological rigor was necessary to promote the reproducibility of intervention protocols. The empirical studies in this thesis challenged the reviewed literature by incorporating

scripted intervention material which provided transparency and permitted future replication. In doing so, the design of the studies supported the principles of evaluation and theory development suggested by the guidance and promoted empirically robust work. This approach however, did not come without a cost, because in general terms ACT, as discussed in chapter 1, is based on an interaction between the therapist and the client so as to address the contextual understanding every individual has of their thoughts, feelings and behaviours (Harris, 2019). The complex and abstract nature of the skills taught in ACT, such as defusion, are aided by ACT's use of metaphor, the purpose of which is to provide a context to a situation, from which an individual may attribute their own experiences and understanding in order to make sense of problems. Although metaphors are essentially scripted stories, the dialogue between the therapist and the client permits clarification or elaboration to promote understanding. However, the construction of relational frames using RFT within the context of metaphor is highly complex and use specific language in order to convey meaning. Therefore, the use of scripted materials during the experimental development ensured intervention content was delivered accurately and without deviation. Contrastingly, a therapist delivered approach, adopted by Sierra et al. (2016), was used to assess the impact of hierarchical relations on the use of metaphor for overcoming physically induced distress. Although their results supported the findings of the established literature on the use of relational framing (Foody et al., 2013; Luciano et al., 2011) more recent attempts to replicate Sierra's findings using a scripted, pre-recorded audio of the protocol (Pendrous et al., 2020) failed to reproduce significant effects. Ruiz et al. (2020) suggest that even small differences, such as the amount of elaboration provided by a researcher to elicit

complex relational understanding, may impact on the outcome. This suggests that scripting the intervention content, whilst enabling the science to be robustly replicated, might not take into consideration differences in contextual understanding and therefore may have the potential to lack external validity. From this perspective scripted intervention protocols serve to aid the development stages of intervention content, because simply adhering to a heavily scripted protocol could dilute the effect of a therapeutic approach to their delivery.

When taking into consideration the programme of work as a whole the findings in this thesis suggested that the inclusion of values as an appetitive cue to action appeared to have a consistent effect on unhelpful private-events experienced during exercise. Indeed, clarifying those values and then framing them in such a way that it allowed people to use values as a motivational tool was also useful (see previous chapters). From one standpoint this challenges the existing research by for example Luciano et al. (2011), which has suggested that the combination of defusion, self-as-context and value orientated cues offers a superior method of overcoming unhelpful private-events. However, the current programme of work also complements Luciano's findings by suggesting that value orientated cues require the support of contextually specific appetitive functions. Luciano's work suggests that defusion might have provided this mechanism, whereas the current programme of work suggests that structured clarification of values and providing the opportunity to align values with a target behavioural outcome may provide a similar appetitive function.

By conducting the controlled empirical research studies, the programme of work presented in this thesis provided empirical evidence to suggest that the ACT processes of defusion, self-as-context and values, when taught using a combination

of deictic and hierarchical relation can act to transfer the stimulus function of discomfort experienced during physical exercise in controlled conditions. This small, but necessary step in the robust development of intervention strategies provides a basis for further work in a naturalistic setting.

7.2.1 Comparison With Wider Exercise Literature

Chapter 1 of this thesis included a brief critical discussion around conceptual overlaps between ACT and existing health-behaviour literature in the promotion of physical activity bound by the transtheoretical model. The thesis maintains that the ability of the ACT approach to teach skills that help clients increase their psychological flexibility in regard to contextual changes in life experiences, increases the likelihood of long-term adherence to health-behaviours. Much of the existing health-behaviour literature investigating exercise promotion can be explained using the transtheoretical model. However, the transtheoretical model does as identified fail to take into account the contextual private-events that may influence engagement. Stage-based interventions such as exercise consultation described by Farnham and Mutrie (1998/2014) and motivational interviewing (Rollnick et al., 2008) share common principles with ACT and the research within this thesis suggests that finding ways to incorporate conceptually overlapping constructs such as defusion and values from ACT into stage-based approaches to health-behaviours may benefit future interventions in several ways. Firstly, the ability to defuse from an unhelpful private-event, such as doubts about self-efficacy or feelings of discomfort, and or, deal with private-events as they occur during exercise can help people adjust to contextual changes in their experiences. Secondly, clarification of values and framing of values

specific to exercise may help people persist in exercise due to their motivational action. By conducting controlled empirical research studies, the programme of work presented in this thesis provided empirical evidence to suggest that the ACT processes of defusion, self-as-context and values, when taught using a combination of deictic and hierarchical relations can act to transfer the stimulus function of discomfort experienced during physical exercise in controlled laboratory conditions.

Critically, these findings have implications beyond that of ACT and RFT and it is possible to draw some comparisons with existing exercise behaviour change literature which has explored the affective responses to exercise and the intensity at which an individual reacts to their experience. Ekkekakis (2003) suggested a two-factor model in which the responses to stimuli (affective-responses) are influenced not only by physiological factors but also by cognitive appraisals, which act as cues to elicit a behavioural response. The model suggests that the relationship changes dependent on the demand relative to the subjective physical ability and the individual's cognitive appraisal. In ACT terms, the cognitive appraisal would be dependent on psychological flexibility. There are several key differences between Ekkekakis's model, and the work explored in this thesis. Firstly, Ekkekakis suggested that the affective responses will be influenced by the intensity of the exercise and that there is an optimum level of physical effort required during exercise at which the impact of interventions would be most effective. In contrast to this, the work in this thesis explored ACT interventions to overcome experiences due to the intensity. Ekkekakis (2003) measured the cognitive responses to exercise at a neurological level, whereas the current thesis focused on the ability of learned behavioural responses via subjective meaning based in language. As such the work presented in

this thesis represents both an alternative and or a complementary approach to influencing the affective responses people have to private-events in relation to exercise. In practical terms, Ekkekakis et al. (2009) later applied the model to an intervention study that explored the constructs of self-efficacy, and social anxiety related to body image. The study showed that the affective responses resulting in lower levels of physical activity could be attributed to body image. The response intensity was stronger for women who were clinically obese compared to women who were overweight and those of normal weight. This suggests that internalised private-events that people experience during exercise can be sufficient to affect engagement. Rose and Parfit (2007) extended these findings by thematic identification of several constructs to show that the perception of control, ability to concentrate, and perception of personal ability all contributed to affective responses during exercise. However, unlike the work conducted for this thesis which used ACT-based processes, the studies using Ekkekakis's dual-model suggested that exercise can be structured to an optimum level in order to maintain engagement. The studies do not detail how a person could deal with unhelpful private-events that occur spontaneously during exercise. Rather they give a useful insight as to the structure, intensity and nature and types of exercise, relevant to the intended audience. By contrast Shrank and Choudhry (2012) argue that people realise how and why they should adhere to a healthy lifestyle but still cite barriers such as self-efficacy or cognitive limitations for their lack of engagement. As such, Shrank and Choudhry (2012) suggested that research should perhaps focus on establishing cognitive relationships between "*happy feelings*" and engagement in health-behaviours. More recently Ekkekakis (2017) has suggested that research exploring affect in exercise

should move away from education on long-term benefits, and instead focus on simpler short-term regulation, and its effects on long-term commitment (Ekkekakis 2017). The emphasis of the work reported in this thesis which promotes attention to spontaneously occurring private-events and the identification of values-consistent action therefore places the present thesis in line with current literature on exercise promotion. Application of the method explored in this thesis may also provide an avenue to prevent relapse in engagement with positive exercise behaviours highlighted by the transtheoretical model.

7.2.2 General Limitations

Limitations related to the design of specific studies have been addressed throughout this thesis. There are however a small number of more global limitations in respect to the programme of work overall. There is the possibility of a discrepancy between the way in which ACT was intended for use by its developers and the way in which the processes were employed during this thesis. This thesis identified and used only a part of the ACT model by taking select components of ACT. Although the intention of this thesis was to identify a more focused efficient use of ACT within the selected audience, there remains the possibility that incorporation of the remaining processes omitted here may provide greater effect. Secondly, the protocols explored for the programme of work asked participants to overcome artificially induced distress. As a whole ACT processes provide people suffering from distress related to existing problems, such as anxiety or addiction, an array of techniques to help people become more psychologically flexible in the face of their distress. ACT was not developed to be used for laboratory induced private-events such as those

experienced during an exercise task. Further, the strategies developed for this thesis have been tested only in a controlled laboratory situation and therefore currently lack external validity.

In sum, these limitations suggest that any potential audience for the use of an intervention strategy using the methods developed here would be limited to those who are contemplating a change from sedentary to a more active lifestyle. The focused nature of the strategy has yet to be tested in relation to people who are, for example, inactive because they perceive they are incapable of participation; a population at risk of the health-related issues associated with a sedentary lifestyle. In such circumstances this thesis concedes that, in line with the existing empirical evidence detailed in the review section, a more comprehensive clinical approach to ACT may be more appropriate.

7.3 Recommendations for Future Research

Several key ideas have emerged during this programme of work in relation to both the nature and the content of protocols to promote psychological flexibility to discomfort experienced during exercise. The findings advocate a number of recommendations for further empirical development.

7.3.1 Recommendation 1 – Combining Defusion II and Values Clarification to Further Explore the Effect on Discomfort Experienced During Exercise

The current research highlighted key ACT processes as focused intervention protocol likely to change the function of private-events experienced during exercise. Firstly, an intervention protocol involving the combination of defusion and values

orientated cues, and in a separate study, an intervention protocol involving identification and clarification of personal values related to exercise. Previous research by Luciano et al. (2011) included a values clarification component as preparatory exercise prior to a defusion II intervention. Luciano's study focused on overcoming impulsive thoughts and behaviours. However, to date, these two protocols have not been tested as an amalgamation for exercise related discomfort.

7.3.2 Recommendation 2 – Incorporating Hierarchically Framed Values within a Defusion II Protocol to Further Explore the Effect on Discomfort Experienced During Exercise

Both the existing literature (discussed throughout this thesis) and that conducted during the current programme of work, concluded that the incorporation of both deictic and hierarchical relations as a method of framing defusion (known as defusion II) improved the effect of participant application of the defusion techniques for their desired outcomes. This framing process based in Relational Frame Theory also suggested a superior effect when a study conducted for the current programme of work tested the theory in relation to the identification and clarification of personal values and without the incorporation of defusion. Further research would allow the extension of the defusion II process to include a hierarchically structured values clarification process, thereby extending the existing defusion II literature.

7.3.3 Recommendation 3 – Testing Longitudinal Effect of a Hierarchically Framed Defusion and Values Protocol on the Level of Exercise Engagement Over Time

Establishing a valid and reliable evidence base on which to base future intervention protocols requires a systematic and robust development process. Part of this necessitates the controlled exploration of the evidence that the current programme of work demonstrates. However, there remains the requirement to test the ability of participants to take the methods learned during the intervention and apply them to their intended exercise regime away from the laboratory. Extension of the findings into a real-life setting should therefore be a focus of further study in order to establish longitudinal effect sizes, rate of attrition and level of acceptability. The ability of participants to successfully apply defusion and values techniques post intervention would suggest that such a protocol could be effective for overcoming inflexible thinking in a targeted and specific way.

7.3.4 Recommendation 4– Testing the External Validity of Hierarchically Framed Defusion and Values with Participants in a General Public Setting

The studies conducted within the laboratory setting, although not necessarily representative of the intended final target population, successfully established the theoretical and practical evidence base recommended by guidance literature for early stage development of complex intervention strategies (Craig et al., 2013). Nevertheless, issues with regard to external validity need to be addressed during the next stage of development. Targeting of participants in contemplation of exercise uptake would further test the validity of intervention protocols.

7.4 Summary

Difficult or uncomfortable personal experiences people have in relation to exertion during physical activity can be a barrier to engagement in exercise. ACT maintains that such barriers result in ongoing avoidance of circumstances that might lead to exposure to those experiences, even if avoiding the situation is contrary to what is important to us (Biddle & Mutrie, 2008; Hayes et al., 1999/2003). From an RFT perspective, this situation arises due to the creation of relational networks of equivalence, which suggests that negative experiences of exertion may be abstractly related with any situation where physical exertion is anticipated (Torneke et al., 2008). ACT has been used to help people overcome avoidance and increase levels of physical activity. However, systematic evaluation of the literature conducted in this thesis revealed gaps in the existing evidence. This thesis therefore answered the call to develop a clear theory driven evidence base for intervention content. Further, given that combating overly sedentary lifestyles is a worldwide issue which has its greatest demand within a sub/non-clinical population, there is a need for sound empirical development of brief, cost effective non-clinical strategies to promote exercise engagement.

The empirical investigation which followed, identified ACT processes of defusion, self-as-context and valued action supported by the RFT principle of hierarchical relations as a method of tackling avoidance of exercise engagement due to private-events experienced as a result of exertion during exercise. In doing so, this thesis concluded that future development of intervention strategies should consider the incorporation of training in cognitive defusion combined with the clarification

and orientation of personal values using both deictic and hierarchical relations that reinforce both valued outcomes and processes of exercise.

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Appendices

Appendix 1: Search terms and the associated coding for each database used in the systematic review

Database: APA PsycInfo

1. TI AB "ACT"
2. TI AB "Acceptance and Commitment Therapy"
3. DE "Acceptance and Commitment Therapy"
4. TI AB "Commitment"
5. DE "Commitment"
6. TI AB "Cognitive Defusion"
7. TI AB "Mindfulness"
8. DE "Mindfulness"
9. TI AB "RFT"
10. TI AB "Relational Frame Theory"
11. TI AB "Personal Values"
12. DE "Personal Values"
13. TI AB "Self as Context"
14. TI AB "Third Wave"
15. 1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7 OR 8 OR 9 OR 10 OR 11 OR 12 OR 13 OR 14
16. TI AB "Physica* Activ*"
17. DE "Physical Activity"
18. TI AB "Exercis*"
19. DE "Exercise"
20. TI AB "Sport*"
21. DE "Sports"
22. 16 OR 17 OR 18 OR 19 OR 20 OR 21
23. 15 AND 22

Search string for APA PsycInfo

((TI "ACT") OR (AB "ACT") OR (TI "Acceptance and Commitment Therapy") OR (AB "Acceptance and Commitment Therapy") OR (DE "Acceptance and Commitment Therapy") OR (TI "Commitment") OR (AB "Commitment") OR (DE "Commitment")) OR (TI "Cognitive Defusion") OR (AB "Cognitive Defusion") OR (TI "Mindfulness") OR (AB "Mindfulness") OR (DE "Mindfulness")) OR (TI "RFT") OR (AB "RFT") OR (TI "Relational Frame Theory") OR (AB "Relational Frame Theory") OR (TI "Personal Values") OR (AB "Personal Values") OR (DE "Personal Values")) OR (TI "Self as Context") OR (AB "Self as Context") OR (TI "Third Wave") OR (AB "Third Wave")) AND ((TI "Physica* Activ*") OR (AB "Physica* Activ*") OR (DE "Physical Activity")) OR (TI "Exercis*") OR (AB "Exercis*") OR (DE "Exercise")) OR (TI "Sport*") OR (AB "Sport*") OR (DE "Sports"))

Database: Medline

1. TI AB "ACT"
2. TI AB "Acceptance and Commitment Therapy"
3. MH "ACCEPTANCE and Commitment Therapy"
4. TI AB "Commitment"
5. TI AB "Cognitive Defusion"
6. TI AB "Mindfulness"
7. MH "Mindfulness"
8. TI AB "RFT"
9. TI AB "Relational Frame Theory"
10. TI AB "Personal Values"
11. TI AB "Self as Context"
12. TI AB "Third Wave"
13. 1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7 OR 8 OR 9 OR 10 OR 11 OR 12
14. TI AB "Physica* Activ*"
15. TI AB "Exercis*"
16. MH "Exercise"
17. TI AB "Sport*"
18. MH "Sports"
19. 14 OR 15 OR 16 OR 17 OR 18
20. 13 AND 19

Search string for Medline

((TI "ACT") OR (AB "ACT") OR (TI "Acceptance and Commitment Therapy") OR (AB "Acceptance and Commitment Therapy") OR (MH "ACCEPTANCE and Commitment Therapy") OR (TI "Commitment") OR (AB "Commitment") OR (TI "Cognitive Defusion") OR (AB "Cognitive Defusion") OR (TI "Mindfulness") OR (AB "Mindfulness") OR (MH "Mindfulness") OR (TI "RFT") OR (AB "RFT") OR (TI "Relational Frame Theory") OR (AB "Relational Frame Theory") OR (TI "Personal Values") OR (AB "Personal Values") OR (TI "Self as Context") OR (AB "Self as Context") OR (TI "Third Wave") OR (AB "Third Wave")) AND ((TI "Physica* Activ*") OR (AB "Physica* Activ*") OR (TI "Exercis*") OR (AB "Exercis*") OR (MH "Exercise") OR (TI "Sport*") OR (AB "Sport*") OR (MH "Sports")))

Database: Cumulative Index to Nursing and Allied Health Literature (CINAHL)

1. TI AB "ACT"
2. TI AB "Acceptance and Commitment Therapy"
3. MH "Acceptance and Commitment Therapy"
4. TI AB "Commitment"
5. TI AB "Cognitive Defusion"
6. TI AB "Mindfulness"
7. MH "Mindfulness"
8. TI AB "RFT"
9. TI AB "Relational Frame Theory"
10. TI AB "Personal Values"

11. MH "Personal Values"
12. TI AB "Self as Context"
13. TI AB "Third Wave"
14. 1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7 OR 8 OR 9 OR 10 OR 11 OR 12 OR 13
15. TI AB "Physica* Activ*"
16. MH "Physical Activity"
17. TI AB "Exercis*"
18. MH "Exercise"
19. TI AB "Sport*"
20. MH "Sports"
21. 15 OR 16 OR 17 OR 18 OR 19 OR 20
22. 14 AND 21

Search string for CINAHL

((TI "ACT") OR (AB "ACT") OR (TI "Acceptance and Commitment Therapy") OR (AB "Acceptance and Commitment Therapy") OR (MH "Acceptance and Commitment Therapy") OR (TI "Commitment") OR (AB "Commitment") OR (TI "Cognitive Defusion") OR (AB "Cognitive Defusion") OR (TI "Mindfulness") OR (AB "Mindfulness") OR (MH "Mindfulness") OR (TI "RFT") OR (AB "RFT") OR (TI "Relational Frame Theory") OR (AB "Relational Frame Theory") OR (TI "Personal Values") OR (AB "Personal Values") OR (MH "Personal Values") OR (TI "Self as Context") OR (AB "Self as Context") OR (TI "Third Wave") OR (AB "Third Wave")) AND ((TI "Physica* Activ*") OR (AB "Physica* Activ*") OR (MH "Physical Activity") OR (TI "Exercis*") OR (AB "Exercis*") OR (MH "Exercise") OR (TI "Sport*") OR (AB "Sport*") OR (MH "Sports"))

Database: Psychology and Behavioural Sciences Collection (PBSC)

1. TI AB "ACT"
2. TI AB "Acceptance and Commitment Therapy"
3. DE "ACCEPTANCE and Commitment Therapy"
4. TI AB "Commitment"
5. DE "COMMITMENT (Psychology)"
6. TI AB "Cognitive Defusion"
7. TI AB "Mindfulness"
8. DE "Mindfulness (Meditation)"
9. TI AB "RFT"
10. TI AB "Relational Frame Theory"
11. TI AB "Personal Values"
12. TI AB "Self as Context"
13. TI AB "Third Wave"
14. 1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7 OR 8 OR 9 OR 10 OR 11 OR 12 OR 13
15. TI AB "Physica* Activ*"
16. DE "Physical Activity"
17. TI AB "Exercis*"
18. DE "Exercise"

19. TI AB "Sport*"
20. DE "Sports"
21. 15 OR 16 OR 17 OR 18 OR 19 OR 20
22. 14 AND 21

Search string for PBSC

((TI "ACT") OR (AB "ACT") OR (TI "Acceptance and Commitment Therapy") OR (AB "Acceptance and Commitment Therapy") OR (DE "ACCEPTANCE and Commitment Therapy") OR (TI "Commitment") OR (AB "Commitment") OR (DE "COMMITMENT (Psychology)") OR (TI "Cognitive Defusion") OR (AB "Cognitive Defusion") OR (TI "Mindfulness") OR (AB "Mindfulness") OR (DE "Mindfulness (Meditation)") OR (TI "RFT") OR (AB "RFT") OR (TI "Relational Frame Theory") OR (AB "Relational Frame Theory") OR (TI "Personal Values") OR (AB "Personal Values") OR (TI "Self as Context") OR (AB "Self as Context") OR (TI "Third Wave") OR (AB "Third Wave")) AND ((TI "Physica* Activ*") OR (AB "Physica* Activ*") OR (DE "Physical Activity") OR (TI "Exercis*") OR (AB "Exercis*") OR (DE "Exercise") OR (TI "Sport*") OR (AB "Sport*") OR (DE "Sports"))


Database: Cochrane Library

1. TI AB "ACT"
2. TI AB "Acceptance and Commitment Therapy"
3. MeSH Descriptor Acceptance and Commitment TherapyTI AB "Commitment"
4. TI AB "Cognitive Defusion"
5. TI AB "Mindfulness"
6. MeSH Descriptor: Mindfulness
7. TI AB "RFT"
8. TI AB "Relational Frame Theory"
9. TI AB "Personal Values"
10. TI AB "Self as Context"
11. TI AB "Third Wave"
12. 1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7 OR 8 OR 9 OR 10 OR 11 OR 12
13. TI AB "Physica* Activ*"
14. TI AB "Exercis*"
15. MeSH Descriptor: Exercise
16. TI AB "Sport*"
17. MeSH Descriptor: "Sports"
18. 14 OR 15 OR 16 OR 17 OR 18
19. 13 AND 19

Search string for Cochrane Library

((("ACT" or "Acceptance and Commitment Therapy" or commitment or "Cognitive Defusion" or mindfulness or "RFT" or "Relational Frame Theory" or "Personal Values" or "Self as Context" or "Third Wave":ti,ab) or [mh^"Acceptance and Commitment Therapy"] or [mh^Mindfulness]) AND ((Physica* next Activ* or Exercis* or Sport*:ti,ab) or [mh^Exercise] or [mh^Sports])

Appendix 2. Effective Public Health Practice Project Quality Assessment Tool



QUALITY ASSESSMENT TOOL FOR QUANTITATIVE STUDIES

COMPONENT RATINGS

A) SELECTION BIAS

(Q1) Are the individuals selected to participate in the study likely to be representative of the target population?

- 1 Very likely
- 2 Somewhat likely
- 3 Not likely
- 4 Can't tell

(Q2) What percentage of selected individuals agreed to participate?

- 1 80 - 100% agreement
- 2 60 - 79% agreement
- 3 less than 60% agreement
- 4 Not applicable
- 5 Can't tell

RATE THIS SECTION	STRONG	MODERATE	WEAK
See dictionary	1	2	3

B) STUDY DESIGN

Indicate the study design

- 1 Randomized controlled trial
- 2 Controlled clinical trial
- 3 Cohort analytic (two group pre + post)
- 4 Case-control
- 5 Cohort (one group pre + post (before and after))
- 6 Interrupted time series
- 7 Other specify _____
- 8 Can't tell

Was the study described as randomized? If NO, go to Component C.

No Yes

If Yes, was the method of randomization described? (See dictionary)

No Yes

If Yes, was the method appropriate? (See dictionary)

No Yes

RATE THIS SECTION	STRONG	MODERATE	WEAK
See dictionary	1	2	3

1

C) CONFOUNDERS**(Q1) Were there important differences between groups prior to the intervention?**

- 1 Yes
- 2 No
- 3 Can't tell

The following are examples of confounders:

- 1 Race
- 2 Sex
- 3 Marital status/family
- 4 Age
- 5 SES (income or class)
- 6 Education
- 7 Health status
- 8 Pre-intervention score on outcome measure

(Q2) If yes, indicate the percentage of relevant confounders that were controlled (either in the design (e.g. stratification, matching) or analysis)?

- 1 80 – 100% (most)
- 2 60 – 79% (some)
- 3 Less than 60% (few or none)
- 4 Can't Tell

RATE THIS SECTION	STRONG	MODERATE	WEAK
See dictionary	1	2	3

D) BLINDING**(Q1) Was (were) the outcome assessor(s) aware of the intervention or exposure status of participants?**

- 1 Yes
- 2 No
- 3 Can't tell

(Q2) Were the study participants aware of the research question?

- 1 Yes
- 2 No
- 3 Can't tell

RATE THIS SECTION	STRONG	MODERATE	WEAK
See dictionary	1	2	3

E) DATA COLLECTION METHODS**(Q1) Were data collection tools shown to be valid?**

- 1 Yes
- 2 No
- 3 Can't tell

(Q2) Were data collection tools shown to be reliable?

- 1 Yes
- 2 No
- 3 Can't tell

RATE THIS SECTION	STRONG	MODERATE	WEAK
See dictionary	1	2	3

F) WITHDRAWALS AND DROP-OUTS**(Q1) Were withdrawals and drop-outs reported in terms of numbers and/or reasons per group?**

- 1 Yes
- 2 No
- 3 Can't tell
- 4 Not Applicable (i.e. one time surveys or interviews)

(Q2) Indicate the percentage of participants completing the study. (If the percentage differs by groups, record the lowest).

- 1 80 -100%
- 2 60 - 79%
- 3 less than 60%
- 4 Can't tell
- 5 Not Applicable (i.e. Retrospective case-control)

RATE THIS SECTION	STRONG	MODERATE	WEAK	
See dictionary	1	2	3	Not Applicable

G) INTERVENTION INTEGRITY**(Q1) What percentage of participants received the allocated intervention or exposure of interest?**

- 1 80 -100%
- 2 60 - 79%
- 3 less than 60%
- 4 Can't tell

(Q2) Was the consistency of the intervention measured?

- 1 Yes
- 2 No
- 3 Can't tell

(Q3) Is it likely that subjects received an unintended intervention (contamination or co-intervention) that may influence the results?

- 4 Yes
- 5 No
- 6 Can't tell

H) ANALYSES**(Q1) Indicate the unit of allocation (circle one)**

community organization/institution practice/office individual

(Q2) Indicate the unit of analysis (circle one)

community organization/institution practice/office individual

(Q3) Are the statistical methods appropriate for the study design?

- 1 Yes
- 2 No
- 3 Can't tell

(Q4) Is the analysis performed by intervention allocation status (i.e. intention to treat) rather than the actual intervention received?

- 1 Yes
- 2 No
- 3 Can't tell

GLOBAL RATING**COMPONENT RATINGS**

Please transcribe the information from the gray boxes on pages 1-4 onto this page. See dictionary on how to rate this section.

A	SELECTION BIAS	STRONG	MODERATE	WEAK
		1	2	3
B	STUDY DESIGN	STRONG	MODERATE	WEAK
		1	2	3
C	CONFOUNDERS	STRONG	MODERATE	WEAK
		1	2	3
D	BLINDING	STRONG	MODERATE	WEAK
		1	2	3
E	DATA COLLECTION METHOD	STRONG	MODERATE	WEAK
		1	2	3
F	WITHDRAWALS AND DROPOUTS	STRONG	MODERATE	WEAK
		1	2	3
				Not Applicable

GLOBAL RATING FOR THIS PAPER (circle one):

- | | | |
|---|----------|----------------------------|
| 1 | STRONG | (no WEAK ratings) |
| 2 | MODERATE | (one WEAK rating) |
| 3 | WEAK | (two or more WEAK ratings) |

With both reviewers discussing the ratings:

Is there a discrepancy between the two reviewers with respect to the component (A-F) ratings?

No Yes

If yes, indicate the reason for the discrepancy

- | | |
|---|---|
| 1 | Oversight |
| 2 | Differences in interpretation of criteria |
| 3 | Differences in interpretation of study |

Final decision of both reviewers (circle one):

- | | |
|----------|-----------------|
| 1 | STRONG |
| 2 | MODERATE |
| 3 | WEAK |

Appendix 3: Example of informed consent form

Research study: How do thoughts and feelings affect our ability to tolerate discomfort

Please read this information carefully and sign the form where indicated if you agree to take part in the research.

Please take time to ask any questions you might have. If you have any concerns about your suitability for the study, please do not take part

- I confirm that I have read and understood the information sheet for the study noted above.
- I understand that my participation is voluntary and that if I decide that I no longer wish to take part I can withdraw before completion of the session, without giving a reason. I also understand that once I have completed the session my responses will be unidentifiable and therefore I will no longer be able to withdraw the responses.
- I have read the list of health issues on the Information Sheet and confirm that there is no reason of which I am aware that I should not take part in moderate physical exercise.
- I understand that in this research any personal information I provide such as name and contact details will be treated as confidential and stored securely.
- Data I generate via my responses will be anonymous and shared for the purposes on research.
- I agree to take part in the study noted above

Please sign in order to indicate your agreement with the statement above, and your consent to take part in this study.

Date

Signature

Appendix 4: Example of debriefing form

Research study: How do thoughts and feelings affect our ability to tolerate discomfort

Thank you for taking part in this study.

You have now completed the study. Thank you for very much for participating. Here is some further information which explains why we asked you to take part. We're still recruiting more people to participate in this study, so we'd be really grateful if you didn't tell other people too much about what this study is about!

The main aim of this research is to investigate ways to improve our resilience to the discomfort we may associate with exercise. Many people dislike the physical sensations that can go along with exercise, such as feeling out of breath or hot. We're comparing various psychological techniques which have been shown to help deal with pain and discomfort. In turn we are looking to see which of these techniques might work best for exercise-related discomfort. The data you have provided will help us answer this question, and might therefore help psychologists to develop better ways to help people who would like to take up exercise but who feel demotivated by how it feels.

Please be assured that all responses you provided during your time spent engaged in the study will be anonymous. If you have provided any contact information such as your email address or student number, it will be kept completely separate from your questionnaire answers and your test results. This means that individual feedback on your responses is not possible. However, if you would like a copy of the overall results for the study, please feel free to contact me: a.whalley@chester.ac.uk.

If you have any health concerns about anything which you may have become aware of during the course of this research, please seek advice from your GP. Alternatively, you may find information provided by the following sources useful:

NHS Choices: For information on getting physically active.

<http://www.nhs.uk/search?collection=nhs-meta&query=Getting%20active>

If you are a student at the University of Chester, you can contact Student Futures: For help, support or information on your physical or mental wellbeing.

Telephone: 01244-511550

<https://portal.chester.ac.uk/patpack/Pages/studentfutures.aspx>

Thank you for taking part!

Anthony Whalley- Principal Investigator

If you require information about this research, please contact me:

Anthony Whalley, Department of Psychology, University of Chester, Parkgate Road, Chester, CH1 4BJ. Email: a.whalley@chester.ac.uk

University of Chester Department of Psychology Ethics Committee (DOPEC) is chaired by Prof. Moira Lafferty. Email: m.lafferty@chester.ac.uk

Appendix 5: Scripted material for the first intervention study – Chapter 4

Condition: Defusion metaphors with mental rehearsal

<p>Introduction</p> <p>Provide a quick introduction to the programme, aims of the intervention – to teach strategies to help people to increase resilience to the discomfort associated with physical exercise.</p>
<p>Example script</p> <p>Introduction</p> <ul style="list-style-type: none"> • <i>You are about to take part in research exploring how we experience the discomfort associated with physical exercise. You will learn a technique that uses something called defusion, which may, or may not, help you to develop psychological resilience in regard to how you feel when you're being physically active.</i> • <i>Some of the ideas that I'm going to ask you to think about may appear a little unusual, so, in order to help you get your head around things we will explore the ideas using metaphors. We'll use three different metaphors each taking a slightly different perspective of the same ideas. Once we've done this you'll get a chance to practice applying the ideas. Are there any questions so far? Pause approx. 5 seconds - Ok, if you are in agreement we'll make a start.</i>
<p>Procedure</p> <p>The participant will be informed on the use of defusion techniques, and receive three defusion exercises (Kicking Footballs; Hands as thoughts; Leaves on a stream) all of which will be presented orally via a script. An example script is detailed below. The wording of each metaphor has been arranged hierarchically framed.</p>
<p>Example script</p> <p>Contextualizing the metaphors</p> <ul style="list-style-type: none"> • <i>Firstly, I think it would be beneficial to add a little context to the techniques you are about to learn. You have just taken part in a step exercise and you are going to try and remember the thoughts that came into your mind as you did the task. Before we start and, if you are in agreement, just take a moment to close your eyes – pause 2 seconds, take a deep breath in – pause 2 seconds, and slowly let the breath out. Feel yourself relaxing into your chair – pause 2 seconds and slowly open your eyes.</i> • <i>Now, I'd like you to think back a few minutes to when you were taking the step test. – pause 2 seconds. Your task now is to become aware of the thoughts and feeling you had during the step exercise. – pause 5 seconds then ask the participant the following questions, taking a few seconds to listen to the participants' responses in between each question.</i> • <i>What <u>thoughts</u> did you have whilst taking the step exercise?</i> • <i>What did you do when these thoughts showed up?</i> • <i>Do you think you could control these thoughts?</i> • <i>Ok, let me talk for a second about thoughts. Do you think we can control our thoughts? - Pause for a response. The truth is its very difficult to control when we think. You know when there's something that you are trying to avoid thinking about, but the more you try NOT to think of it the more it pops into your head. Let try a little exercise to highlight</i>

our inability to control our own thoughts. I'm going to ask you something, and I want you to try NOT thinking of it ok? - **Pause to clarify understanding.** Now, I don't want you to think of a white polar bear. - **Pause 2 seconds.** What did you think of? - **Pause for response.** If we are honest with ourselves, even if it's only for a fleeting moment, we have to think about something in order not to think about it. It works with words too, what if I said to you, - **pause 2 seconds,** Mary had a little – **pause 2 seconds.** What showed in your mind then? – **pause for response.** So we can't easily control what thoughts come into our minds' but we can just accept that they are there.

- There is a useful metaphor that I think helps explain this idea. It describes our counter-productive struggle with distressing thoughts, memories and feelings as like fighting with a ball in a pool. You don't like these things. You don't want them, and you want them out of your life. So you try to push the ball under the water and out of your consciousness. However, the ball just keeps popping back up to the surface, so you have to keep pushing it down or holding it under the water. Struggling with the ball like this actually keeps it close to you, and its tiring and futile. If you were able to let go of the ball, it would pop up and float on the surface near you, and you probably wouldn't like it. But if you let it float there for a while without grabbing it, it could eventually drift away to the other side of the pool. And even if it didn't you'd be able to use your arms and enjoy your swim, rather than spending your time fighting.
- So what we are going to learn is **not** try to stop or resist thoughts, but help you to identify your thoughts and learn strategies to help you change your relationship with those thoughts. Any questions now? – **clarify any issues.**

Teaching the metaphors

- The strategy you're going to learn is called cognitive-defusion. The technique can be used to help you to identify thoughts and sensations, such as those experienced before or during exercise, that prevent you from behaving in a way that you want to. Simply noticing what you are thinking gives you the opportunity to change your relationship with those thoughts and sensations that prevent you from achieving your goal.

Noticing/watching thoughts as external objects

- Let me give you an example about what I mean by noticing your thoughts, firstly, if you are willing. Take a moment to allow yourself to relax into the chair and just breathe - **Pause 2 seconds.** As you sit quietly, it's likely that you will start to feel lots of impulses and thoughts related to those impulses. A common impulse is the urge to fidget, thoughts attached to this may be "Is my hair ok", "I'm bored", "this is a waste of time". The key is to sit quietly and simply allow the thoughts to be. As we've seen already trying to stop having thoughts is nigh on impossible. However, not interfering with your thoughts and just observing them, is possible. The longer you do this, the more you'll notice that your perspective changes. Where it was that you were having thoughts such as "I feel silly" you start to notice that you can observe your own thoughts – **pause 2 seconds** notice thoughts as things, - **pause 2 seconds** as thoughts, somehow separate from you – **pause 2 seconds.** Once you can watch your thoughts in this way you can interact with them. Let's think about this metaphorically.
- Imagine yourself at a football pitch. It can be a famous pitch, like Liverpool's Anfield, or maybe one that you enjoyed playing on when you were younger. As you're imagining yourself on the pitch, take a moment to see yourself on the touchline, near the goal, facing the large open field, and there's a football on the ground next to you. As you bend

down to pick it up you notice something written on it. As you begin to focus on it, you notice the words describe a thought that's distressing you. –**Pause 2 seconds**. When you can see that thought clearly on the ball place the ball back on the ground, keeping your focus on the thought as you step back to kick it. – **pause 2 seconds**. Now run up to the ball and kick it off into the distance, watching it travel from where you are standing. As you watch the ball travel off into the distance take another deep breath. Now return to the touchline and do this with another ball and another thought. It might be the same thought popping back up again, or it might be a different thought. When you can see that thought clearly on the ball, place it on the ground, keeping you focus on the ball, Step back away from it, run up and kick it off into the distance. (**Kicking footballs, Helmer, 2013**)

Separating thoughts from our selves

- So, when we see thoughts in this way it can help us to understand that our thoughts are actually separate from what we know of as our selves. Another example is by imagining for a moment that your hands are your thoughts. Hold your hands together, palms open, as if they were pages of an open book. Then slowly and steadily raise your hands up toward your face. Keep going until you cover your eyes. Now take a few seconds to look at the world around you through the gaps in your fingers and notice how this affects your view of the world.- **pause 2 seconds**. What would it be like going around all day with your hands covering your eyes in this way. How much would it limit you? How much would you miss out on? How much would it reduce your ability to respond to the world around you? This is like fusion: we become so caught up in our thoughts that we lose contact with many aspects of the here-and-now experience, and our thoughts have such an influence over what we do that our ability to act effectively is significantly reduced. Now once again cover your eyes with your hands, but this time lower them from your face very, very slowly. As your hands slowly descend beneath your eyes, notice how much easier it is to connect with the world around you. This is like defusion. As you lower your hands they don't disappear, but getting some separation allows you to engage more fully and flexibly, freeing you to choose to act in ways that are important to you (**Hands as Thoughts, Harris, 2009**).

Noticing thoughts and the self as external objects.

- Once you are happy noticing your thoughts, you can catch yourself watching your own thoughts. This takes things a step further. - **pause 2 seconds**. You could say that you start noticing yourself noticing thoughts. Kind of watching yourself think.
- If you can, I'd like you to imagine a beautiful, slowly floating stream. - **pause 2 seconds**. The water flows over the rocks and around the trees, descends down-hill, and travels through a valley Once in a while, a big leaf drops into the water and floats down-stream. See if you can look down on yourself sitting beside the that stream on a warm sunny day, watching the leaves float by. - **pause 2 seconds**. Now become conscious of your thoughts. - **pause 2 seconds**. Each time an unwanted thought pops into your head, notice the thought, can you notice yourself noticing that thought? - **pause 2 seconds** Now, imagine that the thought is on one of those leaves. If you think in words, put those words onto the leaf. If you think in images, put them on the leaf as images. Don't try to make the stream go faster or slower. Don't try to change what shows up on the leaves in any way. If the leaves disappear, if you mentally go somewhere else, or if you find that you're in the stream on a leaf, just stop and notice that this has happened. Let it be, and then once again return to the stream. – **pause 2 seconds** Notice yourself watching a thought come into your mind, place it on a leaf, and let the leaf float down-stream. So, notice the thought, - **pause 2 seconds** put it on the leaf – **pause 2 seconds** and let it float.

Notice yourself doing this. Continue for the next few moments, just watching your thoughts float by. Visualize yourself doing this. (Leaves on a stream, Hayes, 2005).

- *Can you see that you are now noticing yourself noticing your thoughts? **Pause for response***

Procedure

The participant is asked to engage in **mental visualisation of physical exercises** on two occasions: 1) extending legs out parallel to the floor 2) extending arms out to the sides. An example of the script for this process is detailed below. The participant is presented with the defusion metaphors immediately prior to the mental visualisation exercise.

Example script

Group A visualization tasks

Legs extended exercise

- *Ok, so the first task I'd like you to try is visualize yourself performing a physical exercise. For this I'd like you to imagine yourself seated in a chair. Take a moment to become aware of how your legs feel now, whether they feel relaxed or tense. -**pause 2 seconds**. Just feel the backs of your legs in contact with the chair you're sitting on. Now in your minds-eye I'd like you to imagine gently extending your legs away in front of you until they are parallel to the floor. (**visually demonstrate as you speak**). As you hold your legs there, I'd like you to imagine the muscles in your legs working to keep your legs extended. How do they feel? Perhaps you can imagine feeling your legs becoming heavier, I'd like you to try to become aware of the imagined sensations and notice the thoughts you have about those sensations. – **pause 5 seconds**. Each time a thought about perhaps any heaviness you feel in your legs pops into your head, just watch it for a moment. – **pause 5 seconds**. Perhaps you imagine the muscles in your legs become warm or start to feel fatigued. Each time a you notice your muscles becoming tired, notice that it is you that is watching those thoughts. **Pause 5 seconds**. Each time you notice an unwanted thought try to notice that you are apart from that thought. – **pause 5 seconds**. Notice yourself, noticing the thoughts. **Pause for approx. 15 seconds**. You may perceive your legs becoming too heavy to hold any more – **pause 5 seconds**. When you do I'd like you to imagine, in your minds-eye, slowly lowering your legs and place your feet gently back on the floor and say when you have done this – **continue for maximum 1 minute more at which point ask the participant to** - in your minds-eye, slowly lowering your legs and place your feet gently back on the floor- **pause 2 seconds**, and when you are ready, relax.*

Arms parallel exercise

- *For the second exercise I'd like you to again imagine yourself seated in a chair. Take a moment to become aware of how your arms and shoulders feel now, whether they feel relaxed or tense. -**pause 2 seconds**. Just feel your back in contact with the chair you're sitting on. Now in your mind's eye I'd like you to imagine slowly lifting your arms out to the sides, until they are parallel to the floor. (**visually demonstrate as you speak**). As you hold your arms there, I'd like you to imagine the muscles in your shoulders and back working to keep your arms extended. How do they feel? Perhaps you can imagine feeling your arms becoming heavier, I'd like you to try to become aware of the imagined sensations and notice the thoughts you have about those sensations. – **pause 5 seconds**. Each time a thought about perhaps any heaviness you feel in your arms pops into your head, just watch it for a moment. – **pause 5 seconds**. Perhaps you imagine the muscles in your shoulders become warm or start to feel fatigued. Each time a you notice your muscles becoming tired, notice that it is you that is watching those thoughts. **Pause 5 seconds**. Each time you notice an unwanted thought try to notice that you are apart from that thought. – **pause 5 seconds**. Notice yourself, noticing the thoughts. **Pause for approx. 15 seconds**. You may perceive your arms becoming too heavy to hold any more*

– **pause 5 seconds.** When you do I'd like you to imagine, in your minds-eye, slowly lowering your arms and place your hands gently on your thighs and say when you have done this – **continue for maximum 1 minute more at which point ask the participant to** - in your minds-eye, slowly lowering your arms and place your hands gently on your thighs- **pause 2 seconds**, and when you are ready, relax.

- Now that you have learned these techniques if you are willing I'd like you to try the step task that you completed at the beginning of the session.

Appendix 5

Condition: Defusion metaphors with physical rehearsal

<p>Introduction</p> <p>Provide a quick introduction to the programme, aims of the intervention – to teach strategies to help people to increase resilience to the discomfort associated physical exercise.</p>
<p>Example script</p> <p>Introduction</p> <ul style="list-style-type: none"> • <i>So, you are about to take part in research exploring how we experience the discomfort associated with physical exercise. You will learn a technique that uses something called defusion, which may, or may not, help you to develop psychological resilience in regard to how you feel when you're being physically active.</i> • <i>Some of the ideas that I'm going to ask you to think about may appear a little unusual, so, in order to help you get your head around things we will explore the ideas using metaphors.</i> • <i>We'll use three different metaphors each taking a slightly different perspective of the same ideas. Once we've done this you'll get a chance to practice applying the ideas. Are there any questions so far? Pause approx. 5 seconds - Ok, if you are in agreement we'll make a start.</i>
<p>Procedure</p> <p>The participant will be informed on the use of defusion techniques, and receive three defusion exercises (Kicking Footballs; Hands as thoughts; Leaves on a stream) all of which will be presented orally via a script. An example script is detailed below. The wording of each metaphor has been arranged hierarchically framed.</p>
<p>Example script</p> <p>Contextualizing the metaphors</p> <ul style="list-style-type: none"> • <i>Firstly, I think it would be beneficial to add a little context to the techniques you are about to learn. You have just taken part in a step exercise and you are going to try and remember the thoughts that came into you mind as you did the task. Before we start and, if you are in agreement, just take a moment to close your eyes – pause 2 seconds, take a deep breath in – pause 2 seconds, and slowly let the breath out. Feel your self relaxing into your chair – pause 2 seconds and slowly open your eyes.</i> • <i>Now, I'd like you to think back a few minutes to when you were taking the step test. – pause 2 seconds. Your task now is to become aware of the thoughts and feeling you had during the step exercise. – pause 5 seconds then ask the participant the following questions, taking a few seconds to listen to the participants' responses in between each question.</i> • <i>What <u>thoughts</u> did you have whilst taking the step exercise?</i> • <i>What did you do when these thoughts showed up?</i> • <i>Do you think you could control these thoughts?</i> • <i>Ok, let me talk for a second about thoughts. Do you think we can control our thoughts? - Pause for a response. The truth is we find it very difficult to control our thoughts. You know when there's something that you are trying to avoid thinking about, but the more you try not to think of it the more it pops into your head. Let try a</i>

silly little exercise to highlight our inability to control our own thoughts. I'm going to ask you something, and I want you to try NOT thinking of it ok? - **Pause to clarify understanding.** Now, I don't want you to think of a white polar bear. - **Pause 2 seconds.** What did you think of? - **Pause for response.** If we are honest with ourselves, even if it's only for a fleeting moment, we have to think about something in order not to think about it. It works with words too, what if I said to you, - **pause 2 seconds,** Mary had a little – **pause 2 seconds.** What showed in your mind then? – **pause for response.** So we can't easily control what thoughts come into our minds' but we can just accept that they are there.

- There is a useful metaphor that I think helps explain this idea. It describes our counter-productive struggle with distressing thoughts, memories and feelings as like fighting with a ball in a pool. You don't like these things. You don't want them, and you want them out of your life. So you try to push the ball under the water and out of your consciousness. However, the ball just keeps popping back up to the surface, so you have to keep pushing it down or holding it under the water. Struggling with the ball like this actually keeps it close to you, and its tiring and futile. If you were able to let go of the ball, it would pop up and float on the surface near you, and you probably wouldn't like it. But if you let it float there for a while without grabbing it, it could eventually drift away to the other side of the pool. And even if it didn't you'd be able to use your arms and enjoy your swim, rather than spending your time fighting.
- So what we are going to learn do is **not** try to stop or resist thoughts, but help you to identify your thoughts and learn strategies to help you change your relationship with those thoughts. Any questions now? – **clarify any issues.**

Teaching the metaphors

- The strategy you're going to learn is called cognitive-defusion. The technique can be used to help you to identify thoughts and sensations, such as those experienced before or during exercise, that prevent you from behaving in a way that you want to. Simply noticing what you are thinking gives you the opportunity to change your relationship with those thoughts and sensations that prevent you from achieving your goal.

Noticing/watching thoughts as external objects

- Let me give you an example about what I mean by noticing your thoughts, firstly, if you are willing. Take a moment to allow yourself to relax into the chair and just breathe - **Pause 2 seconds.** As you sit quietly, it's likely that you will start to feel lots of impulses and thoughts related to those impulses. A common impulse is the urge to fidget, thoughts attached to this may be "Is my hair ok", "I'm bored", "this is a waste of time". The key is to sit quietly and simply allow the thoughts to be. As we've seen already trying to stop having thoughts is nigh on impossible. However, not interfering with your thoughts and just observing them is possible. The longer you do this, the more you'll notice that your perspective changes. Where it was that you were having thoughts such as "I feel silly" you start to notice that you can observe your own thoughts – **pause 2 seconds** notice thoughts as things, - **pause 2 seconds** as thoughts, somehow separate from you – **pause 2 seconds.** Once you can watch your thoughts in this way you can interact with them. Let's think about this metaphorically.
- Imagine yourself at a football pitch. It can be a famous pitch, like Liverpool's Anfield, or maybe one that you enjoyed playing on when you were younger. As you're imagining yourself on the pitch, take a moment to see yourself on the touchline, near the goal, facing the large open field, and there's a football on the ground next to you. As you bend down to pick it up you notice something written on it. As you begin to focus on it,

you notice the words describe a thought that's distressing you. –**Pause 2 seconds.** When you can see that thought clearly on the ball place the ball back on the ground, keeping your focus on the thought as you step back to kick it. – **pause 2 seconds.** Now run up to the ball and kick it off into the distance, watching it travel from where you are standing. As you watch the ball travel off into the distance take another deep breath. Now return to the touchline and do this with another ball and another thought. It might be the same thought popping back up again, or it might be a different thought. When you can see that thought clearly on the ball, place it on the ground, keeping you focus on the ball, Step back away from it, run up and kick it off into the distance. (**Kicking footballs, Helmer, 2013**)

Separating thoughts from our selves

- So, when we see thoughts in this way it can help us to understand that our thoughts are actually separate from what we know of as our selves. Another example is by imagining for a moment that your hands are your thoughts. Hold your hands together, palms open, as if they were pages of an open book. Then slowly and steadily raise your hands up toward your face. Keep going until you cover your eyes. Now take a few seconds to look at the world around you through the gaps in your fingers and notice how this affects your view of the world.- **pause 2 seconds.** What would it be like going around all day with your hands covering your eyes in this way. How much would it limit you? How much would you miss out on? How much would it reduce your ability to respond to the world around you? This is like fusion: we become so caught up in our thoughts that we lose contact with many aspects of the here-and-now experience, and our thoughts have such an influence over what we do that our ability to act effectively is significantly reduced. Now once again cover your eyes with your hands, but this time lower them from your face very, very slowly. As your hands slowly descend beneath your eyes, notice how much easier it is to connect with the world around you. This is like defusion. As you lower your hands they don't disappear, but getting some separation allows you to engage more fully and flexibly, freeing you to choose to act in ways that are important to you (**Hands as Thoughts, Harris, 2009**).

Noticing thoughts and the self as external objects.

- Once you are happy noticing your thoughts, you can catch yourself watching your own thoughts. This takes things a step further. - **pause 2 seconds.** You could say that you start noticing yourself noticing thoughts. Kind of watching yourself think.
- If you can, I'd like you to imagine a beautiful, slowly floating stream. - **pause 2 seconds.** The water flows over the rocks and around the trees, descends down-hill, and travels through a valley Once in a while, a big leave drops into the water and floats down-stream. See if you can look down on yourself sitting beside the that stream on a warm sunny day, watching the leaves float by. - **pause 2 seconds.** Now become conscious of your thoughts. - **pause 2 seconds.** Each time an unwanted thought pops into your head, notice the thought, can you notice yourself noticing that thought? - **pause 2 seconds** Now, imagine that the thought is on one of those leaves. If you think in words, put those words onto the leaf. If you think in images, put them on the leaf as images. Don't try to make the stream go faster or slower. Don't try to change what shows up on the leaves in any way. If the leaves disappear, if you mentally go somewhere else, or if you find that you're in the stream on a leaf, just stop and notice that this has happened. Let it be, and then once again return to the stream. – **pause 2 seconds**

Notice yourself watching a thought come into your mind, place it on a leaf, and let the leaf float down-stream. So, notice the thought, - **pause 2 seconds** put it on the leaf – **pause 2 seconds** and let it float. Notice yourself doing this. Continue for the next few moments, just watching your thoughts float by. Visualize yourself doing this. (Leaves on a stream, Hayes, 2005).

- Can you see that you are now noticing yourself noticing your thoughts? **Pause for response**

Procedure

The participant is asked to engage in **physical exercises** on two occasions: 1) extending legs out parallel to the floor 2) extending arms out to the sides 3). An example of the script for this process is detailed below. The participant is presented with the defusion metaphor immediately prior to the physical exercise.

Example script

Group B Physical tasks

Legs extended exercise

- *Ok, so the first task I'd like you to try is performing a physical exercise. For this I'd like you to be seated in a chair. Take a moment to become aware of how your legs feel now, whether they feel relaxed or tense. -**pause 2 seconds**. Just feel the backs of your legs in contact with the chair you're sitting on. Now I'd like you to gently extending your legs away in front of you until they are parallel to the floor. (**visually demonstrate as you speak**). As you hold your legs there, I'd like you to be aware of the muscles in your legs working to keep your legs extended. How do they feel? Perhaps you can feel your legs becoming heavier, I'd like you to try to become aware of the physical sensations and notice the thoughts you have about those sensations. – **pause 5 seconds**. Each time a thought about perhaps any heaviness you feel in your legs pops into your head, just watch it for a moment. – **pause 5 seconds**. Perhaps you feel the muscles in your legs become warm or start to feel fatigued. Each time a you notice your muscles becoming tired, notice that it is you that is watching those thoughts. **Pause 5 seconds**. Each time you notice an unwanted thought try to notice that you are apart from that thought. – **pause 5 seconds**. Notice yourself, noticing the thoughts. **Pause for approx. 15 seconds**. You may perceive your legs becoming too heavy to hold any more – **pause 5 seconds**. When you do I'd like you to, slowly lower your legs and place your feet gently back on the floor – **continue for maximum 1 minute more at which point ask the participant to** - slowly lower your legs and place your feet gently back on the floor- **pause 2 seconds**, and when you are ready, relax.*

Arms parallel exercise

- *For the second exercise I'd like you to again be seated in a chair. Take a moment to become aware of how your arms and shoulders feel now, whether they feel relaxed or tense. - **pause 2 seconds**. Just feel your back in contact with the chair you're sitting on. Now I'd like you to slowly lift your arms out to the sides, until they are parallel to the floor. (**visually demonstrate as you speak**). As you hold your arms there, I'd like you to be aware of the muscles in your shoulders and back working to keep your arms extended. How do they feel? Perhaps you can feel your arms becoming heavier, I'd like you to try to become aware of the physical sensations and notice the thoughts you have about those sensations. – **pause 5 seconds**. Each time a thought about perhaps any heaviness you feel in your arms pops into your head, just watch it for a moment. – **pause 5 seconds**. Perhaps you feel the muscles in your shoulders become warm or start to feel fatigued. Each time a you notice your muscles becoming tired, notice that it is you that is watching those thoughts. **Pause 5 seconds**. Each time you notice an unwanted thought try to notice that you are apart from that thought. – **pause 5 seconds**. Notice yourself, noticing the thoughts. **Pause for approx. 15 seconds**. You may perceive your arms becoming too heavy to hold any more – **pause 5 seconds**.*

*When you do I'd like you to slowly lower your arms and place your hands gently on your thighs – **continue for maximum 1 minute more at which point ask the participant to** - slowly lowering your arms and place your hands gently on your thighs- **pause 2 seconds**, and when you are ready, relax.*

- *Now that you have learned these techniques if you are willing I'd like you to try the step task that you completed at the beginning of the session.*

Appendix 5

Condition: Progressive muscle relaxation with physical rehearsal

<p>Introduction</p> <p>Provide a quick introduction to the programme, aims of the intervention – to teach strategies to help people to increase resilience to the discomfort associated physical exercise. This is flowed by a short introduction to progressive muscle relaxation.</p>
<ul style="list-style-type: none"> • <i>So, you are about to take part in research exploring how we experience the discomfort associated with physical exercise. Ok, as you have now completed the step task, if you are in agreement we can take a few moments to relax. I'm going to run through a technique called progressive muscle relaxation. Its an exercise that you can do sitting down and helps to relax both your body and your mind. I will talk you through the exercise during which you will, without straining, tensing various muscle groups around your body. When I say the word "Now" You will be asked to tense each muscle group for a short period, about five to seven seconds, and then when I say the word "Relax", immediately release the tension and feel the muscles relaxing for 10 – 20 seconds. If you have any existing problems with one of the muscle groups, or you feel and pain or discomfort then please feel free to miss that stage out. Its also important that you don't hold your breath, so continue to breathe even if you are tensing your muscles. You might like to close your eyes for this as it helps you to focus on the different muscle groups.</i>
<p>Procedure</p> <p>Participant to be presented with a progressive muscle relaxation exercise that focuses on tensing major muscle groups for a period of 5-7 seconds followed by a period of not tension for 10-15 seconds. An example of the script for this process is detailed below. After completion of the exercise the investigator then allows a few minutes to answer any questions the participant may have. The investigator then allows a few minutes for the participant reflect their understanding to the investigator, and to answer any questions the participant may have. The script for the exercise is adapted from published work by Williams (2010).</p>
<p>Progressive muscle relaxation</p> <ul style="list-style-type: none"> • <i>Let's begin with by tensing all the muscles in your dominant hand and arm by making a fist – Now, feel the tension in your hand and up you arm – pause 3 -4 seconds. Relax, immediately let go of the tension, make a note of the difference in sensations between tensed and relaxed – pause 15 -20 seconds.</i> • <i>Next tense the muscles in you not dominant hand and arm. Now, feel the tension in your hand and up you arm, keeping any tension out your back and shoulder - pause 3-4 seconds. Ok, relax, immediately let go of the tension, make a note of the difference in sensations between tensed and relaxed muscles and let all the tension drain away – pause 10 - 15 seconds.</i> • <i>Next, pay your attention to the muscles in your face by raising your eyebrows. Now, feel the tension in your forehead, and your scalp -Pause 3-4 seconds. And relax, enjoy the pleasant sensations as your muscles relax, - Pause 10-15 seconds. Now, frown again, -pause 5-7 seconds. Relax, and allow your forehead to become smooth again and the tension to melt away, -pause 10-15 seconds.</i> • <i>Next, squint your eyes very tightly, purse your lips and tense your jaw, but not so tightly that it hurts. Tense now, feel the tension, - pause 3-4 seconds, and relax. Feeling the jaw relax and the eyes become soft – pause 10-15 seconds. And tense</i>

again, **now**, - **pause 5-7 seconds**. **Relax**, let the tension go, feel the lips slightly part as you breathe and your jaw relax – **pause 10-15 seconds**.

- Next we're going to tense all the muscles in your back and shoulders by squeezing your shoulder blades together. **Now**, shrugging your shoulders –**pause 5-7 seconds**. **Relax**, letting the shoulders drop and the tension fade away. Again, **now**, feel the tension, -**pause 5-7 seconds**. **Relax**, noticing the difference when the tension drains away – **pause 10-15 seconds**.
- Turn your attention to your abdomen, you're going to tense by sucking in your stomach and tensing your buttocks. Try not to hold your breath. **Now**, – **pause 5-7 seconds**. **Relax**, breathe freely –**pause-10-15 seconds**. The same again, **now**, breathe, -**pause 5-7 seconds**. **Relax**, breathing freely –**pause 10-15 seconds**.
- Next to the legs, tensing all of the muscles in your thighs, tensing both thighs at the same time. **Now**, try to notice the sensation as you tense – **pause 3-4 seconds**. **Relax**, feel the difference as to relax the muscles in your legs – **pause 10-15 seconds**. Once more, **now**, tense, -**pause 5-7 seconds**. **Relax**, as the muscles become soft –**pause 10-15 seconds**.
- Next, you're going to flex your ankles so as your toes point away, tensing your toes, feet and calves. **Now**, squeeze, -**pause 5-7 seconds**. **Relax**, placing your feet flat on the floor, feeling the tension drain away into floor. -**Pause 10-15 seconds**. Once more, **now**, pointing the toes, -**pause 5-7 seconds**. **Relax**, - **pause 5-7 seconds**. Relax all the muscles in your body, let your face become soft, shoulders down, take a deep breath in, and slowly let the breath out feeling any last traces of tension drain away into the floor. – **pause 10-15 seconds**.
- Take a couple more, deep breaths, noticing how your body feels –**pause 10-15 seconds**. Then, when you are ready, slowly, open your eyes.

Appendix 5

Condition: Progressive muscle relaxation with mental rehearsal

<p>Introduction</p> <p>Provide a quick introduction to the programme, aims of the intervention – to teach strategies to help people to increase resilience to the discomfort associated physical exercise. This is flowed by a short introduction to progressive muscle relaxation.</p>
<ul style="list-style-type: none"> • <i>So, you are about to take part in research exploring how we experience the discomfort associated with physical exercise. Ok, as you have now completed the step task, if you are in agreement we can take a few moments to relax. I'm going to run through a technique called progressive muscle relaxation. Its an exercise that you can do sitting down and helps to relax both your body and your mind. I will talk you through the exercise during which you will imagine tensing various muscle groups around your body. When I say the word "Now" You will be asked to imagine tensing each muscle group for a short period, about five to seven seconds, and then when I say the word "Relax", immediately imagine releasing the tension and feel the muscles relaxing for 10 – 20 seconds. You should not physically tense, just try to imagine tension in the muscles. It's also important that you don't hold your breath, so continue to breathe even if you are imagining tensing your muscles. You might like to close your eyes for this as it helps you to focus on the different muscle groups.</i>
<p>Procedure</p> <p>All participant to be presented with a progressive muscle relaxation exercise that focuses on imagining tensing major muscle groups for a period of 5-7 seconds followed by a period of mentally visualising no tension for 10-15 seconds. An example of the script for this process is detailed below. After completion of the exercise the investigator then allows a few minutes to answer any questions the participant may have. The investigator then allows a few minutes for the participant reflect their understanding to the investigator, and to answer any questions the participant may have. The script for the exercise is adapted from published work by Williams (2010).</p>
<p>Progressive muscle relaxation</p> <ul style="list-style-type: none"> • <i>Let's begin with by imagining tensing all the muscles in your dominant hand and arm by thinking about by making a fist. Don't physically tense your muscles, Just try to imagine the tension in your hand and up your arm – Now, pause 3 -4 seconds. Relax, immediately imagine letting go of the tension, make a note of the difference in sensations between tensed and relaxed – pause 15 -20 seconds.</i> • <i>Next imagine you tense the muscles in your non dominant hand and arm. Now, imagine the tension in your hand and up your arm, think about keeping any tension out your back and shoulder - pause 3-4 seconds. Ok, relax, immediately think about let go of the tension, make a note of the difference in sensations between tensed and relaxed muscles and imagine letting all the tension drain away – pause 10 - 15 seconds.</i> • <i>Next, pay your attention to the muscles in your face by raising your eyebrows. Now, think about the tension in your forehead, and your scalp -Pause 3-4 seconds. And relax, imaging enjoying the pleasant sensations as your muscles relax, - Pause 10-15 seconds. Now, imagine frowning again, -pause 5-7 seconds. Relax, and think about your forehead to become smooth again and the tension to melting away, -pause 10-15 seconds.</i> • <i>Next, imaging you squint your eyes very tightly, purse your lips and tense your jaw. Remember not to actually tense, just imagine. Now, think about the tension, - pause 3-4 seconds, and relax. Thinking of the jaw relaxing and the eyes becoming soft –</i>

pause 10-15 seconds. And think tension again, **now**, - **pause 5-7 seconds.** **Relax**, imagining let the tension go, the lips slightly part as you breathe and your jaw relax – **pause 10-15 seconds.**

- Next we're going to think about tensing all the muscles in your back and shoulders imagining squeezing your shoulder blades together. **Now**, think of shrugging your shoulders –**pause 5-7 seconds.** **Relax**, imagine letting the shoulders drop and the tension fade away. Again, **now**, thinking of the tension, -**pause 5-7 seconds.** **Relax**, noticing the difference when you think tension draining away – **pause 10-15 seconds.**
- Turn your attention to your abdomen, you're going to imagine tensing by your stomach and your buttocks. Try not to hold your breath. **Now**, – **pause 5-7 seconds.** **Relax**, breathe freely –**pause-10-15 seconds.** The same again, **now**, breathe, -**pause 5-7 seconds.** **Relax**, breathing freely –**pause 10-15 seconds.**
- Next to the legs, thinking about all of the muscles in your thighs, tensing both thighs at the same time. **Now**, try to notice the sensation as you imagine tensing – **pause 3-4 seconds.** **Relax**, feel the difference as to relax the muscles in your legs – **pause 10-15 seconds.** Once more, **now**, think tense, -**pause 5-7 seconds.** Think **relax**, imagining muscles becoming soft –**pause 10-15 seconds.**
- Next, you're going to think about flexing your ankles so as your toes point away, imagine tensing your toes, feet and calves. **Now**, imagine squeezing, -**pause 5-7 seconds.** **Relax**, imagine placing your feet flat on the floor and feeling the tension drain away into floor. -**Pause 10-15 seconds.** Once more, **now**, -**pause 5-7 seconds.** **Relax**, - **pause 5-7 seconds.** Now try to imagine relaxing all the muscles in your body, think about letting your face become soft, shoulders down, take a deep breath in, and slowly let the breath out feeling any last traces of tension drain away into the floor. – **pause 10-15 seconds.**
- Take a couple more, deep breaths, noticing how your body feels –**pause 10-15 seconds.** Then, when you are ready, slowly, open your eyes.

Appendix 6: Example answer sheet

CR-10 prompt			CR-10		Heart Rate							
			St	F	St	2	4	6	8	10	F	
0	Nothing at all	“No P”										
0.3												
0.5	Extremely weak noticeable	Just										
1	Very weak											
1.5												
2	Weak	Light										
2.5												
3	Moderate											
4												
5	Strong	Heavy										
6												
7	Very Strong											
8												
9												
10	Extremely Strong	“Max P”										
11												
#												
•	Absolute maximum possible	Highest										

80% of max HR for age	
Task round 1	
Stepping Duration	
Heart Rate at finish	
Discomfort level at finish	
Task round 2	
Stepping Duration	
Heart Rate at finish	
Discomfort level at finish	

Appendix 7: Borg CR-10 scale and general instructions for use

You can use this scale to tell how strong your perception of a certain attribute is. As you can see the scale stretches from “nothing at all” to “Absolute maximum.” “Extremely strong – max P” (10) is such an extremely strong perception of an attribute that it is the strongest that you have ever experienced: “max P.” It may however, be possible to experience or to imagine a magnitude even more than what you yourself have previously experienced. Therefore, “Absolute maximum,” the “highest possible” level, is placed somewhat further down the scale without a fixed number and marked with a dot. If you should perceive an intensity stronger than 10, “extremely strong-max P”, you may use numbers on the scale above 10, such as 11, 12, or even higher. “Extremely weak,” corresponding to 0.5 on the scale, is something just noticeable, i.e., something that is on the boundary of what is possible to perceive. You use the scale in the following way: Always start by looking at the verbal expressions. Then choose a number. If your perception corresponds to “very weak,” you say 1. If it is “moderate,” you say 3, and so on. You may use whatever numbers you want, also half values, such as 1.5 or 2.5, or decimals, e.g., 0.3, 0.8, 1.7, 2.3, 5.6, or 11.5.

It is very important that you answer what you perceive and not what you believe you ought to answer. Be as honest as possible and try not to overestimate or underestimate the intensities. Remember you start by looking at the verbal expression before rating, then give the number.

0	Nothing at all	“No P”
0.5	Extremely weak	Just noticeable
1	Very weak	
1.5		
2	Weak	Light
2.5		
3	Moderate	
4		
5	Strong	Heavy
6		
7	Very Strong	
8		
9		
10	Extremely Strong “Max P”	
11		
#		

- Absolute maximum Highest possible

To see that you have understood the instruction and how to use the scale, please answer the following questions:

1. How black do you perceive a piece of pure black charcoal to be?
2. How loud do you perceive an ordinary conversation between two people to be?
3. How white do you perceive a piece of pure white sugar to be?
4. How sour do you perceive a lemon to be?
5. How sweet is a ripe banana?

General instructions for using the Borg CR10 Scale. Retrieved from: Borg, G., (1998). *Borg’s Perceived Exertion and Pain Scales*. Pg. 50. Human Kinetics, Leeds, United Kingdom.

Appendix 8: Scripted intervention material used in the second intervention study – Chapter 5

*The following scripts were copied and adapted from published peer reviewed work with the reference: Gil-Luciano, B., Ruiz, F., Valdivia-Salas, S., & Suárez-Falcón, J. (2017). Promoting psychological flexibility on tolerance tasks: Framing behavior through deictic/hierarchical relations and specifying augmental functions. *Psychological Record*, 67(1), 1–9. <https://doi.org/10.1007/s40732-016-0200-5>*

Note: Script for the defusion-I intervention is italicised, additional text included in the defusion-II condition is highlighted. Text for the PMR condition is available in Appendix 9.

Introduction

You are about to take part in a study that aims to teach you some strategies to cope with the pain and discomfort we're doing this so that you could try to perform the tasks for a longer period of time in the second round.

To do this I would like you to just sit upright, but remain as relaxed as possible (Pause). Just to try to prevent distraction, I'd like to close your eyes then listen closely to what I say. If at any point, you find yourself distracted or your thoughts wander from the exercise, you can replay the recording from where you were before the distraction.

I'm going to ask you questions at various points during these exercises, and ask you to answer things out loud. Try not to worry about this. No-one can hear you, you will be in a room on your own and you are not being recorded. Saying things out aloud will help you to focus on your answers. I'd like you to remain relaxed with your eyes closed during the process.

*To start, I'd just like you to focus on your breathing. See if you can notice your belly rising every time you inhale (**Pause 3 seconds**) and how it falls every time you exhale. Ask yourself, who is breathing? Who is noticing your belly rising (**Pause 3 seconds**) and then falling. Now, in your mind's eye, see if you can picture your belly as if it were a bag that inflates every time you inhale (**Pause 3 seconds**) . . . and that deflates when you exhale. Ask yourself who is it that is picturing your belly like a big, inflating and deflating. Do you notice that you are the one watching your belly?*

Noticing physical sensations

*Now, try to focus on the posture you are maintaining. Take your attention to your arms (**Pause 3 seconds**), and to your legs (**Pause 3 seconds**) . . . I'd like you to say out loud, which part of your body has the most comfortable posture? (**Pause for answer**) Ok, I'd like you to notice that comfort. Ask yourself, who is noticing that*

comfort there? Can you realise you are the one noticing it? If you could give it a shape, try to imagine what shape it would be. See if you can give it a shape (**pause 3 seconds**) If you could give it a colour, try to imagine what it would be (**pause 3 seconds**) don't do anything with it, just think of it. Now, go over your general posture again and say out loud which part of your body feels a bit uncomfortable (**Pause for answer**) Ok, just notice the discomfort. If you could give it a shape, try to imagine what shape it would be. See if you can imagine giving it a shape (**pause 3 seconds**) If you could give it a colour, try to imagine what it would be (**pause 3 seconds**) don't do anything with it, just think of it. Ask yourself, who is noticing that discomfort there? Do you realise that you are the one contemplating it? Now, I'd like you to imagine yourself doing whatever you would do if you let that discomfort be in charge of what you do. Imagine changing your posture so that the discomfort is gone. Now, imagine that you are the one in charge of what you do, and not the discomfort. Imagine yourself remaining in the posture, making room for the discomfort.

Ok, we're going to repeat that little exercise with some other bodily **sensations** that you are experiencing at the moment. I'd like you to again notice the posture that you are maintaining (**Pause 3 seconds**). I'd like you say out loud, which part of your body feels comfortable? (**Pause for answer**) Ok, I'd like you to notice that comfort. Ask yourself, who is noticing that comfort there? Can you realise you are the one noticing it? If you could give it a shape, try to imagine what shape it would be. See if you can imagine it having a shape (**pause 3 seconds**) If you could give it a colour, try to imagine what it would be (**pause 3 seconds**) don't do anything with it, just think of it.

Now, go over your general posture again and say out loud which part of your body feels a bit uncomfortable (**Pause for answer**) Ok, I'd like you to take your attention to that discomfort. If you could give it a shape, try to imagine what shape it would be. See if you can imagine it as a shape (**pause 3 seconds**) If you could give it a colour, try to imagine what it would be (**pause 3 seconds**) don't do anything with it, just think of it. Ask yourself, who is noticing that discomfort there? Do you realise that you are the one contemplating it? Now, I'd like you to imagine yourself doing whatever you would do if you let that discomfort be in charge of what you do. Imagine changing your posture so that the discomfort is gone. Now, imagine that you are the one in charge of what you do, and not the discomfort. Imagine yourself remaining in the posture, making room for the discomfort.

Noticing thoughts

Now, I'd like you to pay attention to your mind and the **thoughts** it is giving you right now. Try to notice what thoughts you are having right now (**Pause 3 seconds**). Try and notice thoughts and see how thoughts just show up. When you notice thoughts, pick one, any one of them. Now, I'd like you to say what that thought is out loud? (**Pause for response**) **If that thought is something unpleasant** - Imagine yourself doing whatever you would do if you let that thought be in charge of what you do: Imagine yourself pushing that thought away, or arguing with it (**Pause 3**

seconds). Then, see if you can imagine yourself just letting the thought stay there without doing anything, just noticing it. Great, imagine you can write that thoughts on a balloon, in big letters (**Pause 3 seconds**). When you can to see it written there (**Pause 3 seconds**) don't do anything with it, just let it be there, floating in front of you (**Pause 3 seconds**). Ask yourself, who is contemplating that thought there, written on the balloon? Do you realise that you can watch the thought there? Now, let's grab any other thought your mind is giving you right now (**pause 3 seconds**).

So, take your attention to what thoughts you are having right now (**Pause 3 seconds**). Try and notice thoughts and see how thoughts just show up. When you notice thoughts, pick one, any one of them. Now, I'd like you to say what that thought is out loud? (**Pause for response**) **If that thought is something unpleasant** - Imagine yourself doing whatever you would do if you let that thought be in charge of what you do: Imagine yourself pushing that thought away, or arguing with it (**Pause 3 seconds**). Then, see if you can imagine yourself just letting the thought stay there without doing anything, just noticing it. Great, imagine you can write that thoughts on a balloon, in big letters (**Pause 3 seconds**). When you can to see it written there (**Pause 3 seconds**) don't do anything with it, just let it be there, floating in front of you (**Pause 3 seconds**). Now, allow yourself to be much bigger than all the thoughts that are here with you (**Pause 3 seconds**) try to realise you have enough room to have whatever thoughts might show up. See that thoughts don't take up any room at all and that you are actually much bigger than your thoughts.

Noticing sensations from the cold pressor task

Now, I would like you to go back to the moment before you placed your arm in the water (**pause 3 seconds**) So, before you put your hand in the tank. (**pause 3 seconds**). Try to go back to that moment. See if you recall the instructions saying '3,2,1, Go' and then see yourself placing your hand and forearm into the water (**pause 3 seconds**). Try to think of what sensations you felt as you submerged your hand (**pause 3 seconds**). Now, I'd like you to say out loud just one **sensation** you had in your hand (**pause 3 seconds**). Imagine that you can feel that sensation in your hand (**Pause 3 seconds**). Now, imagine you can take a picture of that sensations in your hand (**pause 3 seconds**) take that picture and place it in front of you. Don't do anything with it, just look at it. Who is contemplating that picture of intense cold in your hand. Now imagine letting that intense cold be in charge of what you do. Visualise yourself doing whatever you would do if that discomfort was in charge. I'd like you to say out loud what you would do (**Pause for answer**) Now, I'd like you to imagine that you allow yourself to be in charge of the situation. Ask yourself what would you do if you were in charge (**Pause 3 seconds**) Would you be bigger than your discomfort in that case? Imagine that you give yourself the chance to place yourself over your discomfort. Imagine if you could apply this situation to any sort of situation in your daily life, when you feel something you don't want to feel.

Noticing thoughts from the cold pressor task

*Ok, now let's do the same thing with **thoughts** you had at that time. Recall the instruction saying '3,2,1, Go' and then see yourself submerging your hand and forearm into the water (**pause 3 seconds**). This time try to remember what **thought** you had as you placed your hand in the tank (**pause 3 seconds**). Again, I'd like you to say out loud just one thought you had. (**pause 3 seconds**). Imagine that you can feel the sensations you had and notice the thought you had as a direct result of those sensations. Ask yourself, who is imagining the sensations that are over there? Now, imagine you can take a picture of the thought you had. (**pause 3 seconds**) take that picture and place it in front of you. Who is contemplating that picture of wanting to take your hand out. Now imagine letting that intense cold be in charge of what you do. Visualise yourself doing whatever you would do if that discomfort was in charge. I'd like you to say out loud what you would do (**Pause for answer**) Now, I'd like you to imagine that you allow yourself to be in charge of the situation. Ask yourself what would you do if you were in charge (**Pause 3 seconds**) Would you be bigger than your discomfort in that case? Imagine that you give yourself the chance to place yourself over your discomfort. Imagine if you could apply this situation to any sort of situation in your daily life, when you feel something you don't want to feel.*

Great, so now we've done this with the thoughts and sensations you had during the cold pressor task we can do the same with the step test. So, for now I'd like you to just sit upright, but remain as relaxed as possible (Pause). Just to try to prevent distraction, I'd like to close your eyes then listen closely. If at any point, you find yourself distracted or your thoughts wander from the exercise, you can replay the recording from where you were before the distraction. Just like before I'm going to ask you questions at various points during these exercises, I'd like you to give your answers out loud.

Noticing sensations from the step test

*Now, I would like you to go back to the moment before you started the step test (**pause 3 seconds**) So, before you stepped up onto the box (**pause 3 seconds**). Try to go back to that moment. See if you recall the instructions saying '3,2,1, Go' and then see yourself placing your foot onto the box (**pause 3 seconds**). Try to think of what sensations you felt as you stepped up (**pause 3 seconds**). Now, I'd like you to say out loud just one **sensation** you had in your legs (**pause 3 seconds**). Imagine that you can feel that sensation of tired legs (**Pause 3 seconds**). Now, imagine you can take a picture of that sensation (**pause 3 seconds**) take that picture and place it in front of you. Don't do anything with it, just look at it. Who is contemplating that picture of effort in your legs. Now imagine letting that be in charge of what you do. Visualise yourself doing whatever you would do if that discomfort was in charge. I'd like you to say out loud what you would do (**Pause for answer**) Now, I'd like you to imagine that you allow yourself to be in charge of the situation. Ask yourself what would you do if you were in charge (**Pause 3 seconds**) Would you be bigger than your discomfort in that case? Imagine that you give yourself the chance to place yourself over your discomfort. Imagine if you could apply this situation to any sort of situation in your daily life, when you feel something you don't want to feel.*

Noticing thoughts from the step test

*Ok, now let's do the same thing with **thoughts** you had at that time. Recall the instruction saying '3,2,1, Go' and then see yourself stepping up onto the box (**pause 3 seconds**). This time try to remember what **thought** you had as you placed your foot on the step(**pause 3 seconds**). Again, I'd like you to say out loud just one thought you had. (**pause 3 seconds**). Imagine that you can feel the sensations you had and notice the thought you had as a direct result of those sensations. Ask yourself, who is imagining the sensations that are over there? Now, imagine you can take a picture of the thought you had. (**pause 3 seconds**) take that picture and place it in front of you. Who is contemplating that picture of wanting to stop stepping. Now imagine letting that thought be in charge of what you do. Visualise yourself doing whatever you would do if that discomfort was in charge. I'd like you to say out loud what you would do (**Pause for answer**) Now, I'd like you to imagine that you allow yourself to be in charge of the situation. Ask yourself what would you do if you were in charge (**Pause 3 seconds**) Would you be bigger than your discomfort in that case? Imagine that you give yourself the chance to place yourself over your discomfort. Imagine if you could apply this situation to any sort of situation in your daily life, when you feel something you don't want to feel.*

Ending

*OK, now finally, I'd like you to take your attention back to your breathing. Just for a few moments see if you can notice your belly rising every time you inhale (**Pause 3 seconds**) and how it falls every time you exhale. Now, in your mind's eye, see if you can picture your belly as if it were a bag that inflates every time you inhale (**Pause 3 seconds**) and that deflates when you exhale. (Pause 6 seconds) Now, slowly open your eyes.*

OK, that's the end of your training. I hope you enjoyed it. When you are ready, please let the examiner know you have finished.

Appendix 9: Scripted materials for the third intervention study – Chapter 6

Scripted guidance and intervention materials for Group 1. The metaphor and values clarification task.

Introduction

During the next couple of exercises, you're going to explore things that are important to you. The things in your life in which you find meaning and purpose. This takes quite a bit of careful thought, and so it's a good idea to uncover these deeply held fundamental personal values in stages. I'm going to ask you to take part in another short task. It's a questionnaire designed to help you explore aspects of your life that you value the most. It's in three parts. The first part, helps you rate general areas of your life that might be really important to you. Things like family, personal relationships or physical wellbeing. Then we'll go a little deeper and ask you to explore why the things you rate most highly are so important to you and how they make you feel. The exercise is for your information only. I will not be collecting the questionnaire from you. You can take it with you or destroy it. The contents are for you alone. As such I'd like you to be as honest as you can, please feel able to make a note of your innermost thoughts and feelings knowing that whatever you write is for you alone.

The participant is then given some time and privacy to complete the values exercise. See below.

1. For this exercise you are asked to think about areas of your life that are of key importance to you. The things in life that you value on a deeply personal level. Things you consider to be your core values, they are, and probably always will, be fundamentally important to you. Below are listed areas of life that valued by some people. We are interested in the level of importance you place on the different aspects of life. Please try to rate the importance of each area (by circling a number) on a 1-10 scale; 1 means that the area is not important at all to you, 10 means that the area is of fundamental importance to you. Not everyone will value all of these areas, or value all areas the same. If during the process, you think of an area that is of key importance to you, and that isn't listed, you can insert it in the space marked 11. Please rate each area according to **how important things are to you personally.**

	Area	Not at all important										Extremely important
		1	2	3	4	5	6	7	8	9	10	
1	Family (other than Intimate relationships or parenting)	1	2	3	4	5	6	7	8	9	10	
2	Intimate Relationships	1	2	3	4	5	6	7	8	9	10	
3	Parenting / Relationships with Children	1	2	3	4	5	6	7	8	9	10	
4	Friends/Social life	1	2	3	4	5	6	7	8	9	10	
5	Work / Career	1	2	3	4	5	6	7	8	9	10	
6	Education / training / Learning	1	2	3	4	5	6	7	8	9	10	
7	Recreation / Fun	1	2	3	4	5	6	7	8	9	10	
8	Spirituality	1	2	3	4	5	6	7	8	9	10	
9	Citizenship/Community Life	1	2	3	4	5	6	7	8	9	10	
10	Physical well-being	1	2	3	4	5	6	7	8	9	10	
11		1	2	3	4	5	6	7	8	9	10	

2.

In the first part of this questionnaire, you identified the level of importance you put on the different areas of your life. The next step is to decide which are your top three highest scoring areas and rank them in order below using **column 1**. Do this by writing the **Area** description you identified previously, ranking what you consider to be the most important 1st, the second most important 2nd and so on. Once you've done this, take a minute to consider things like what type of person you want to be? What do you as a person want to stand for? What gives your life meaning and how would you like to behave to achieve this? When you've done this write a short statement explaining **why** the area you chose is so important to you. When you've done this go to point 3.

	Column 1	Column 2
Rank	Area of value	Why this area so important to me
1	<i>Friends and Social life</i>	<i>Example – Having good friends means that I share good times with people I care about. The sense of belonging and companionship shows me I'm liked. This gives me a sense of worth.</i>
1		
2		
3		

3.
Rate how your ability to act according to your ideas would impact on how you feel.

To what level would being able to act in a way that corresponds with your values impact on your feelings. Use the 1-10 scale; 1 means that being able to act in a way that corresponds with the ideas you've identified would have very little impact on your feelings. 10 means that being able to act in a way that corresponds with the ideas you've identified would have a **very high** impact on your feelings.

Rank	Very little impact										Very high impact
1	1	2	3	4	5	6	7	8	9	10	
2	1	2	3	4	5	6	7	8	9	10	
3	1	2	3	4	5	6	7	8	9	10	

When you have finished please let the experimenter know.

Following the values exercise the experimenter continues guided by the following script.

People often experience unpleasant thoughts and feelings about physical exercise. Often they can present a reason not to be more active, what we call a psychological barrier. It's these barriers that can prevent people from taking part in an activity that they value. People can overcome these barriers by giving themselves a reason to push past unhelpful thoughts in order to achieve what's important to them. Like training to do a marathon in aid of Cancer research. People run for a cause, but what if that cause was related to one of your deepest personal values. I'd like you to try to reflect on your top three values and see if you can use just one of them as a reason to push past unhelpful thoughts and feelings you experience during exercise. (Pause) What I mean is, could you use one of those values to motivate yourself? (Pause).

The participant is given the opportunity for brief clarification with the experimenter.

A famous psychologist once said "We don't walk into pain because we like pain. We walk through pain in the service of taking a valued direction."

The Metaphor

Suppose you are on your pushbike beginning a ride to a beautiful mountain you can see clearly in the distance. No sooner than you start your ride, the road becomes a rough and overgrown muddy track that extends for as far as you can see. You say to yourself, "Blimey, I didn't realise that I was going to have to go cross country. It's bumpy and the mud is making it slippery. It's hard to peddle through the ruts. I'm hot and tired. Why didn't anyone tell me about this track?" Exercise is like that. Life is like that. We go down the track not because we want to get muddy, but because it stands between us and where we are going. At this point you have a choice you can either stop and go back, or you can carry on because the value of the getting to the mountain is worth the discomfort.

Please, let yourself imagine the feeling you'd have riding toward something you value. (Pause). What would you choose to do? Would you stop at the start of the track? Would you power on through and peddle on despite the discomfort of the fatigue? (Pause) What would you choose to do?

Noticing values and how you feel.

Great, so up to now you've explored some of your most important personal values and thought about how living more closely to those important personal values would affect how you feel. I'm going to ask you now to use these ideas when you take part in the cycling exercise.

The participant is then invited to take part in the static bike test for the second time.

Whilst you're cycling I'd like you to pay close attention to your thoughts. Notice when you start to feel tired. I'd also like you to keep in mind the important value we discussed. Give yourself the choice, when you feel tired, you can either stop or continue to strive for those things that are important to you. How do think you will feel when you notice that with every step you are nearer to achieving your values. Knowing that every time you beat the thought of feeling uncomfortable or sweaty or your heart pumping faster, that you are living life closer to the things that you find the most important. I want you to notice how that feels for you. Ask yourself, would you stop? Or would you push on, in order to, to have that feeling?

Scripted guidance and intervention materials for Group 2. Metaphor and short relaxation task.

Following the task, the participant is invited to listen to an audio recording during which they will be asked to engage in a relaxation exercise.

The script is presented by the experimenter via a recording.

Ok, as you have now completed the cycling task, you can take a few moments to relax.

During the next couple of exercises, you're going to explore things that are important to you. The things in your life in which you find meaning and purpose. Firstly, you're going to be guided through a technique called progressive muscle relaxation. To do this I would like you to sit upright in your chair, but remain as relaxed as possible (Pause). Just to try to prevent distraction, I'd like to close your eyes then listen closely to what I say. If at any point, you find yourself distracted or your thoughts wander from the exercise try not to worry, this is completely natural. If you wish you can replay the recording from where you were before the distraction.

Progressive muscle relaxation (PMR) task.

I'm going to run through a technique called progressive muscle relaxation. It's an exercise that you can do sitting down and helps to relax. I will talk you through the exercise during which you will be asked to imagine tensing various muscle groups around your body. So, when I say the word "Go" I want you to imagine tensing whichever part of the body you've been directed to for about five seconds, and then when I say the word "Relax", immediately imagine releasing the tension and imagine feeling the muscles relaxing for 10 – 20 seconds. You should not physically tense, just try to imagine the sensations that would have in the muscles. It's also important that you don't hold your breath, so continue to breathe even if you are imagining tensing your muscles. You might like to close your eyes for this as it may help you to focus on the different muscle groups.

*Let's begin with by imagining tensing all the muscles in your right hand and arm by thinking about making a fist. Remember, don't physically tense your muscles, just try to imagine the tension in your hand and up your arm – ready, **Go, pause 5 seconds,** and **Relax**, immediately imagine letting go of the tension, make a note of any difference in sensations between tensed and relaxed – **pause 10 seconds.** Next imagine you tense the muscles in your left hand and arm. Ready, **Go**, imagine the tension in your hand and up your arm, think about keeping any tension out your back and shoulder - **pause 10 seconds.** Ok, **relax**, immediately think about letting go of the tension, make a note of any difference in sensations between tensed and relaxed muscles and imagine letting all the tension drain away – **pause 10 seconds.***

Next we're going to think about tensing all the muscles in your back and shoulders imagining squeezing your shoulder blades together. **Go**, think of shrugging your shoulders –**pause 5 seconds**. **Relax**, imagine letting the shoulders drop and the tension fade away. Again, **go**, thinking of the tension, –**pause 5 seconds**. **Relax**, noticing any difference when you think of the tension draining away – **pause 10 seconds**.

Next to the legs, thinking about all of the muscles in your thighs, thinking of tensing both thighs at the same time. **Go**, try to notice the sensation as you imagine tensing – **pause 5 seconds**. **Relax**, feel the difference as to relax the muscles in your legs – **pause 10 seconds**. Once more, **go**, think tense, –**pause 5 seconds**. Think **relax**, imagining muscles becoming soft –**pause 10 seconds**.

Now try to imagine relaxing all the muscles in your body, think about letting your face become soft, shoulders down, take a deep breath in, and slowly let the breath out feeling any last traces of tension drain away into the floor. – **pause 10 seconds**. Take a couple more, deep breaths, noticing how your body feels –**pause 10 seconds**. Then, when you are ready, slowly, open your eyes.

OK, that's the end of your training. I hope you enjoyed it. When you are ready, please let the experimenter know you have finished.

Following the relaxation exercise the experimenter continues guided by the following script

People often experience unpleasant thoughts and feelings in about physical exercise. Often they can present a reason not to be more active, what we call a psychological barrier. It's these barriers that can prevent people from taking part in an activity that they value. People can overcome these barriers by giving themselves a reason to push past unhelpful thoughts in order to achieve what's important to them. Like training to do a marathon in aid of Cancer research. People run for a cause, but what if that cause was related to one of your deepest personal values. I'd like you to try think about things that are important to you can use just one of them as a reason to push past unhelpful thoughts and feelings you experience during exercise. What I mean is, could you use your values to motivate yourself? (Pause).

The participant is given the opportunity for brief clarification with the experimenter.

A famous psychologist once said "We don't walk into pain because we like pain. We walk through pain in the service of taking a valued direction."

The Metaphor

Suppose you are on your pushbike beginning a ride to a beautiful mountain you can see clearly in the distance. No sooner than you start your ride, the road becomes a rough and overgrown muddy track that extends for as far as you can see. You say to yourself, "Blimey, I didn't realise that I was going to have to go cross country. It's

bumpy and the mud is making it slippery. It's hard to peddle through the ruts. I'm hot and tired. Why didn't anyone tell me about this track?" Exercise is like that. Life is like that. We go down the track not because we want to get muddy, but because it stands between us and where we are going. At this point you have a choice you can either stop and go back, or you can carry on because the value of the getting to the mountain is worth the discomfort.

Please, let yourself imagine the feeling you'd have riding toward something you value. (Pause). What would you choose to do? Would you stop at the start of the track? Would you power on through and peddle on despite the discomfort of the fatigue? (Pause) What would you choose to do?

Noticing values and how you feel Noticing values and how you feel.

I'm going to ask you now to use these ideas when you take part in the cycling exercise. I want you to just keep in mind that thing that's important to you.

The participant is then invited to take part in the static bike test for the second time.

Whilst you're cycling I'd like you to pay close attention to your thoughts. Notice when you start to feel tired. I'd also like you to keep in mind the that important value we discussed. Give yourself the choice, when you feel tired, you can either stop or continue to strive for those things that are important to you. How do think you will feel when you notice that with every step you are nearer to achieving your values. Knowing that every time you beat the thought of feeling uncomfortable or sweaty or your heart pumping faster, that you are living life closer to the things that you find the most important. I want you to notice how that feels for you. Ask yourself, would you stop? Or would you push on, in order to, to have that feeling?

Scripted guidance and intervention materials for Group 3. Long version of the relaxation task.

Following the task, the participant is invited to listen to an audio recording during which they will be asked to engage in a relaxation exercise.

The script details the relaxation task presented by the researcher via an audio recording.

Introduction

Ok, as you have now completed the cycling task, if you are in agreement we can take a few moments to relax. During this next task you're going to be guided through a technique called progressive muscle relaxation. To do this I would like you to just sit upright, but remain as relaxed as possible (Pause). Just to try to prevent distraction, I'd like to close your eyes then listen closely to what I say. If at any point, you find yourself distracted or your thoughts wander from the exercise, you can replay the recording from where you were before the distraction.

Progressive muscle relaxation (PMR) task.

I'm going to run through a technique called progressive muscle relaxation. It's an exercise that you can do sitting down and helps to relax both your body and your mind. I will talk you through the exercise during which you will imagine tensing various muscle groups around your body. When I say the word "Go" You will be asked to imagine tensing each muscle group for a short period, about five to seven seconds, and then when I say the word "Relax", immediately imagine releasing the tension and feel the muscles relaxing for 10 – 20 seconds. You should not physically tense, just try to imagine tension in the muscles. It's also important that you don't hold your breath, so continue to breathe even if you are imagining tensing your muscles. You might like to close your eyes for this as it may help you to focus on the different muscle groups.

*Let's begin with by imagining tensing all the muscles in your right hand and arm by thinking about by making a fist. Don't physically tense your muscles, just try to imagine the tension in your hand and up your arm – ready, **Go, pause 5 seconds.** and **Relax**, immediately imagine letting go of the tension, make a note of any difference in sensations between tensed and relaxed – **pause 10 seconds.***

*Next imagine you tense the muscles in your left hand and arm. Ready, **Go**, imagine the tension in your hand and up your arm, think about keeping any tension out your back and shoulder - **pause 10 seconds.** Ok, **relax**, immediately think about letting go of the tension, make a note of any difference in sensations between tensed and relaxed muscles and imagine letting all the tension drain away – **pause 10 seconds.***

Next, pay your attention to the muscles in your face, imagine raising your eyebrows and wrinkling your forehead. **Go**, think about the tension in your forehead, and your scalp -**Pause 5 seconds**. And **relax**, imagining enjoying the pleasant sensations as your muscles relax, - **Pause 10 seconds**. And let's do that again, **Go**, imagine frowning again, -**pause 5 seconds**. **Relax**, and think about your forehead to becoming smooth again and the tension to melting away, -**pause 10 seconds**.

Next, imagining you squint your eyes very tightly, purse your lips and tense your jaw. Remember not to actually tense, just imagine. **Go**, think about the tension, - **pause 5 seconds**, and **relax**. Thinking of the jaw relaxing and the eyes becoming soft – **pause 10 seconds**. And thinking about tension in the eyes again, **Go**, - **pause 5 seconds**. **Relax**, imagining letting the tension go, as you breathe and your jaw relaxes – **pause 10 seconds**.

Next we're going to think about tensing all the muscles in your back and shoulders, imagining squeezing your shoulder blades together. **Go**, think of shrugging your shoulders –**pause 5 seconds**. **Relax**, imagine letting the shoulders drop and the tension fade away. Once again, **go**, thinking of the tension, -**pause 5 seconds**. **Relax**, noticing any difference when you think of the tension draining away – **pause 10 seconds**.

Now turn your attention to your abdomen, you're going to imagine tensing by your stomach. Try not to hold your breath. **Go**, – **pause 5 seconds**. **Relax**, breathe freely – **pause-10 seconds**. The same again, **Go**, breathe, -**pause 5 seconds**. **Relax**, breathing freely –**pause 10 seconds**.

Next to the legs, thinking about all of the muscles in your thighs, thinking of tensing both thighs at the same time. **Go**, try to notice the sensation as you imagine tensing – **pause 5 seconds**. **Relax**, feel the difference as you imagine relaxing the muscles in your thigh muscles – **pause 10 seconds**. Once more, **go**, think tense, -**pause 5 seconds**. Think **relax**, imagining muscles becoming soft –**pause 10 seconds**.

Next to the legs, thinking about all of the muscles in the backs of your legs, thinking of tensing both legs at the same time. **Go**, try to notice the sensation as you imagine tensing – **pause 5 seconds**. **Relax**, feel the difference as you imagine relaxing the muscles in the back of your legs – **pause 10 seconds**. Once more, **go**, think tense, - **pause 5 seconds**. Think **relax**, imagining muscles becoming soft –**pause 10 seconds**.

Next, you're going to think about flexing your ankles so as your toes point away, imagine tensing your toes, feet and calves. **Go**, imagine squeezing, -**pause 5 seconds**. **Relax**, imagine placing your feet flat on the floor and feeling the tension drain away into floor. -**Pause 10 seconds**. Once more, **go**, -**pause 5 seconds**. **Relax**

Now try to imagine relaxing all the muscles in your body, think about letting your face become soft, shoulders down, take a deep breath in, and slowly let the breath out feeling any last traces of tension drain away into the floor. – **pause 10 seconds**. Take a couple more, deep breaths, noticing how your body feels –**pause 15 seconds**. Then, when you are ready, slowly, open your eyes.

OK, that's the end of your training. I hope you enjoyed it. When you are ready, please let the experimenter know you have finished.

Noticing values and how you feel Noticing values and how you feel.

I'm going to ask you now to use these ideas when you take part in the cycling exercise.

The participant is then invited to take part in the static bike task for the second time.

Appendix 10: The international physical activity questionnaire

INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE

(October 2002)

LONG LAST 7 DAYS SELF-ADMINISTERED FORMAT

FOR USE WITH YOUNG AND MIDDLE-AGED ADULTS (15-69 years)

More detailed information on the IPAQ process and the research methods used in the development of IPAQ instruments is available at www.ipaq.ki.se and Booth, M.L. (2000).

Assessment of Physical Activity: An International Perspective. Research Quarterly for Exercise and Sport, 71 (2): s114-20. Other scientific publications and presentations on the use of IPAQ are summarized on the website.

LONG LAST 7 DAYS SELF-ADMINISTERED version of the IPAQ. Revised October 2002.

INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the last 7 days. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport. Think about all the vigorous and moderate activities that you did in the last 7 days. Vigorous physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Moderate activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal.

PART 1: JOB-RELATED PHYSICAL ACTIVITY

The first section is about your work. This includes paid jobs, farming, volunteer work, course work, and any other unpaid work that you did outside your home. Do not include unpaid work you might do around your home, like housework, yard work, general maintenance, and caring for your family. These are asked in Part 3.

1. Do you currently have a job or do any unpaid work outside your home?

Yes

No Skip to PART 2: TRANSPORTATION

The next questions are about all the physical activity you did in the last 7 days as part of your paid or unpaid work. This does not include traveling to and from work.

2. During the last 7 days, on how many days did you do vigorous physical activities like heavy lifting, digging, heavy construction, or climbing stairs as part of your work?

Think about only those physical activities that you did for at least 10 minutes at a time.

_____ days per week

No vigorous job-related physical activity Skip to question 4

3. How much time did you usually spend on one of those days doing vigorous physical activities as part of your work?

_____ hours per day

_____ minutes per day

4. Again, think about only those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do moderate physical activities like carrying light loads as part of your work? Please do not include walking.

_____ days per week

No moderate job-related physical activity Skip to question 6

5. How much time did you usually spend on one of those days doing moderate physical activities as part of your work?

_____ hours per day

_____ minutes per day

6. During the last 7 days, on how many days did you walk for at least 10 minutes at a time as part of your work? Please do not count any walking you did to travel to or from work.

_____ days per week

No job-related walking Skip to PART 2: TRANSPORTATION

7. How much time did you usually spend on one of those days walking as part of your work?

_____ hours per day

_____ minutes per day

PART 2: TRANSPORTATION PHYSICAL ACTIVITY

These questions are about how you travelled from place to place, including to places like work, stores, movies, and so on.

8. During the last 7 days, on how many days did you travel in a motor vehicle like a train, bus, car, or tram?

_____ days per week

No traveling in a motor vehicle Skip to question 10

9. How much time did you usually spend on one of those days traveling in a train, bus, car, tram, or other kind of motor vehicle?

_____ hours per day

_____ minutes per day

Now think only about the bicycling and walking you might have done to travel to and from work, to do errands, or to go from place to place.

10. During the last 7 days, on how many days did you bicycle for at least 10 minutes at a time to go from place to place?

_____ days per week

No bicycling from place to place Skip to question 12

11. How much time did you usually spend on one of those days to bicycle from place to place?

_____ hours per day

_____ minutes per day

12. During the last 7 days, on how many days did you walk for at least 10 minutes at a time to go from place to place?

_____ days per week

No walking from place to place Skip to PART 3: HOUSEWORK,

HOUSE MAINTENANCE, AND CARING FOR FAMILY

13. How much time did you usually spend on one of those days walking from place to place?

_____ hours per day
 _____ minutes per day

PART 3: HOUSEWORK, HOUSE MAINTENANCE, AND CARING FOR FAMILY

This section is about some of the physical activities you might have done in the last 7 days in and around your home, like housework, gardening, yard work, general maintenance work, and caring for your family.

14. Think about only those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do vigorous physical activities like heavy lifting, chopping wood, shovelling snow, or digging in the garden or yard?

_____ days per week

No vigorous activity in garden or yard Skip to question 16

15. How much time did you usually spend on one of those days doing vigorous physical activities in the garden or yard?

_____ hours per day
 _____ minutes per day

16. Again, think about only those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do moderate activities like carrying light loads, sweeping, washing windows, and raking in the garden or yard?

_____ days per week

No moderate activity in garden or yard Skip to question 18

17. How much time did you usually spend on one of those days doing moderate physical activities in the garden or yard?

_____ hours per day
 _____ minutes per day

18. Once again, think about only those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do moderate activities like carrying light loads, washing windows, scrubbing floors and sweeping inside your home?

_____ days per week

No moderate activity inside home Skip to PART 4: RECREATION, SPORT AND LEISURE-TIME PHYSICAL ACTIVITY

19. How much time did you usually spend on one of those days doing moderate physical activities inside your home?

_____ hours per day
 _____ minutes per day

PART 4: RECREATION, SPORT, AND LEISURE-TIME PHYSICAL ACTIVITY

This section is about all the physical activities that you did in the last 7 days solely for recreation, sport, exercise or leisure. Please do not include any activities you have already mentioned.

20. Not counting any walking you have already mentioned, during the last 7 days, on how many days did you walk for at least 10 minutes at a time in your leisure time?

_____ days per week

No walking in leisure time Skip to question 22

21. How much time did you usually spend on one of those days walking in your leisure

time?

_____ hours per day

_____ minutes per day

22. Think about only those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do vigorous physical activities like aerobics, running, fast bicycling, or fast swimming in your leisure time?

_____ days per week

No vigorous activity in leisure time Skip to question 24

23. How much time did you usually spend on one of those days doing vigorous physical activities in your leisure time?

_____ hours per day

_____ minutes per day

24. Again, think about only those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do moderate physical activities like bicycling at a regular pace, swimming at a regular pace, and doubles tennis in your leisure time?

_____ days per week

No moderate activity in leisure time Skip to PART 5: TIME SPENT

SITTING

25. How much time did you usually spend on one of those days doing moderate physical activities in your leisure time?

_____ hours per day

_____ minutes per day

PART 5: TIME SPENT SITTING

The last questions are about the time you spend sitting while at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading or sitting or lying down to watch television. Do not include any time spent sitting in a motor vehicle that you have already told me about.

26. During the last 7 days, how much time did you usually spend sitting on a weekday?

_____ hours per day

_____ minutes per day

27. During the last 7 days, how much time did you usually spend sitting on a weekend day?

_____ hours per day

_____ minutes per day

This is the end of the questionnaire, thank you for participating.

Appendix 11: The Valued Living Questionnaire

Valued Living Questionnaire

Below are areas of life that are valued by some people. We are concerned with your quality of life in each of these areas. One aspect of quality of life involves the importance one puts on different areas of living. Rate the importance of each area (by circling a number) on a scale of 1-10. 1 means that area is not at all important. 10 means that area is very important. Not everyone will value all of these areas, or value all areas the same. Rate each area according to your own personal sense of importance.

<u>Area</u>	not at all important										extremely important
1. Family (other than marriage or parenting)	1	2	3	4	5	6	7	8	9	10	
2. Marriage/couples/intimate relations	1	2	3	4	5	6	7	8	9	10	
3. Parenting	1	2	3	4	5	6	7	8	9	10	
4. Friends/social life	1	2	3	4	5	6	7	8	9	10	
5. Work	1	2	3	4	5	6	7	8	9	10	
6. Education/training	1	2	3	4	5	6	7	8	9	10	
7. Recreation/fun	1	2	3	4	5	6	7	8	9	10	
8. Spirituality	1	2	3	4	5	6	7	8	9	10	
9. Citizenship/Community Life	1	2	3	4	5	6	7	8	9	10	
10. Physical self care (diet, exercise, sleep)	1	2	3	4	5	6	7	8	9	10	

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Revised date (4 October 2006)

In this section, we would like you to give a rating of how consistent your actions have been with each of your values. We are **not** asking about your ideal in each area. We are also **not** asking what others think of you. Everyone does better in some areas than others. People also do better at some times than at others. **We want to know how you think you have been doing during the past week.** Rate each area (by circling a number) on a scale of 1-10. 1 means that your actions have been completely inconsistent with your value. 10 means that your actions have been completely consistent with your value.

During the past week

<u>Area</u>	not at all consistent with my value					completely consistent with my value				
1. Family (other than marriage or parenting)	1	2	3	4	5	6	7	8	9	10
2. Marriage/couples/intimate relations	1	2	3	4	5	6	7	8	9	10
3. Parenting	1	2	3	4	5	6	7	8	9	10
4. Friends/social life	1	2	3	4	5	6	7	8	9	10
5. Work	1	2	3	4	5	6	7	8	9	10
6. Education/training	1	2	3	4	5	6	7	8	9	10
7. Recreation/fun	1	2	3	4	5	6	7	8	9	10
8. Spirituality	1	2	3	4	5	6	7	8	9	10
9. Citizenship/Community Life	1	2	3	4	5	6	7	8	9	10
10. Physical self care (diet, exercise, sleep)	1	2	3	4	5	6	7	8	9	10

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Revised date (4 October 2006)

Appendix 12: The adapted values questionnaire used in Chapter 3

Adapted from Valued Living Questionnaire (VLQ) Wilson, K. G. & Groom, J. (2002). The Valued Living Questionnaire. The adaptations are additional statements that have been identified below using a *.

In this section, we would like you to give a rating of how consistent your actions are with each value. Everyone has different personal values, so there are no right or wrong answers. Rate each item on a scale of 1-10. 1 means that you strongly disagree with the statement and 10 means that statement is highly consistent with your value.

1 Family relations other than personal or parenting

Agree

	Strongly Disagree					Strongly Agree				
	1	2	3	4	5	6	7	8	9	10
Family relationships are important to me	1	2	3	4	5	6	7	8	9	10
*Staying in shape helps me fulfil this value	1	2	3	4	5	6	7	8	9	10

2 Marriage/partner/intimate personal relationships

Close personal relationships are important to me	1	2	3	4	5	6	7	8	9	10
*Exercise helps me maintain this value	1	2	3	4	5	6	7	8	9	10

3 Parenting

Being a good parent is a key part of my life	1	2	3	4	5	6	7	8	9	10
*Being physically active helps me achieve this value	1	2	3	4	5	6	7	8	9	10

4 Friendships and social relations

Having good friends is important to me	1	2	3	4	5	6	7	8	9	10
*Physical activity is a way of maintaining this value	1	2	4	4	5	6	7	8	9	10

5 Employment

Being employed is an important part of adult life	1	2	3	4	5	6	7	8	9	10
*Staying in shape helps me fulfil this value	1	2	3	4	5	6	7	8	9	10

6 Education and Training

My education is important to me	1	2	3	4	5	6	7	8	9	10
*Exercise helps me to act on this value	1	2	3	4	5	6	7	8	9	10

7 Recreation

My spare time interests are of key importance	1	2	3	4	5	6	7	8	9	10
*Being physically active helps me with this value	1	2	3	4	5	6	7	8	9	10

8 Spirituality

My spiritual beliefs are key part of my life	1	2	3	4	5	6	7	8	9	10
*Physical activity enables me to fulfil this value	1	2	3	4	5	6	7	8	9	10

9 Citizenship/social community

Being a member of the community is important	1	2	3	4	5	6	7	8	9	10
*Involvement in exercise helps me achieve this	1	2	3	4	5	6	7	8	9	10

10 Health/Wellbeing

My wellbeing is important to me	1	2	3	4	5	6	7	8	9	10
*Being physically active helps me fulfil this value	1	2	3	4	5	6	7	8	9	10

Appendix 13: Acceptance and psychological flexibility questionnaire

ACCEPTANCE & ACTION QUESTIONNAIRE – II (AAQ-II)

Below you will find a list of statements. Please rate the truth of each statement as it applies to you. Use the following rating scale to help you make your choices.

**1=Never true. 2=Very rarely true. 3=Seldom true. 4=Sometimes true. 5=Often true.
6=Almost always true. 7=Always true**

1.	My painful experiences and memories make it difficult for me to live a life that I would value.	1	2	3	4	5	6	7
2.	I'm afraid of my feelings.	1	2	3	4	5	6	7
3.	I worry about not being able to control my worries and feelings.	1	2	3	4	5	6	7
4.	My painful memories prevent me from having a fulfilling life.	1	2	3	4	5	6	7
5.	Emotions cause problems in my life.	1	2	3	4	5	6	7
6.	It seems like most people are handling their lives better than I am.	1	2	3	4	5	6	7
7.	Worries get in the way of my success.	1	2	3	4	5	6	7

Appendix 14: Drexel defusion scale

Drexel Defusion Scale (DDS) Forman et al., (2012)

Defusion is a term used by psychologists to describe a state of achieving distance from internal experiences such as thoughts and feelings. Suppose you put your hands over your face and someone asks you, "What do hands look like?" You might answer, "They are all dark." If you held your hands out a few inches away, you might add, "they have fingers and lines in them." In a similar way, getting some distance from your thoughts allows you to see them for what they are. The point is to notice the process of thinking as it happens rather than only noticing the results of that process, in other words, your thoughts. When you think a thought, it "colours" your world. When you see a thought from a distance, you can still see how it "colours" your world (you understand what it means), but you also see that you are doing the "colouring." It would be as if you always wore yellow sunglasses and forgot you were wearing them. Defusion is like taking off your glasses and holding them several inches away from your face; then you can see how they make the world appear to be yellow instead of only seeing the yellow world.

Similarly, when you are defused from an emotion you can see yourself having the emotion, rather than simply being in it. When you are defused from a craving or a sensation of pain, you do not just experience the craving or pain, you see yourself having them. Defusion allows you to see thoughts, feelings, cravings, and pain as simply processes taking place in your brain. The more defused you are from thoughts or feelings, the less automatically you act on them.

For example, you may do something embarrassing and have the thought "I'm such an idiot." If you are able to defuse from this thought, you will be able to see it as just a thought. In other words, you can see that the thought is something in your mind that may or may not be true. If you are not able to defuse, you would take the thought as literally true, and your feelings and actions would automatically be impacted by the thoughts.

Based on the definition of defusion above, please rate each scenario according to the extent to which you would normally be in a state of defusion in the specified situation. You may want to read through all the examples before beginning to respond to the questions. (Important: you are not being asked about the degree to which you would think certain thoughts or feel a certain way, but the degree to which you would defuse if you did.)	0	1	2	3	4	5
	Not at all	A little	Somewhat	Moderate	Quite a lot	Very much
Feelings of anger. You become angry when someone takes your place in a long line. To what extent would you normally be able to defuse from feelings of anger?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cravings for food. You see your favorite food and have the urge to eat it. To what extent would you normally be able to defuse from cravings for food?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Physical pain. Imagine that you bang your knee on a table leg. To what extent would you normally be able to defuse from physical pain?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Anxious thoughts. Things have not been going well at school or at your job, and work just keeps piling up. To what extent would you normally be able to defuse from anxious thoughts like "I'll never get this done."	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Thoughts of self. Imagine you are having a thought such as "no one likes me." To what extent would you normally be able to defuse from negative thoughts about yourself?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Thoughts of hopelessness. You are feeling sad and stuck in a difficult situation that has no obvious end in sight. You experience thoughts such as "Things will never get any better." To what extent would you normally be able to defuse from thoughts of hopelessness?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Thoughts about motivation or ability. Imagine you are having a thought such as "I can't do this" or "I just can't get started." To what extent would you normally be able to defuse from thoughts about motivation or ability?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Thoughts about your future. Imagine you are having thoughts like, "I'll never make it" or "I have no future." To what extent would you normally be able to defuse from thoughts about your future?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sensations of fear. You are about to give a presentation to a large group. As you sit waiting your turn, you start to notice your heart racing, butterflies in your stomach, and your hands trembling. To what extent would you normally be able to defuse from sensations of fear?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Feelings of sadness. Imagine that you lose out on something you really wanted. You have feelings of sadness. To what extent would you normally be able to defuse from feelings of sadness?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Forman E. M., Herbert J. D., Juarascio A. S., Yeomans P. D., Zebell J. A., Goetter E. M., & Moitra E. (2012). The Drexel defusion scale: A new measure of experiential distancing. *Journal of Contextual Behavioral Science*, 1, 55-65.

Appendix 15: Cognitive fusion questionnaire

Cognitive Fusion Questionnaire (CFQ)

Below you will find a list of statements. Please rate the truth of each statement as it applies to you. Use the following rating scale to help you make your choices.

1=Never true. 2=Very rarely true. 3=Seldom true. 4=Sometimes true. 5=Often true. 6=Almost always true.

7=Always true.

- | | |
|--|---------------|
| 1. My thoughts cause me distress or emotional pain. | 1 2 3 4 5 6 7 |
| 2. I get so caught up in my thoughts that I am unable to do the things that I most want to do. | 1 2 3 4 5 6 7 |
| 3. I over-analyse situations to the point where it's unhelpful to me. | 1 2 3 4 5 6 7 |
| 4. I struggle with my thoughts. | 1 2 3 4 5 6 7 |
| 5. I get upset with myself for having certain thoughts. | 1 2 3 4 5 6 7 |
| 6. I tend to get very entangled in my thoughts. | 1 2 3 4 5 6 7 |
| 7. It's such a struggle to let go of upsetting thoughts even when I know that letting go would be helpful. | 1 2 3 4 5 6 7 |

Appendix 16: Mindfulness questionnaire

Mindful Attention Awareness Scale (MAAS), trait version (Brown & Ryan, 2003).

Instructions: Below is a collection of statements about your everyday experience. Using the 1-6 scale below, please indicate how frequently or infrequently you currently have each experience. Please answer according to what really reflects your experience rather than what you think your experience should be. Please treat each item separately from every other item.

1	2	3	4	5	6
Almost Always	Very Frequently	Somewhat Frequently	Somewhat Infrequently	Very Infrequently	Almost Never
I could be experiencing some emotion and not be conscious of it until some-time later.					1 2 3 4 5 6
I break or spill things because of carelessness, not paying attention, or thinking of something else.					1 2 3 4 5 6
I find it difficult to stay focused on what's happening in the present.					1 2 3 4 5 6
I tend to walk quickly to get where I'm going without paying attention to what I experience along the way.					1 2 3 4 5 6
I tend not to notice feelings of physical tension or discomfort until they really grab my attention.					1 2 3 4 5 6
I forget a person's name almost as soon as I've been told it for the first time.					1 2 3 4 5 6
It seems I am "running on automatic," without much awareness of what I'm doing.					1 2 3 4 5 6
I rush through activities without being really attentive to them.					1 2 3 4 5 6
I get so focused on the goal I want to achieve that I lose touch with what I'm doing right now to get there.					1 2 3 4 5 6
I do jobs or tasks automatically, without being aware of what I'm doing.					1 2 3 4 5 6
I find myself listening to someone with one ear, doing something else at the same time.					1 2 3 4 5 6
I drive places on 'automatic pilot' and then wonder why I went there.					1 2 3 4 5 6
I find myself preoccupied with the future or the past.					1 2 3 4 5 6
I find myself doing things without paying attention.					1 2 3 4 5 6
I snack without being aware that I'm eating.					1 2 3 4 5 6

Appendix 17: Self as Context Scale (SACS)

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

1 = Strongly Disagree 2 = Disagree 3 = Slightly Disagree 4 = Neither Agree Nor Disagree
5 = Slightly Agree 6 = Agree 7 = Strongly Agree

_____ 1. When I am upset, I am able to find a place of calm within myself.

_____ 2. I have a perspective on life that allows me to deal with life's disappointments without getting overwhelmed by them.

_____ 3. Despite the many changes in my life, there is a basic part of who I am that remains unchanged.

_____ 4. As I look back upon my life so far, I have a sense that part of me has been there for all of it.

_____ 5. I allow my emotions to come and go without struggling with them.

_____ 6. I am able to notice my thoughts without getting caught up in them.

_____ 7. There is a basic sense I have of myself that doesn't change even though my thoughts and feelings do.

_____ 8. Though I have had many roles in my life, I have always had a sense of self that is stable and enduring.

_____ 9. Even though there have been many changes in my life, I'm aware of a part of me that has witnessed it all.

_____ 10. I am able to access a perspective from which I can notice my thoughts, feelings, and emotions.

_____ 11. When I think back to when I was younger, I recognize that a part of me that was there then is still here now.

Appendix 18: Committed Action Questionnaire (CAQ-8)

Below you will find a list of statements. Please rate the truth of each statement as it applies to you. Use the following rating scale to help you make your choices.

0=Never true. 1=Very rarely true. 2=Seldom true. 3=Sometimes true. 4=Often true. 5=Almost always true. 6=Always true

1	I can remain committed to my goals even when there are times that I fail to reach them.	0	1	2	3	4	5	6
2	When a goal is difficult to reach, I am able to take small steps to reach it.	0	1	2	3	4	5	6
3	I prefer to change how I approach a goal rather than quit.	0	1	2	3	4	5	6
4	I am able to follow my long terms plans including times when progress is slow.	0	1	2	3	4	5	6
5	I find it difficult to carry on with an activity unless I experience that it is successful.	0	1	2	3	4	5	6
6	If I feel distressed or discouraged, I let my commitments slide.	0	1	2	3	4	5	6
7	I get so wrapped up in what I am thinking or feeling that I cannot do the things that matter to me.	0	1	2	3	4	5	6
8	If I cannot do something my way, I will not do it at all.	0	1	2	3	4	5	6