Predicting and preventing obesity and weight gain.

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Predicting and Preventing Obesity and Weight Gain

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Submitted to Swansea University in fulfilment of the requirements for the Degree of Doctor of Philosophy

Swansea University

2012

Summary (Abstract)

Overweight and obesity have significant health and economic consequences for people living in the UK. The psychological factors involved in the development of overweight and obesity are very important and can make a significant contribution to the development of interventions that inform public health policy and services. The current thesis employed three studies to examine the psychological factors that may predict overweight and obesity and contribute to the development of interventions that help to promote long-term weight loss maintenance, which have implications for improving health outcomes and reducing the economic burden. Study One (N=60) employed a 5-day diary to examine overweight and obese individuals' perceived reasons for eating (particularly in relation to unhealthy snacking). Study Two (N=30) was a follow-up to Study One and examined the factors that may predict long-term weight change. Finally, Study Three (N=60) employed an exploratory randomised controlled trial to examine the efficacy of a combined mindfulness plus implementation intentions intervention for promoting physical activity. The results of Study One provided evidence for the existence of reasons for eating unhealthy snacks other than hunger and highlighted the importance of addressing these factors within weight management interventions. Study Two did not conclusively demonstrate that psychological reasons for eating were long-term predictors of weight change, suggesting future research is needed to obtain further information on this complicated issue. This will help to determine whether reasons for eating can indeed predict weight change. The combined intervention in Study Three failed to promote physical activity, but highlighted a number of interesting factors such as task difficulty, unsupportive environments and insufficient motivation that need to be addressed in future research. Ensuring the population maintain a healthy weight and improving long-term health outcomes is very important, and therefore needs to be addressed at multiple levels in order to inform effective public health policy and services.

Declaration and Statements

DECLARATION

This work has not previously been accepted in substance for any degree and is not being concurrently submitted in candidature for any degree.

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STATEMENT 1

This thesis is the result of my own investigations, except where otherwise stated. Where correction services have been used, the extent and nature of the correction is clearly marked in a footnote(s).

Other sources are acknowledged by footnotes giving explicit references. A bibliography is appended.

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STATEMENT 2

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Acknowledgements

First of all I would like to thank my supervisor Dr Katy Tapper. I would like to express my extreme gratitude for her help, guidance and understanding throughout the course of my PhD, not only in terms of academic work but also on a personal level. Your help, support, guidance and understanding (not to mention patience!) have been invaluable and I will be forever grateful.

Secondly to my loving fiancée Richard. At last we can plan the rest of our lives together! You have been there for me both practically and emotionally over the years; you have stood by me and been endlessly supportive of not only my PhD but everything that has come our way. I will always be grateful for the unconditional love, support, understanding and patience you have given me over these last seven years of my PhD; you are my life and I cannot wait to spend the rest of it with you.

To Mum, Dad and Dean. The years have been difficult on many levels, but you have never failed to support me, no matter what crosses our path. Your unconditional love and support mean everything to me and I will be forever grateful for all that you have done.

Last but not least to all my wonderful friends Catherine, Rhian, Elen, Charlotte, Claire, Laura, Katy, Jordan and Dave. You have all, in one way or another, been there for me and supported me and I am privileged to be able to call you all my friends.

Research Publications and Conference Presentations

- Cleobury, L., & Tapper, K. (2010). Reasons for Eating: A Diary Study. *Appetite, 55(1),* 173. *Oral presentation at the annual meeting of the British Feeding and Drinking Group,* Swansea, 2009.

- Cleobury, L., & Tapper, K. (2011). Temptation or Obligation? Reasons for Eating in Overweight and Obese Males and Females. *Appetite, 57(2),* 555. *Oral presentation at the annual meeting of the British Feeding and Drinking Group,* Belfast, 2011.

- Cleobury, L., & Tapper, K. (2012). Exploratory Randomised Controlled Trial of a Mindfulness and Implementation Intention Intervention to Target Physical Activity and BMI. *Appetite, 59(2),* 623. *Oral presentation at the annual meeting of the British Feeding and Drinking Group,* Brighton, 2012.

- Cleobury, L., & Tapper, K. (2012). Reasons for eating 'unhealthy' snacks in overweight and obese males and females. (Under Review).

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Abbreviations

%	Percent/percentage
7-Day PAR	7-Day Physical Activity Recall
AC	Attentional Control
ACT	Acceptance and Commitment Therapy
ANOVA	Analysis of Variance
ATQ	Adult Temperament Questionnaire
BDI	Beck Depression Inventory
BES	Binge Eating Scale
BMI	Body Mass Index
BPAT	Brief Physical Assessment Tool
CBT	Cognitive Behavioural Therapy
CHD	Coronary heart disease
DBS	Decision Balance Sheet
DEBQ	Dutch Eating Behaviour Questionnaire
EDE-Q	Eating Disorder Examination Questionnaire
EFT	Episodic Future Thinking
EMS	Electronic Management System
FCQ-T	Food Cravings Questionnaire – Trait
FMI	Freidburg Mindfulness Inventory
FSA	Food Standards Agency
g	Grams
GLTEQ	Godin Leisure Time Exercise Questionnaire
GP	General Practitioner
grp	Group
IC	Inhibitory Control
II	Implementation intentions
IOR	Inter-observer reliability
kcal	Kilocalories
kg	Kilograms
kJ	Kilojoules
lbs	Pounds

LOCF	Last Observation Carried Forward
m^2	Metres squared
M&II	Mindfulness plus implementation intentions
MAAS	Mindful Awareness Attention Scale
MI	Myocardial Infarction
min	Minutes
MMS	Mindfulness/Mindlessness Scale
MRC	Medical research Council
NEO-FFI	Neuroticism-Extroversion-Openness Five Factor Inventory
NEO PI-R	Neuroticism-Extroversion-Openness Personality Inventory Revised
NHS	National Health Service
NICE	National Institute for Health and Clinical Excellence
PA	Physical activity
PDA	Personal Digital Assistant (electronic diary)
PMT	Protection Motivation Theory
POMS	Profile of Mood States
PSS	Perceived Stress Scale
SDT	Self-determination Theory
Self-reg.	Self-regulation
SES	Socioeconomic status
SMS	Short messaging service (text messaging)
STAI	State-Trait Anxiety Inventory
T1	Time 1
T2	Time 2
T3	Time 3
T4	Time 4
T5	Time 5
TMQ	Toronto Mindfulness Scale
UK	United Kingdom
VLCD	Very low calorie diet
WHO	World Health Organisation
wk	Week

Chapter One

General Introduction

Overweight and obesity, and ensuring the population maintain a healthy weight, is one of the biggest health challenges and concerns currently facing the UK government (Wang, McPherson, Marsh, Gortmaker & Brown, 2011). Overweight and obesity can be defined as abnormal or excessive fat accumulation that may impair health, or more simply as an unhealthy amount of body fat (Jeffery et al., 2000; Anderson, 2008). It occurs when an individual carries too much weight for their height and sex and can be determined by calculating Body Mass Index (BMI). BMI is defined as the weight in kilograms divided by the square of the height in metres (kg/m^2). A person with a BMI of 25 or over is deemed to be overweight, whilst someone with a BMI that is equal to 30 or more is considered obese (Canoy & Buchan, 2007; Anderson, 2008). In a two-year study conducted by Sir David King and colleagues, published in the Foresight Report by the Department of Health in 2007, as many as 60% of males and 50% of females were estimated to be obese by 2050, with obesity-related diseases estimating to cost the UK approximately £45.5 billion per year if they are not addressed (King, 2011). Consequently, the burden of overweight and obesity does not only affect the NHS, as there may also be a number of costs to society and the broader economy. For example, sickness absence due to conditions brought about by overweight and obesity will reduce productivity.

According to Anderson (2008), overweight and obesity are the fourth most important risk factor for ill health and premature death after tobacco, blood pressure and alcohol, and can cause or exacerbate a large number of health problems. Being overweight or obese can place a person at greater risk of developing chronic conditions such as type 2 diabetes, metabolic syndrome, hypertension, coronary artery disease and stroke, respiratory effects, some cancers, infertility, osteoarthritis and liver and gall bladder disease, with the risk of developing any of these conditions increasing significantly as BMI increases (Must et al., 1999; Kopelman & Grace, 2004; Kopelman, 2007).

According to Swinburn and Egger (2004), socioeconomic status (SES) is strongly associated with overweight and obesity (particularly amongst females), with a higher proportion of overweight and obese people among those from lower SES groupings (Swinburn and Egger, 2004; Law, Power, Graham & Merrick, 2007). This can lead to a reduced opportunity for jobs and lower income, which in turn leads to a reduced range of healthy choices such as fresh fruit and vegetables or taking part in physical activity (e.g., joining the gym). Areas of low SES are classed as more obesogenic environments than those of high SES, and low income is associated with chronic stress, which can in turn lead to comfort eating or excessive consumption of alcohol (Swinburn & Egger, 2004). Reducing health inequalities is currently a large UK Government focus and as Law, Power, Graham and Merrick (2007) state, the challenge for current government policy is to assess the interaction of social, behavioural and biological determinants of these health inequalities through life course research and ecological studies in order to inform both our understanding of the environmental causes of overweight and obesity as well as the policies and interventions that can help to prevent it. It can therefore be argued that health inequalities research should focus on areas of low SES.

Most commonly overweight and obesity is thought to be the cause of an energy imbalance between the calories consumed and the calories expended, however the process is much more complex than that. The causes of overweight and obesity involve a range of psychological, environmental, social, genetic and economic factors that can interact in varying degrees to the development of obesity (Wright & Aronne, 2012). Some of the factors that may contribute to becoming overweight or obese include lifestyle choices such as poor food choices, overeating and heavy alcohol consumption, lack of physical activity (e.g. desk-based occupation, car as only means of travel, watching TV in spare time as opposed to taking a walk) (Brown, Kelly & Summerbell, 2007), and various medical conditions and medications. It can therefore be argued that research needs to address multiple (e.g., psychological, environmental, social, genetic and economic) factors as well as individual factors through collaboration, in order to ensure healthy outcomes for the population.

The current thesis examines the psychological factors that contribute to overweight and obesity. From a psychological perspective there is good evidence to suggest overweight and obesity are associated with both emotional eating (overeating in response to negative emotions) and external eating (overeating in response to external food cues such as the sight and smell of food) (Van Strien, 2002; Van Strien et al., 1986). However, amongst both normal and overweight populations, it is unclear what proportion and types of eating episodes can be attributed to these cues relative to other factors such as hunger, social facilitation, stress and habit. It is also unclear whether any sex differences exist. Overweight and obese individuals report a variety of different reasons for eating, which differ from the reasons given for the termination of eating. However, it is surprising that very little research has been conducted on sex differences, particularly given that the reasons associated with eating (as well as the reasons given for the cessation of eating) do appear to differ between males and females (O' Connor et al., 2008; Tuomisto et al., 1998). These factors have important implications for the development of interventions aimed at predicting and preventing overweight and obesity. Study One therefore, will examine overweight and obese participants' perceived reasons for eating, with the additional aim of investigating sex differences. These will be investigated with a particular focus on the consumption of unhealthy snacks, as people who are sensitive to the influence of for example, emotional eating and stress, have demonstrated a tendency towards the selection of sweet, high-fat foods (e.g. Ganley, 1989; Oliver et al., 2000). Snacks have been shown to be an important contributor to weight gain, with sex differences in intentions to consume sweet snacks also evident (Grogan et al., 1997). This may therefore also be a good target for intervention.

Furthermore, psychological factors that are associated with the reasons why people eat could be important predictors of weight change. Research in this area is very limited (Tiggemann, 2004) and because of the implications this may have for weight loss interventions, further research to identify the psychological factors that contribute to, or predict, weight change is important. Study Two therefore, will act as a follow-up to Study One, with the aim of determining what factors (specifically in terms of reasons for eating) predict weight change 12 months later amongst a group of overweight and obese males and females.

As well as identifying the factors that lead to overweight and obesity, tackling lifestyle and behaviour change through increased physical activity for example, is also important on a number of levels. As well as reducing the burden to the NHS and the broader economy, tackling overweight and obesity through the identification of successful psychological interventions to change unhealthy behaviour will improve general well being and decrease the risk of developing a number of chronic conditions. Study Three of the thesis therefore, will examine the efficacy of a new approach designed to change behaviour, specifically to increase levels of physical activity.

Current interventions for obesity include pharmacological treatments, surgery, dieting, psychological interventions and physical activity. Pharmacological treatments for obesity are usually employed if the person in question has failed to lose around 10% of their body weight through either behavioural or nutritional interventions (Royal College of Physicians of London, 2003). However, the efficacy of pharmacological treatment is poor (around 40% of those taking appetite suppressants will lose 5-10% of their body weight); therefore simply addressing the biological processes of overweight and obesity is not sufficient. Surgical interventions are elective surgeries that physically stop people from eating. This form of treatment is generally only employed after all other avenues have been explored and proved unsuccessful. It almost guarantees weight loss, however it is a drastic form of treatment that is only used as a last resort if a person's quality of life is very poor and they have attempted all other forms of intervention (Dixon et al., 2001; Pontiroli, 2008).

Traditional dietary interventions for obesity involve the consumption of low-fat foods in order to achieve weight loss within a relatively short period. Weight losses after dieting are generally 3% or less, with drop-out rates in the region of 58% (Rapoport, Clark & Wardle, 2000). Evidence suggests that dieting will decrease weight in the short term but increase it in the long term. It is argued that dieting can lead to weight gain and not weight loss in the long term (Field et al., 2003) , and produces rebound weight gain after dieting (Stice et al., 1999). Even if individuals are successful in losing weight in the short-term after dieting and reach their target weight, these individuals can still revert back to their old eating habits and regain all of their lost weight (Byrne, 2002). According to Rapoport, Clark and Wardle (2000), repeated loss and regain of weight can be more hazardous to health and well-being than stable weight; therefore interventions that promote long-term weight loss are needed. Psychological interventions tend to target factors such as food selection, preferences, triggers to eat and situations and behaviours that may place the individual at risk of violating dieting practices. Psychological treatments that are directed at bringing about behaviour change with regard to overweight and obesity have often employed Cognitive Behavioural Therapy (CBT), with weight losses in the region of 5-20% and a drop-out rate of approximately 20% (Rapoport, Clark & Wardle, 2000). Negative thoughts have been a prominent focus of CBT, and this form of therapy attempts to alter negative thoughts by reducing their frequency, intensity, sensitivity or to change them into more desirable forms (Masuda et al., 2004).

Weight loss is therefore difficult to achieve, but is even more difficult to maintain. Weight loss is almost always regained over time (Byrne, 2002), therefore knowing how to maintain weight loss is important. Research has shown that successful weight maintenance is associated with a wide variety of factors, as is the risk for weight regain, but that the challenge of weight maintenance can be overcome through self-determined goals, a physically active lifestyle, and a healthier choice of foods and control of overeating (Elfhag and Rossner, 2004). Previous research has suggested that the reason people struggle to maintain weight losses is due to the individual failing to maintain their healthy eating and exercise habits (McGuire et al., 1999; Byrne 2002). For example, in a study by McGuire et al. (1999) of predictors of weight gain versus maintenance, researchers found evidence to suggest that several years of successful weight maintenance increased the probability of future weight maintenance and that weight regain was due to failure to adhere to behaviour change strategies. A better understanding of the psychological processes that lead to overweight and obesity and how to tackle them will be beneficial for the development of interventions aimed at helping individuals to adhere to their already adopted weight loss practices (Byrne, 2002).

An effective method of maintaining weight loss is through physical activity (PA) (Pronk & Wing, 1994; Elfhag and Rossner, 2004; Hill and Wyatt, 2005). PA is defined as any bodily movement produced by skeletal muscles that requires energy expenditure (WHO, 2012, Physical activity: A global health problem). Physical *inactivity* is an independent risk factor for chronic diseases, and overall is estimated to cause 3.2 million deaths globally (WHO, 2012, Physical activity: A global health problem). Different types and amounts of PA are required for different health outcomes, and it is recommended that 18-64 years olds engage in 150 minutes of moderate intensity or 75 minutes of vigorous intensity aerobic physical activity throughout the week, or an equivalent combination of moderate and vigorous intensity activity. This can reduce the burden of overweight and obesity not just on a personal level, but also in economical terms (WHO, 2011). As Hill and Wyatt (2005) state "Although physical activity does not appear to contribute significantly to weight loss, it is critical for maintenance of weight loss" (Hill & Wyatt, 2005, p. 765) and a number of studies have been highlighted that demonstrate how high levels of physical activity are beneficial for long-term weight loss maintenance (Pronk & Wing, 1994; Hill & Wyatt, 2005). Study Three therefore, will be designed as a three-arm randomised controlled trial to examine the efficacy of a new approach designed to promote physical activity. The study will have two aims, primarily to increase individual's current levels of physical activity, and secondly to reduce BMI and body fat percentage relative to controls. Interventions such as this may have implications for not only improving general wellbeing and decreasing the risk of chronic health conditions, but also for helping to maintain weight loss after dieting.

To conclude, the current thesis examines just one of the many factors that contribute to the onset of overweight and obesity, namely psychological factors. However, psychological issues are very important and can make a significant contribution to the development of interventions that may inform public policies and health services. Research such as that of Abraham and Michie (2008) and Michie et al. (2009) addressing unhealthy behaviour and behaviour change have successfully contributed to government policy and White Papers, such as the Wanless Report (2004) and the public health White Paper, Choosing Health (2004). Health Psychologists are often asked to respond to government consultations (Johnston, Weinman & Chater, 2011), therefore the psychological issues involved in unhealthy behaviour and behaviour change can make a significant contribution to public health policy and services.

Chapter Two

Reasons for eating in overweight and obese males and females

2.1 Introduction

2.1.1 Why do we eat?

Eating is a fundamental part of life. We need to eat to survive, and to do so is one of the most natural and instinctive behaviours we will engage in throughout our lives. The decision to eat varies across individuals and situations and individual differences in food experiences and attitudes developed throughout life will be reflected in these decisions to eat. Self-reported reasons for eating differ from the reasons for the termination of eating. In a study investigating the reasons for the initiation and termination of eating, Tuomisto et al. (1998), found that environmental cues were selected as the main reason for the initiation of eating, while the reasons given for the termination of eating were based on self-assessment and cognitions such as 'I felt I had eaten enough'. The decision to eat may also be influenced by certain environmental cues (e.g., time of day or smells of certain foods) preceding meals and mealtimes, thereby becoming associated with eating and leading people to believe that they are hungry in these situations (Wardle, 1990). People may also choose to eat because of the pleasure anticipated following eating (Jackson et al., 2003), or due to strong urges or cravings (Burton et al., 2007). In terms of meal termination however, Hetherington (1996) found that participants' reasons for stopping eating included becoming tired of the food as well as the decreasing pleasantness of the food.

Previous research has identified a number of psychological factors associated with the reasons why people eat, which include social factors (de Castro, 1990, 1991, 1994; de Castro et al., 1990; Redd & de Castro, 1992) external eating (Herman, Olmsted & Polivy, 1983; Tuomisto et al., 1998), emotional eating (Benton & Donohoe, 1999; Macht & Simons, 2000; Rogers, 1995; Ruderman, 1983), stress (Conner et al., 1999; Greeno & Wing, 1994; Heatherton & Baumeister, 1991; Kaplan & Kaplan, 1957; O'Connor et al., 2008; Solomon, 2001) and 'automaticity' (Tiffany, 1990; Wansink & Sobal, 2007). These factors have been identified as possible reasons for eating in normal weight participants and each will be described and evaluated in this literature review, in relation to the general population and also in those of greater weight where possible. This literature review will also examine the frequencies with which these reasons are reported as well as potential sex differences.

2.1.1.1 Hunger

Hunger is an appetite or need for food and might understandably be considered the most primary or basic reason for choosing to eat. It may be argued that everyone eats because they are hungry; however this is not always the case. The amount eaten is not always well correlated with the levels of hunger measured (Le Magnen, 1986) and hunger is less commonly reported as a reason for initiating eating than, for example, environmental reasons (Tuomisto et al., 1998). It has been argued that a number of other cues have preceded meals and mealtime, and that these cues have consequently been associated with hunger, thus leading people to believe that the reason they are eating in these particular situations is actually due to hunger (Tuomisto et al., 1998; Wardle, 1990).

Tuomisto et al. (1998) investigated the main reasons for starting and stopping eating in obese males and females and the emotional changes that were experienced during a meal in these participants following the completion of a 3-week weight control programme. Participants were required to complete a 1-day diary, and were asked to fill it in every time they ate over the 24-hour period. They were provided with 26 different reasons to choose from plus an open-ended response option. According to their results hunger was not identified as the main reason for starting to eat, accounting for only 20% of cases. A large number of reasons were found, and these varied greatly from one individual to the next. The majority of reasons for eating included because it was 'mealtime' or because it was part of the participants' regular lifestyle. Around 45% of eating occasions were associated with these environmental reasons for eating and they concluded from their findings that weight control methods based on the elimination or suppression of hunger feelings (which are often regarded as an important target in the treatment of obesity) may not work well because the majority of reasons for eating identified in their research were not hunger related.

Research findings such as these suggest that there are a variety of psychological and behavioural reasons why people choose to initiate eating, not just because they are hungry. Determining what these additional reasons are is beneficial for developing more informed interventions that are aimed at reducing overweight and obesity.

2.1.1.2 Social facilitation

Social facilitation as a factor affecting eating behaviour in humans has attracted a lot of research over the years. According to Herman et al. (2003), this phenomenon can affect an individuals' eating behaviour when part of a group, by directly influencing the amount eaten. De Castro and colleagues have conducted extensive research on social facilitation and have concluded from their findings that this phenomenon ultimately leads to more eating. In 1991, De Castro found a positive correlation between meal size and the number of people present. When adult participants ate with other people, food intake was 60% higher than when they ate alone. They also consumed more water, sodium and alcohol (Redd & de Castro, 1992). De Castro and colleagues have also concluded from other studies (de Castro, 1994; de Castro et al., 1990) that participants will consume 40-50% more food in the presence of others. They report that these findings occur regardless of whether the eating episode occurs on a weekday or weekend, or whether it is a meal or snack (de Castro, 1990; de Castro et al., 1990), although Redd and de Castro (1992) found that the proportion of calories accounted for by fat increased, and the overall percentage of fat consumed was higher, when participants ate with others than when they ate alone. Similarly Clenenden et al. (1994) reported an effect of social facilitation on sweet, high fat foods and Hetherington et al. (2006) found that being in the presence of friends increased the intake of cookies compared to eating with strangers. Therefore it could be suggested from these findings that increased high-calorie snack consumption may be associated with social reasons for eating.

Pliner et al. (2006) suggest that this phenomenon may come about through the amount of time a meal lasts when eating as part of a group. This is known as the time-extension hypothesis (de Castro, 1990) and illustrates that meal time is increased when socialising as opposed to when eating alone. This extension in time essentially increases the individual's exposure to food, and can therefore lead to overeating (de Castro, 1990). Pliner et al. (2006) tested this explanation for the social facilitation effect and found that males ate more than females, and that participants eating for longer ate more than those in the shorter meal group. They concluded from this that social facilitation is mediated by meal duration. However, Hetherington et al. (2006) argue that while this time-extension hypothesis provides an explanation for the increase in meal duration and size, it does not explain *why* people might eat excessively in the presence of others. They suggest a possible explanation for this could be distraction. When in a social context people tend to become distracted by other engaging activities such as talking and listening. However, these same distractions would occur when eating in the presence of strangers, but Hetherington et al. found no increase in intake as compared to those eating with familiar people. They therefore conclude that distraction alone is not a sufficient explanation of social facilitation, but that distraction *and* eating with familiar others increases food intake. They suggest that eating when engaged in other activities should be avoided or at least limited in some way, and that careful planning is required to avoid social facilitation effects when eating with friends or family. The *relationship* of dining companion therefore, is an important factor that contributes to social facilitation. De Castro (1994) also found that the 'type' of others has an affect on eating behaviour. They noted that if the other members of the group were *not* part of the individual's family, they were less likely to have an affect on the individual's eating behaviour. Hetherington et al. (2006) have also shown that social facilitation of eating does not occur when in the presence of strangers and Clenenden (1994) found that participants who ate with friends consumed more dessert than participants who ate with strangers.

Each of these studies indicates that the presence of other people in social situations has a direct effect upon eating behaviour, whether the amount eaten is increased through the presence of familiar others, or decreased in the presence of strangers. It is important to note at this point though, that research on social facilitation has only focused on the amount of food intake and does not provide us with the reasons why people choose to initiate eating. As de Castro and de Castro (1989) state, "...social factors are a major influence on the eating behaviour of humans", and "...feeding is often constrained by social conditions". "People are often not free to initiate eating whenever they desire food because of the social constraints of family, work, school schedules, etc" (de Castro & de Castro, 1989, pg 237) therefore suggesting that the reason people will give for *initiating* eating in these kinds of situations will be social reasons. We also often celebrate special occasions by dining out in groups. Therefore each of these social factors is an important influence on eating behaviour. It can be justifiably argued that one of the many reasons that people may give for initiating eating will involve a form of social influence, facilitated by the presence of familiar others, which is one of the factors that this study will aim to address.

2.1.1.3 External eating

External eating is eating in response to external food cues such as the sight and smell of food. It is a form of disinhibition, and according to Braet and Van Strien (1997), it is the inability to resist when in the presence of food, or when there are some sort of sensory cues to eat. This type of eating can occur regardless of the internal state of hunger or satiety (Schachter, Goldman & Gordon, 1968), and Schachter and Rodin (1974) believe that external eating is a consequence of a certain personality disposition.

The concept of external eating comes from the work of Schachter and colleagues through the development of externality theory (Schachter, 1968; Schachter et al., 1968). Externality theory (Schachter, 1968) suggests that external eaters will eat in response to external stimuli regardless of their internal state of hunger or satiety. The theory originally suggested that overweight and obese individuals were more reactive to external cues and less reactive to hunger signals than those of normal weight and that external eating applied only to obese individuals (Schachter, 1968). However, the notion of external eating is now also applied to normal weight individuals. In 1981, Rodin put forward the argument that studies which demonstrated that overweight people were more responsive to external cues than normal weight people were difficult to replicate, leading researchers to apply the concept of external eating to normal weight individuals also. Herman and Polivy (1980, 1984) however, suggested the application of external eating to restrained eaters, regardless of their weight status. According to the boundary model (Herman & Polivy, 1984), restrained eaters have a higher tolerance towards the internal signs and signals of hunger and satiety, but tend to be more responsive to external triggers such as the availability of food. In a series of studies investigating the amount of food consumed during a 'taste test' following a 'pre-load' in restrained eaters, Herman and Polivy (1980, 1984), found that restrained eaters typically consumed more food during the taste test with a pre-load than without. This suggests that by consuming a high-calorie pre-load, restrained eaters become disinhibited, believing they have broken their dietary rules and therefore overeat. However, it is also possible that the results are due to restrained eaters' sensitivity to external cues and that exposure to a food cue (i.e. the pre-load) triggers strong cravings that lead to increased consumption (Blechert et al., 2010).

Herman, Olmsted and Polivy (1983) however, investigated the influence of external cues and social influence as a motivator for eating, by asking waitresses to provide appetising descriptions of desserts in a restaurant and encouraging the participant to order it. They found that overweight participants were more likely to order the particular dessert being described, and participants who were not overweight were much less affected by the waitress's description and encouragement, therefore suggesting that overweight or obese individuals are more responsive to external cues than those of normal weight. Herman and Polivy (2008), in their review of external cues as an important factor in the control of food intake, suggest that it is possible to make a distinction between two types of external cues, and that each of these affects certain individuals differently. They suggest that normative cues such as portion size are indicators of appropriate intake and affect everyone, whereas sensory cues are hedonic in nature and have more of an affect on those who are obese.

In their investigation of the reasons for meal initiation in obese males and females, Tuomisto et al. (1998) found that cues such as mealtime and regular lifestyle were selected as the main reason for starting to eat in the majority of eating episodes (45%). These reasons were reported more often than any other physiological, emotional or social reasons, and they therefore concluded from their findings that as hunger was less commonly reported as a reason for starting to eat than environmental/external reasons (hunger was not identified as the main reason for initiating eating), treatment strategies for obese people would benefit from targeting individual reasons for eating.

To summarise, external eating has been shown to be an important reported reason for choosing to initiate eating in obese males and females (Tuomisto et al., 1998), however additional research in this area is sparse. This is particularly surprising given that the reasons for initiating eating may vary from individual to individual, and indeed from eating episode to eating episode, therefore further research in this area is necessary.

2.1.1.4 Emotional eating

Emotional eating refers to eating in response to emotions or because of changes in mood and is an area of research that has received a lot of interest. It refers to the tendency to eat more when anxious or emotionally aroused (Conner et al., 1999). Whilst a normal reaction to emotions such as fear or anxiety would be a loss of appetite, some people will respond through excessive eating (Van Strien et al., 1986). Bruch (1961, 1964) attributes this excessive eating to confusion between this type of internal arousal and hunger, with certain individuals assuming that internal emotional states are in fact hunger signals. Macht, Gerer and Ellgring (2003) state that foods' ability to change an emotional eaters' mood depends on various psychological factors, and these factors arise from individual experiences of eating. The psychological factors associated with foods can have an immediate affect on a person's emotional state (i.e. emotional changes may start to occur as soon as the individual perceives the food item), and this in turn can lead to physiological responses such as salivation. Physiological responses such as these could lead people to believe that they are in fact hungry. Robbins and Fray (1980) suggest that obese people who eat in emotionally arousing situations do so through the process of avoidance, resulting in emotional eating becoming a learned response. According to Larsen et al. (2006), because of this early learning, people may develop poor interoceptive awareness and therefore cannot accurately recognise or discern the difference between emotions and feelings of hunger, thereby leading them to eat in emotionally arousing situations.

Eating can also have a direct affect on our mood through the release of endogenous opioids that give us that 'feel good factor', which is another reason why people engage in this type of eating behaviour. They do it in order to improve their mood and this behaviour tends to be associated mainly with negative emotions, such as eating when 'feeling down', anxious or bored. In their study of reasons for eating in everyday life, Tuomisto et al. (1998) found that there was a significant decline in negative emotions such as tension and tiredness during eating and in heavier participants they observed an increase in happiness following the consumption of food. These changes were observed for both males and females, with no differences in the magnitude of changes between sexes. Reductions in other negative moods such as irritability and sadness were also noted, but these changes were not significant. The important point reported by Tuomisto and colleagues here was that a trend was observed for the heavier group of obese participants (BMI > 33.65), in that they experienced an increase in positive emotions following eating compared to that of the lighter group of obese participants, whose happiness increased slightly but were more likely to experience a reduction in negative emotions. This therefore could suggest that changes in mood are weight specific.

As well as improving mood however, food also provides the individual with a distraction from the particular emotion they are experiencing, through switching their attention and focusing on food and eating. This provides the individual with a means of coping, and may lead them to turn to food in future similar situations (Macht, Roth & Ellgring, 2002). Tuomisto et al. (1998) found that eating significantly reduced levels of tension and fatigue in a group of obese males and females. Before and after eating, males were more tense than females, but eating reduced these levels in both groups. Additional negative emotions were also decreased following food consumption, such as irritability and sadness (although not significantly), and positive emotions increased, although again these increases were not significant. Spoor et al. (2007) examined the relations between negative affect, coping and emotional eating, and found that both 'emotion-oriented coping' and 'avoidance distraction' were related to emotional eating, in a bid to control levels of negative affect. These findings were demonstrated in both clinical and non-clinical samples of females, and they concluded that emotional eating is related to emotionally oriented coping and distraction in both populations.

Macht and Simons (2000) investigated the motivation to eat under emotional circumstances in real-life conditions. Their aim was to examine the association of subjective motivation to eat with everyday emotional states in 23 non-clinical female participants. As people are generally motivated to eat under emotional conditions in an attempt to improve mood, Macht and Simons expected to observe an increased motivation to eat during these states. Participants were required to complete a questionnaire at five different time points over six consecutive days, and rate on a seven-point scale to what extent a number of six emotion- and 10 eating-related items matched their present state. The six emotional items included 'angry/annoyed', 'anxious/fearful', 'sad/depressed', 'joyful/happy', 'tense/excited' and 'at ease/relaxed'. The motivation to eat items were those that have been shown to vary across the emotions of anger, fear, sadness and joy identified by Macht (1999), and included 'feelings of hunger', 'desire to eat', 'bodily symptoms of hunger', 'tendency to eat irregularly', 'tendency to eat sweet food', 'tendency to eat good tasting food', 'tendency to eat to provide distraction', 'tendency to eat something to relax' and 'tendency to eat to feel better'. Participants were also required to record whether they had eaten during the previous three hours and whether it was a meal or snack. Via cluster analysis, Macht and Simons identified four different patterns of emotional experiences, namely 'Anger-Dominance', 'Tension/Fear', 'Relaxation/Joy' and 'Unemotional State'. They found that the majority of subjective motivations to eat were increased during times of negative emotions (i.e. 'Anger-Dominance and 'Tension/Fear') and that there were no differences in the reported motivations to eat between each of these two negative emotion clusters. They also found that there was a higher tendency for participants to eat irregularly during negative emotions. Macht and Simons concluded that there are no differential effects of negative mood on eating during everyday situations and that these negative states may be involved in 'emotionally instrumental eating' (eating in order to regulate or control emotions).

A number of researchers have also concluded that negative mood acts as a trigger to binge eat, which therefore has implications for overweight and obesity (Arnow, Kenardy & Agras, 1992; Davis, Freeman & Garner, 1988; Lingswiler, Crowther & Stephens, 1989), and the explanation for engaging in this type of eating again refers back to eating as a temporary escape from negative mood (Heatherton & Baumeister, 1991). An example of such comes from Wegner et al. (2002), who studied the relationship between mood and binge eating in a natural environment and found that participants reported having significantly worse mood on days where they binged than when they did not.

According to the concept of emotional eating, psychosomatic theory, emotional eating is more frequent in obese individuals (Kaplan & Kaplan, 1957) and is the result of learning experiences in early life in which food was used as a coping response to emotional problems (Larsen et al., 2006). The higher the anxiety, the more likely individuals are to start eating (Ruderman, 1983); however, research findings have been mixed. For example, McKenna (1972) found that obese individuals ate more when they were anxious than when they were calm, that normal weight participants did the opposite, but that eating did not reduce the levels of anxiety for either group. Schachter (1968) on the other hand, found that anxiety decreased the amount of food consumed by normal weight participants, but in fact had no effect on the amount eaten by overweight individuals. Wardle et al. (1992) found that emotional eating was not related to BMI; however Stice et al. (2002) found that emotional eating and binge eating were positively associated and that binge eating was predictive of obesity. In a study of 80 females, Van Strien et al. (1985) found that emotional eating and BMI were significantly correlated. However, when looking at whether this association differed between obese and non-obese females, they found no difference existed. When considering these mixed findings, it could be suggested that anxiety or eating in response to such emotions is affected by other variables, such as the different levels of anxiety experienced. Ruderman (1983) demonstrated that obese individuals ate significantly less when highly anxious than when mildly anxious and that consumption was relaxed when anxiety was at an intermediate level, whereas normal weight participants ate similar amounts at all levels of anxiety. Ruderman claimed that these findings complemented those of Robbins and Fray (1980), who argued that maximum food consumption occurs when moderate levels of anxiety occur.

It could also be suggested that emotional eating is not only an issue for overweight and obese individuals. From those results of Wardle et al. (1992) where no association was found between emotional eating and BMI, it could be that emotional eating is a potential difficulty for normal weight individuals also. Nguyen-Rodriguez et al. (2008) provided support for the notion that emotional eating is not just an issue for overweight and obese individuals. They argue that the relationship between emotional eating and weight is more complicated than originally thought, which is also apparent from the inconsistent findings, and that emotional eating may be used as a coping strategy in people of all weights, but that perhaps people of normal weight have certain compensatory skills that overweight individuals do not have (such as eating less the following day or engaging in exercise). It could also be argued that perhaps the lives of those who are of normal weight are not as stressful as those who were overweight or obese and therefore do not experience the same level of emotions. Another suggestion is that perhaps normal weight individuals simply have not yet become overweight, and that should they continue to eat for emotional reasons this behaviour may lead to overweight or obesity.

It could also be suggested that findings are mixed because some of these studies used self-reported emotional eating scales that required a retrospective account of participants' emotional eating. That is, participants required to complete the Dutch Eating Behaviour Questionnaire (DEBQ) for example, would be required to recall their eating behaviours in particular situations, which could potentially involve a recall bias. Barrett (1997) and Ready, Weinberger and Jones (2007) have shown that retrospective emotional ratings are highly sensitive to recall bias, and Nordgren, van der Pligt and van Harreveld (2007) have demonstrated how people can underestimate the impact of emotions on their behaviour when they are not in any kind of emotional state. Evers, de Ridder and Adriaanse (2009) also suggest that inconclusive findings indicate that people are not entirely accurate at assessing themselves as emotional eaters if, when at the time of reporting their emotional eating behaviour, they are not in what they term as a 'hot' state (i.e. emotional). They argued that this leads people to underestimate the impact of these 'hot states' on their emotional eating behaviour and that this recall bias may tell us more about a person's *perceived* association between their emotions and eating behaviour than between their emotions and *actual* eating behaviour. Evers and colleagues conducted a study to examine whether emotional eating scales actually do reflect the tendency to eat when feeling emotional by inducing emotional situations and measuring food intake. They found that people who previously described themselves as emotional eaters on a self-reported scale did not increase their food intake during these emotional situations as compared to controls or those who do not describe themselves as emotional eaters, thus suggesting that people find it difficult to assess their own emotional eating behaviour.

A final suggestion for the mixed findings could be to do with sex. The research conducted either tended to focus solely on the differences between obese and normal weight participants, or used wholly male *or* female samples. No differences were reported in relation to any potential differences between males and females either in terms of their levels of anxiety or emotion experienced, or whether either sex tended to engage in more emotional eating than the other.

Emotional eating also appears to have an effect on the type of food consumed. Diets that are high in carbohydrate sweet foods, such as chocolate, have been shown to be associated with improved mood (Benton & Donohoe, 1999; Rogers, 1995), and it can therefore be argued that in times of negative emotion, emotional eaters will engage in consumption of high fat and sweet carbohydrate foods. An example of this comes from Oliver et al. (2000) who found that emotional eaters consumed significantly more sweet, high-fat foods in response to stressful situations/emotions. Lyman (1982) found that participants consumed healthier foods during positive emotions and unhealthy junk foods when experiencing negative emotions. This effect of negative emotions or stressful events has been extensively studied, and Ganley (1989) concludes in a review of this literature that emotional eating is associated with different emotions in different people and characterised by the intake of high calorie or high carbohydrate foods. However, Adriaanse, de Ridder and Evers (2011) conducted two studies in order to determine the extent to which self-reported emotional eating was a predictor of unhealthy snack consumption. These studies involved the use of a 7-day snack diary and results showed that snack consumption was not predicted by emotional eating but was more to do with the habit of snack eating and restraint. A third study was therefore conducted to assess whether emotional eating was a better predictor of concerns regarding eating behaviour. The results of this study led Adriaanse, de Ridder and Evers to conclude that emotional eating was indeed a significant predictor of increasing concerns about eating behaviour, and that emotional eating has more of a tendency to reflect beliefs about the relation between emotions and eating rather than actual emotional eating behaviour. They suggest that perhaps people who report more emotional eating have a tendency to experience more negative emotions and therefore over-interpret these feelings and incorrectly report that they eat more in these situations, therefore implying a biased perception of the frequency of the desire to eat when emotional.

Macht (2008) argues however, that food intake is only increased in certain groups of eaters. He argues that emotions will increase food intake in restrained eaters but not in non-restrained eaters. Restrained eaters attempt to control or lower their body weight by consciously restricting their food intake (Herman & Mack, 1975). Also, certain emotions may increase or decrease eating within the same group of individuals, that is, boredom may increase appetite in restrained eaters for example, but sadness may decrease appetite.

According to Schachter and Rodin (1974) a high degree of emotionality is considered to enhance reactions to external cues. Therefore a relationship between emotional and external eating would be expected, and probable that those who experience high levels of emotional eating will also experience high levels of external eating. Van Strien et al. (1985) provided support for this, demonstrating that a significant relationship existed between emotional eating and external eating in 80 female participants. It could be suggested that certain personality traits can predict both emotional and external eating behaviour. Heaven et al. (2001) investigated the extent to which two domains (Neuroticism and Conscientiousness) of the Big Five personality questionnaire were related to emotional and external eating. They concluded that emotional and external eaters are not particularly conscientious, which is predictive of their susceptibility to these types of eating.

In both psychosomatic and externality theory, a person's inability to recognise their internal states has been argued to be a causal factor in the development of obesity (Robbins & Fray, 1980). However, Rodin and Slochower (1976) have argued that a high degree of externality or emotional eating does not necessarily lead people to become overweight and that some people will compensate or try to correct their body weight through dieting regardless of whether they are emotional or external eaters. They therefore state that emotional and external eating can be found in people of all weights, and not just in those who are obese.

In summary, research has shown that emotional eaters consume more sweet, high fat foods in response to emotional states than non-emotional eaters (Oliver et al., 2000), and that this type of behaviour comes about as a means to cope with everyday negative emotions. Negative emotions have been extensively studied and it is clear from the results of such studies that these types of emotions lead to an increase in food intake. What is unclear however is to what extent differing levels of negative emotions may lead people to initiate eating, with mixed results of the effects of anxiety on eating demonstrated by various research (McKenna, 1972; Schachter, 1968; Stice et al., 2002; Van Strien et al., 1985; Wardle et al., 1992). Many studies of emotional eating have conducted their investigations on obese populations, and have found differences between this population and normal-weight controls, leading these researchers to conclude that obese people engage in more emotional eating than normal weight individuals. However, Allison and Heshka (1993) have argued that this may not be the case. It may be that people who are overweight or obese actually report more emotional eating than normal weight individuals because they are conforming to social expectations.

2.1.1.5 Stress

Within the area of emotional eating there is a subset of research on the effects of stress on eating. Stress is extremely difficult to define due to the fact that what one person considers stressful may not necessarily be so for another. However, it is generally assumed that this experience is the result of a person's perception that the demands of the environment exceed their available coping resources (Lazarus & Folkman, 1984). Stress has received a lot of attention in both field and laboratory research and is widely considered an influence on eating. As this area has received such a vast amount of attention, the scope of which is too detailed for this particular review, a general overview of how stress can affect eating and how it can lead people to start eating, will be described here.

Eating has been suggested to be a universal response to stress (Greeno & Wing, 1994) and as a coping mechanism that is brought about by stressors (conditions that trigger stress) (Solomon, 2001), with a significant amount of evidence to suggest that individuals may increase or decrease the amount they eat in response to stress. Kaplan and Kaplan (1957) suggest that stress leads to an increase in emotional eating as people fail to distinguish between anxiety and hunger, and respond to stress as if it were hunger. Although a large amount of research has demonstrated these findings, in that high levels of stress are associated with increased food intake, research has also shown that it is associated with decreased food consumption (Wardle et al., 2000). Specifically, restrained and emotional eaters tend to increase the amount of food intake, whilst unrestrained and non-emotional eaters tend to decrease their food consumption during times of stress (Wallis & Hetherington, 2004). The majority of the stress and eating research however, has relied heavily on laboratory stressors, which do not occur on a long-term basis and are also usually of low or moderate severity (Greeno & Wing, 1994). 'Life stressors' though, are potentially longer lasting.

Greeno and Wing (1994) conducted a review of the stress-eating literature in order to determine whether stress affects eating in the non-disordered eating population and suggested two general hypotheses. The first of these was termed a 'general effect hypothesis' and stated that stress changes the consumption of food generally, whilst the second was an individual difference hypothesis that argued stress leads to changes in eating only in particular groups of people (such as obese people or females). However, studies that provide support for the general effect hypothesis have primarily employed the use of animals, and studies supporting the individual differences hypothesis have primarily used female participants (Greeno & Wing, 1994; Solomon, 2001). Studies that have employed this second model have identified a number of key findings. They state that obese people are not more likely than normal weight people to eat in response to stress, that females may be more vulnerable than males, and finally that strict control of eating is a strong predictor of eating in response to stress (Solomon, 2001). This model posits that individual differences influence the level of vulnerability a person has for changes brought about by stressful situations, which causes an individual to start eating. Greeno and Wing conclude from their review that stress does affect eating in the non-disordered eating population and that there is strong evidence for individual differences in stress-induced eating (Greeno & Wing, 1994).

The notion of individual differences in stress-induced eating has received a lot of attention, and research suggests that there are a number of moderator variables affecting the stress-eating relationship. Conner et al. (1999) investigated the relationship between self-reports of daily hassles and the number of between-meal snacks consumed in 60 participants. Hassles are daily stressors, events, thoughts or situations that can produce negative feelings such as irritability, annoyance, worry or frustration. They occur more frequently than major life events and occur in most people. The participants in the Conner et al. study were required to keep a 7-day diary and report the number and severity of daily hassles as well as the number of snacks consumed. The researchers chose to examine the consumption of between-meal snacks as their measure of eating, as this form of eating has been commonly reported as a response to stress. Conner and colleagues found that the number of hassles experienced was significantly correlated with the number of snacks consumed.

Stress has also been shown to have an effect on externality and the amount and type of food consumed. According to Heatherton and Baumeister (1991), stress reduces internal cues to hunger and draws attention to external cues, therefore increasing levels of eating in external eaters. In an attempt to address this possible moderating relationship, Conner et al. (1999) (in their investigated of the association between self-reported daily hassles and the number of between-meal snacks consumed) found that externality was an important variable (amongst a large number of other variables) moderating the relationship between daily hassles and the number of snacks consumed. Those participants that were high on external eating showed a significant positive relationship between hassles and snacking, leading these researchers to conclude that external eating is important when examining the stress-eating relationship.

Another similar study looking at the effects of daily hassles on eating behaviour was that of O'Connor et al. (2008). O'Connor and colleagues examined the relationship between daily hassles and eating behaviour and its moderators. They found that daily hassles were associated with increased consumption of high fat/sugar snacks and with a reduction in main meal and vegetable consumption. This relationship was significantly stronger and more positive when assessed in people with high levels of restraint, emotional eating and external eating, and led the researchers to conclude that daily hassles are associated with an increase in unhealthy eating behaviour. Further support for the intake of certain types of food following bouts of stress comes from Grunberg and Straub (1992) who found that females were more likely to select foods high in calories and fat when stressed and from Steptoe et al. (1998) who found that increased consumption of fast foods was associated with a greater number of hassles. Also Oliver and Wardle (1999) found that stress was associated with increased consumption of high fat snack foods and decreased consumption of main meal-type foods and Wallis and Hetherington (2004) found that chocolate intake was enhanced in females when exposed to an ego-threatening Stroop task. These results demonstrate the potentially unhealthy eating behaviour of individuals exposed to stressful situations.

There is still inconsistent evidence to suggest what the key variables or contributors of the stress-eating relationship are. Studies such as that of Oliver et al. (2000) have demonstrated that emotional eating is important, whereas Conner et al. (1999) concluded that the most significant contributor was external eating. Early research in this area was focused on obesity as key in the stress-eating relationship, but even though researchers still believe this to be an important factor, evidence has shown that it may in fact be dieting rather than obesity that is more important. Baucom and Aiken (1981) found that in both obese and non-obese groups, stress only produced increased eating in a group of dieters. Whilst it appears that each of these variables are important contributors, the vast majority of studies conducted have been laboratory based or of cross-sectional design, and have focused solely on the use of females in their studies (O'Connor et al., 2008).

In summary, stress has been found to affect food consumption and people's decision to start eating when faced with a stressful situation, and does so by affecting both the amount of food consumed as well as the type of food chosen for consumption. Research that has identified the effects of stress on the type of food chosen have noted that people tend to choose high fat/sugar snacks when stressed, demonstrating the potentially unhealthy eating behaviour of individuals exposed to stressful situations, which will subsequently have implications for weight gain and potential health consequences.

2.1.1.6 'Automatic' eating

Automatic processes or responses are also known as 'habits'. According to Verplanken and Aarts (1999), habits can be defined as '...learned sequences of acts that have become automatic responses to specific cues, and are functional in obtaining goals or end states' (pg104) (as cited in Verplanken, 2005, pg100). Habits develop through practice and repetition. The amount of time spent practicing and the number of repetitions that are required for a habit to develop will vary, and it is possible that more complex behaviours such as learning to drive will take longer than more simple behaviours such as brushing your teeth in the morning. Habits also tend to occur as an immediate response to something specific that triggers behaviour without purposeful thinking and often without any sense of awareness, and can be difficult to control (Verplanken, 2005). Habits can become potentially damaging if they are undesirable behaviours, such as unhealthy eating or the use of drugs and alcohol. They can become problematic due to the frequency with which they occur, the fact that they occur automatically and without any conscious thought and finally that they are difficult to change (i.e. they are sustained by reinforcers) (Verplanken, 2005).

Research into addictive behaviours has investigated the role of automaticity, and how repeated practice of a task can lead it to become automatic. Tiffany (1990) claims that drug-use behaviour is automatic and proposed a cognitive theory of addictive or habitual behaviours, with specific reference to drug use, and asserted that these behaviours are largely controlled by 'automised action schemata'. That is, in specific relation to the example of drug use, these types of behaviours "tend to be relatively fast and efficient, readily enabled by particular stimulus configurations (i.e. stimulus bound), initiated and completed without intention, difficult to impede in the presence of triggering stimuli, effortless, and enacted in the absence of awareness" (Tiffany, 1990, pg 154). Tiffany claims that "the procedures for carrying out these skills are stored in memory in the form of automised action schemata or action plans" (Tiffany, 1990, pg 154). According to Tiffany, within these schemata adequate information (or cues) is stored that allows the individual to engage in the initiation and coordination of complex sequences of drug-use behaviour. This information includes the stimulus configurations necessary to elicit the behaviour, such as particular locations or emotions; the pre-action plans or goals involved (such as finding a vein) that allow the individual to carry out the specific behaviour; the coordination of specific actions into their appropriate sequences; alternative action sequences that the individual can carry out should their behaviour be blocked in any way or in the event of a minor obstacle; specific physiological responses that are associated with particular components of the action plan and finally the generation of physiological adjustments in anticipation of drug intake. Tiffany's theory suggests that drug use cues elicit urges and cravings in drug users that are not necessarily elicited unless the individuals' procedural behaviour is blocked. That is, the drug-use behaviour becomes so automatic through repetition that these individuals will only experience conscious urges and cravings if this automatic behaviour is prevented in some way, such as in those attempting abstinence.

Tiffany's theory of cue reactivity has been applied to eating behaviours (e.g., Fedoroff, Polivy & Herman, 1997; Green, Rogers & Elliman, 1999; Nederkoorn & Jansen, 2002; Overduin & Jansen, 1996; Sobik, Hutchison & Craighead, 2005), with evidence demonstrating that food-deprived participants exhibit high degrees of self-reported food cravings during the presentation of a food cue (Overduin & Jansen, 1996). It can be argued that if the automatic action schemata present in drug-users can be applied to eating behaviours and have similarities with drug addiction, we would expect to see an absence of awareness featuring in a large portion of eating episodes of participants (i.e. participants would report high levels of unawareness during eating). The literature available on habits would also suggest that eating is a behaviour that can become automatic through repetition and can occur without awareness. According to Aarts and Dijksterhuis (2000), habitual behaviours tend to occur without conscious awareness. An example of this comes from the two studies by Adriaanse, de Ridder and Evers (2011) mentioned in the discussion of emotional eating, who demonstrated that snack consumption was not predicted by emotional eating but was more to do with the habit of snack eating and restraint. With specific regard to the significant relationship found between snack consumption and habit strength, this provides support for the consumption of unhealthy snacks without conscious awareness. As Adriaanse et al. (2011) state, it follows that if this is indeed the case and that unhealthy snacking is a habitual behaviour that occurs without awareness, people may be unable to accurately report their eating behaviour, specifically when emotional in the case of this particular study.

An unawareness of eating can lead to both under- and over-estimation of food consumed. Wansink and Sobal (2007) investigated how aware people were of the food-related decisions they made and how the environment influenced those decisions. They demonstrated that people both underestimated the number of food-related decisions they made and ate more food after being given an exaggerated environmental cue (such as a large bowl). They concluded from these results that we are aware of only a fraction of the food decisions we make and that we are either unaware of how our environment influences these decisions or we are unwilling to acknowledge it. According to Wolkoff et al. (2011), episodes of loss of control over eating in children and adolescents (often characterized by the consumption of highly palatable dessert and snack-type foods) are associated with an unawareness of eating. Findings showed that compared to those without loss of control, children with loss of control were less accurate at reporting the percentage of energy intake from carbohydrates and their intake of desserts. They concluded that children with loss of control may have poorer recall of sweet food consumption and this poor recall may reflect a lack of awareness while eating this type of food.

To summarise, eating is a behaviour that can become automatic, or become a habit, through the process of daily repetition and can therefore occur without awareness. If Tiffany's concept of action schemata in his theory of cue reactivity (automaticity) can be applied to eating behaviour, it follows that this lack of awareness would be observed in a large number of eating episodes and that participants would report high levels of unawareness as to why they chose to initiate eating. Certainly Adriaanse et al. (2011) have shown that unhealthy snacking is a habitual behaviour that can occur without awareness. It could be suggested then, that the continued consumption of high-fat/sugar unhealthy snack foods in those that are overweight or obese may have become a habit and ultimately led to their current weight status. Therefore, we may expect to see a high level of reported unawareness when choosing to consume this type of food in those that are overweight or obese.

2.1.1.7 Summary of reasons for eating

A number of psychological factors have been identified as possible reasons for eating, the most common of which have been addressed in this literature review. Arguably, the most 'obvious' reason for eating is that of hunger, but as highlighted here, this is not always the case, and hunger has been shown to be less commonly reported as a reason for eating than other reasons such as environmental influences (Tuomisto et al., 1998). Social facilitation demonstrates the influence that the presence of others has on eating behaviour, insofar as the effect this has on the amount of food consumed, but does not go as far as to suggest why people choose to eat in these situations. This is an area of investigation that is lacking within the literature and therefore a factor that will aim to be addressed in this study.

External eating, or environmental influences, has also been shown to be an important reported reason for eating (Tuomisto et al., 1998). Despite this however, research is limited in this area, and therefore requires further investigation. The research that has been conducted has employed the use of overweight or obese participants only, and Rodin (1981) has argued that these findings have been difficult to replicate in normal weight participants. Research on overweight and obese participants has however demonstrated the influence of external or environmental triggers, suggesting that these individuals are very responsive to these cues.

People who engage in emotional eating do so in an attempt to alleviate the feelings associated with negative emotionally arousing situations. It provides the individual with a distraction and has been argued to be a learned form of avoidance in order to cope with these emotional situations. Research has shown that emotional eating can occur in people of all weights (Nguyen-Rodriguez, 2008), but has been argued to be more frequent in overweight or obese individuals (Kaplan and Kaplan, 1957). Findings have been mixed though and this could be to do with weight, sex or other variables such as personality traits, influencing responses to emotional eating. Importantly, emotional eaters engage in the consumption of high fat and sweet carbohydrate foods (e.g. Ganley, 1989; Oliver et al., 2000), which can ultimately lead to overweight or obesity. However, Adriaanse, de Ridder and Evers (2011) provided evidence to suggest that unhealthy snacking was not predicted by emotional eating, but that emotional eating rather predicted increasing concerns of eating behaviour, which subsequently brings about a perceived bias of the consumption of unhealthy snacks during emotional eating. Another reason for eating addressed in this review is that of stress. Stress and emotional eating are very closely linked in that they both influence the type of food chosen for consumption. In stressful situations people tend to choose high fat/sugar snacks, which again has consequences for overweight and obesity. According to Solomon (2001) obese people are more likely to eat in response to stress than those of normal weight and females are more vulnerable than males. One of the disadvantages of research on the effects of stress on eating is that the vast majority of studies are laboratory based or cross-sectional in nature, which is one of the factors that this study will aim to address.

The final reason for eating addressed here is that of 'automatic' eating or 'habit'. Research has applied the theory of cue reactivity (Tiffany, 1990) to eating behaviour, providing support for the role of automaticity and how these behaviours become 'automatic' or 'a habit'. The evidence is limited, but does go some way to suggest that as eating behaviour becomes more of a habit, people may become less aware of their decision to eat and subsequently their reasons for eating.

It is important to note that individuals could experience any of these behaviours or relate their reasons for eating to any of the factors mentioned above. People may have more than one reason for initiating eating, and it is possible that there may be a combination of these reasons or behaviours.

2.1.2 Frequencies of reasons for eating

As hunger has been shown to be less commonly reported as a reason for initiating eating than environmental reasons (Tuomisto et al., 1998), it is important to explore other reasons for eating and the frequency with which these occur, as they may have important implications for weight management interventions.

In their study of reasons for meal initiation with 76 female and 36 male obese participants, Tuomisto et al. (1998) converted the primary reasons for initiating eating into percentages in order to find the most common reasons amongst males and females. They placed each of the reasons into five main 'intuitive clusters' of reasons and found that time of day or habitual patterns were the most common reasons for the initiation of eating, which formed part of the cluster 'Environmental Events or Activities'. The remaining four clusters were named 'Hunger and Other Sensations', 'Social reasons', 'Reasons based on Self-Assessment and Cognitions' and 'Other Reasons'. Across the whole group 32.7% of eating occasions were started because it was 'mealtime' (Environmental Events or Activities), whilst 13.1% occurred because of regular lifestyle (Reasons based on Self-Assessment and Cognitions) and 20.9% due to hunger (Hunger and Other Sensations). Other cues such as fancying food (Hunger and Other Sensations) accounted for 8% of the eating occasions, and Tuomisto et al. report that several other occasions occurred because people saw, smelled or handled food (Environmental Events or Activities), or saw other people eating (Social Reasons). This research indicates that physiological cues are not the most common or important reason for eating, and highlights the varied range of reasons that exist. It also points towards the potential differences in reasons reported by males and females, with males reporting more environmental reasons, as well as bodily sensations and hunger than females, and females reporting more thoughts, cognitions and social reasons for initiating eating. For example, males reported eating for environmental reasons 38.9% of the time as compared to 30.1% of the time for females. The frequency of occurrence for reasons of hunger was 22.1% for males and 20.3% for females. Males reported thoughts 2.7% of the time whilst females reported this as a reason 3.4% of the time and finally females reported social reasons for eating including 'because they wanted to be with other people' or 'be polite' 2% of the time compared to 1.3% for males.

In a study of triggers of eating in everyday life, Tomiyama et al. (2009) asked participants to complete questions provided in a PDA diary when paged. These questions were related to hunger levels, whether the food they had eaten was a meal or snack, the number of servings consumed, the fat content and also their psychological state prior to the time of eating. Tomiyama and colleagues found that participants reported feeling hungry in 56% of the recorded eating episodes, but also reported feeling distracted 71.2% of the time, feeling anxiety 47.8% of the time, feeling some negative mood 54.2% and some positive mood 79% of the time (Tomiyama et al., 2009). However, these observations were in relation to restraint and reflected the importance of the role of hunger in the eating of restrained eaters only. In their study of *emotions* and eating in everyday life, Macht and Simons (2000) identified four clusters of emotional states that emerged from their cluster analysis of self-reported emotions of participants. 'Anger-Dominance accounted for 76% of the frequency of eating, 'Tension/Fear' 84%, 'Relaxation/Joy' 81% and emotionally neutral ('Unemotional State') 75%.

The little research that has been conducted within the area of reasons for eating has identified a range of different reasons that people report when choosing to initiate eating. These can vary from person to person as well as differ from one eating episode to the next, therefore highlighting the need for further research in this area. External reasons for eating have been shown to be important, as well as thoughts, cognitions, social reasons and emotions, in influencing people's decisions to eat.

2.1.3 Sex differences in reasons for eating

Although very little research has been carried out investigating whether any differences exist in the reasons given for eating between males and females, there have been suggestions that differences do in fact exist. To date, research on the factors described within this literature review have focused mainly on the use of females. Stereotyped beliefs exist in relation to what and how much males and females will consume (Vartanian et al., 2007), but as far as sex *differences* regarding perceived reasons for eating are concerned, the literature is particularly lacking in this area. There are however, suggestions within the literature that sex is an important potential moderator (O' Connor et al., 2008) and some differences have been suggested, which have been addressed in this review. Addressing these differences has further implications in terms of predicting the factors associated with reasons for eating as well as for the development of interventions. Research such as that of Tuomisto et al. (1998) points towards the potential differences in reasons reported by males and females, with males reporting more environmental reasons, as well as bodily sensations and hunger than females, and females reporting more thoughts, cognitions and social reasons for initiating eating.

Zylan (1996) conducted a study exploring sex differences in the reasons given for meal termination. She discovered that males tended to place importance on external factors when controlling their food intake, whilst females placed more emphasis on hedonic factors. From her results Zylan concludes that these differences in sex are important in informing future research in this area. She states that the results indicate that future research should include the examination of possible sex differences. However, these findings are specifically in relation to meal *termination* and research such as that of Mook and Votaw (1992) have found no sex differences at all when examining the reasons for meal termination. The discrepancy here could be a reflection of how extensive the lists of reasons were that were provided, but it could also be suggested that males and females differ more in the reasons for initiating rather than terminating eating.

Grogan et al. (1997) conducted a study of sex differences in the components of the Theory of Reasoned Action in relation to eating sweet snacks, as well as the role of those components in predicting sweet-snacking in males and females. They found that females were more ambivalent to eating sweet snacks than were males. They perceived these types of snacks to be less healthy but more pleasant than did males. Males and females did not differ in the amount of sweet snacks consumed, but females' intentions to eat sweet snacks were predicted by perceived social pressures and attitudes towards these snacks, while males' intentions were only predicted by attitudes. Studies such as these suggest that whether investigating the types of foods eaten or looking at attitudes to consuming various foods, differences in eating behaviour do exist between males and females. This may then suggest that differences could potentially exist in the reasons males and females give for eating and highlights the need for further research in this area.

The effect of social facilitation on eating behaviour also appears to differ between males and females. While testing the time-extension hypothesis as an explanation for the social facilitation effect, Pliner et al. (2006) found that males ate more than females when part of a group. Salvy et al. (2007) found that females appear to eat more when part of a couple, whilst males tend to eat more when with friends. Salvy, Jarrin et al. (2007) reported that males ate more with a same-sex friend than with a stranger (but this difference disappeared when participants were with their partner), and that females ate significantly less with opposite-sex strangers than with their partners.

Additionally, some of the literature has shown that people tend to match or model the amount eaten in a bid to convey a positive impression. Salvy, Jarrin et al. (2007) found that participants' sex had an effect on this phenomenon, in that matching only occurred when at least one female was present, suggesting that females are more likely than males to conform to their co-eaters' eating behaviour. However they suggested that the extent to which people do this is dependent on the characteristics of the eating companion. For example, Mori et al. (1987) and Pliner and Chaiken

(1990) found that both male and female participants ate less in the presence of a 'desirable' partner of the opposite sex than in the presence of a less desirable partner. Salvy, Jarrin et al. (2007) found that both the familiarity between eaters as well as their sex predicted the influence on food intake and consumption. Studies such as these demonstrate that only certain eating companions make people more eager to suppress their intake in order to convey a good impression and that sex can influence eating behaviour.

In terms of external eating, research into sex differences is sparse. Tuomisto et al. (1998) found that males revealed a greater tendency to start eating for environmental reasons than did females, but that females were more likely to *stop* eating for environmental reasons than males. They reported that the three main differences between males and females' reasons for initiating eating were 'mealtime', with males reporting this reason significantly more than females, *'I felt weak'*, which was reported only by females, and finally *'I fancied food'*, which was also selected more often by females than males. Further Chi-Square analysis demonstrated that environmental cues were more common for males than females.

Following the construction of the Dutch Eating Behaviour Questionnaire (DEBQ), as part of a validation study, Van Strien, Frijters, Bergers and Defares (1986) administered the final version of the questionnaire to overweight and normal weight male and female participants. Obese males and females achieved similar scores on external eating in the DEBQ, as did normal weight males and females. Similarly, Burton et al. (2007), when investigating the association between food cravings and emotional, external and restrained eating as measured by the DEBQ, found that there was no significant difference in external eating between normal weight males and females, as did Wardle (1987) in her validation of the DEBQ in normal weight males and females.

Sex is found to be correlated with emotional eating, with females reporting more emotional eating than males (Larsen et al., 2006), and according to Conner et al. (1999) there is a greater susceptibility for emotional eating in females than in males. In the Ede sample of participants who took part in the Van Strien et al. (1986) validation study of the DEBQ, obese and normal-weight females scored higher on the emotional eating scale than males. Similarly, Burton et al. (2007) found a significant difference in emotional eating between normal weight males and females, with females scoring higher, as did Wardle (1987). Larsen et al. (2006) found, in line with previous research, that females showed more emotional eating and depression than males did. They took their research a step further and investigated whether emotional eating was associated with alexithymia and whether sex differences existed in this potential relationship. Alexithymia involves a difficulty in identifying and describing subjective emotional feelings, and Larsen et al. found that this difficulty in identifying and describing feelings was more strongly associated with emotional eating in males than in females. These findings may provide an explanation for the differences observed in emotional eating between males and females, but also have implications for the development of sex-specific interventions.

A small number of studies have examined the role of sex in eating in response to stress and found differences in the amount of food as well as the type of food consumed. For example, Grunberg and Straub (1992) investigated whether there were any differences between males and females' vulnerability to stress induced eating. They found that unstressed males consumed significantly more food than any other group (i.e. stressed males, stressed females and unstressed females). They did also find however, that stressed females consumed twice as much sweet food as unstressed females, suggesting that the type of food is important. Pine (1985) also found that stress induced eating is more pronounced in obese and normal weight females than males. O'Connor et al. (2008) found when examining whether any relationships exist between daily hassles and eating behaviour, that daily hassles were indeed associated with the increased consumption of high fat/sugar snacks, but that the relationship was stronger and more positive in females than males.

Zellner et al. (2007) investigated the effect of stress on males' food choices. Participants were placed into one of two groups, namely the no-stress or the stress group, and were presented with four bowls of snack foods. Two of these bowls were healthy and two were unhealthy. They found that males in the no-stress group ate significantly more of the unhealthy snacks than the males in the stress group, providing contrastingly different results to those that have been found in females in previous research. Females tend to eat more healthy foods when not stressed and more unhealthy when stressed. Wardle et al. (2004) have reported that when not stressed, females report healthier food choices than males and Oliver and Wardle (1999) have reported that females are more likely than males to choose more sweets and chocolates than males when stressed. Zellner et al. report that their findings were not in line with the subjective reports given from their male participants. The participants reported that they snacked in response to stress on unhealthy foods such as fast food or high fat sweets such as cookies. This however was not the case and suggests that perhaps males lacked insight into the effects that stress have on their food choices. Stress therefore does not have the same effect on food choice in males and females.

2.1.4 Conclusions of Literature Review

2.1.4.1 Summary

Eating can be a source of conflict for individuals who are obese or overweight; therefore the processes involved in the initiation of eating are very important. Self-reported reasons for eating differ from the reasons for the termination of eating, with environmental cues being selected as the main reason for the initiation of eating, and the termination of eating being based on self-assessment and cognitions (Tuomisto et al., 1998). Although there is a paucity of information, overweight and obese individuals report a variety of different reasons for eating, and although very little research has been carried out investigating whether any sex differences exist, the reasons associated with eating appear to differ between males and females (O' Connor et al., 2008; Tuomisto et al., 1998), which highlights the need for further research in this area. Also, considering the effects that weight gain has on both the individual in terms of long term health (Allender & Rayner, 2007) and the economy in terms of sickness (Foresight, 2007), it is important to develop a more in-depth knowledge of the processes that lead males and females to eat. Knowledge about the relative presence of different reasons for eating will be beneficial for developing more informed interventions that are aimed at reducing overweight and obesity.

2.1.4.2 Addressing the gaps

Eating can be a source of conflict for individuals who are obese or overweight; therefore the processes involved in meal initiation are very important. Previous research has suggested that there are a variety of psychological and behavioural reasons why people choose to eat, not just because they are hungry; therefore it was important to explore additional reasons for eating and the frequency with which they occur, as they may have important implications for weight management interventions. To explore the issues addressed above, the present research is designed to assess participant's perceived reasons for initiating eating, with the additional aim of investigating differences between males and females. Also, importantly, people who are sensitive to the influence of, for example, emotional eating and stress, have demonstrated a tendency towards the selection of sweet, high-fat foods (e.g. Ganley, 1989; Oliver et al., 2000). Snack consumption has increased significantly in recent years (Zizza, Siega-Riz & Popkin, 2001) and given the contribution of sweet high-fat foods to overweight and obesity (Bes-Rastrollo et al., 2010), this has implications for weight gain and obesity. The current study therefore, will investigate these reasons in specific relation to the consumption of snack foods. Snacks are an important contributor to weight gain (Grogan et al., 1997) and may be a good target for intervention. Charles and Kerr (1986) reported that sweet snack foods are a source of conflict particularly for females, and Grogan et al. (1997) suggested that females' intended reasons for consuming sweet snacks would differ from males'. Grogan et al. (1997) found significant differences between male and females' predicted intentions to eat sweet snacks, with males intending to eat snacks more frequently than females providing justification for including this as an area of investigation.

The current study aimed to address two main questions. The first of these is what is the frequency with which overweight and obese males and females initiate eating for reasons other than hunger when it comes to (a) main meals, (b) healthy snacks and (c) unhealthy snacks? Considering the evidence presented (Tuomisto et al., 1998), and based on the 'intuitive clusters' presented by Tuomisto et al. (1998), the following predictions were made regarding frequency of reasons for eating:

1) External/environmental reasons for eating will be reported more frequently than any other reason.
2) There will be a high frequency of reported emotional reasons for eating (given that there is a strong relationship between emotional eating and external eating, e.g., Van Strien et al., 1985; Van Strien, et al., 1986; Van

Strien & Bergers, 1988, whereby a high degree of emotionality is considered to enhance reactions to external cues, e.g., Schachter & Rodin, 1974).

The second aim of the current study is to determine whether males and females report different reasons for initiating eating. Available studies point towards the potential differences in reasons reported by males and females, with males reporting more environmental reasons, as well as bodily sensations and hunger than females, and females reporting more thoughts, cognitions and social reasons for initiating eating (Tuomisto et al., 1998). Sex is also correlated with emotional eating, with females reporting more emotional eating than males (Conner et al., 1999; Larsen et al., 2006) and obese (Van Strien et al., 1986) and normal-weight females (Burton et al., 2007; Van Strien et al., 1986; Wardle, 1987) score higher on the DEBQ emotional eating scale than males. Stress-induced eating is more pronounced in obese and normal weight females than males (Grunberg & Straub, 1992; Pine, 1985) and leads females to consume more high fat/sugar foods than males or other unstressed females (Grunberg & Straub, 1992; O'Connor et al., 2008; Oliver & Wardle, 1999), with females reporting healthier food choices than males when not stressed (Wardle et al., 2004).

Based on the literature available on sex differences in reasons for eating presented here, the following predictions were made:

1) No significant sex differences in reported social influences for eating are predicted.
2) Males will report more external reasons for eating than females when eating main meals, healthy snacks and unhealthy snacks (Tuomisto et al., 1998).
3) Females will report more negative emotional reasons for eating main meals, healthy and unhealthy snacks (Burton et al., 2007; Conner et al., 1999; Larsen et al., 2006; Van Strien, 2002; Wardle, 1987). This will be particularly expected in relation to unhealthy snacks (Ganley, 1989; Lyman, 1982; Oliver et al., 2000).
4) No significant sex differences in reported 'automatic' eating are predicted.

No literature or evidence exists in terms of sex differences and food cue reactivity (i.e. 'automatic' eating), therefore without such evidence, it cannot be said that differences do or do not exist between males and females' unawareness of eating. Also, given that there is no literature indicating any sex differences in social influence on eating, no predictions of potential differences can be made.

The study employed a food diary, which participants were required to complete every time they ate for 5 days. To prevent recall-bias, participants were asked to record everything at the time of eating. Participants were required to provide background information and have their height and weight measured in order to determine BMI. The diary consisted of a number of closed format questions which related to the reasons why they were eating and they were asked to indicate their levels of hunger and mood. At the end of each day participants were also required to complete the Daily Hassles and Uplifts Scale (DeLongis, Folkman, & Lazarus, 1988). By including a section dealing with daily hassles in this diary, it was possible to address and identify a large number of occurrences of stress and determine whether snacking on high fat/sugar snacks is associated with stress, as found by Conner et al. (1999), O'Connor and O'Connor (2004) and O'Connor et al. (2008). It is likely that the type of food chosen in times of stress is important, as demonstrated by Grunberg and Straub (1992) who found that females were more likely to select foods high in calories and fat when stressed. After completing the 5-day diary participants were required to complete a number of questionnaires measuring a range of behaviours.

2.1.5 Measuring eating behaviour

Eating behaviour has been investigated in both the laboratory and under real-life, natural conditions. There are now several methods that are commonly used to measure people's eating behaviour. Some examples include 24-hour recalls, diet histories, questionnaires, and food diaries to name but a few (Schlundt, 1995). Laboratory studies tend to produce conflicting findings (Conner et al., 1999; O'Connor and O'Connor, 2004; O'Connor et al., 2008; Wallis & Hetherington, 2009), and the real-life technique of diary data collection has been argued to underestimate factors such as actual food intake. However, diary methodologies have been shown to be sensitive enough to detect very subtle influences in eating behaviour that may not otherwise be observed or demonstrated within the laboratory environment (de Castro, 2000). According to de Castro (2000), research into eating behaviour has failed to produce effective interventions for people who are overweight, with the problem lying in the overestimation and underestimation of the importance of certain factors that are drawn out of laboratory research. An example of a variable that greatly influences food intake in real-life settings provided by de Castro is that of food cost, which is a variable that is often missing in the laboratory environment (de Castro, 2000). This, argues de Castro, is to do with the high degree of control that is exerted over participants within the laboratory, with the research eliminating certain variables that may actually be an important influence on the outcome of results. Ecological Momentary Assessment (EMA), used predominantly within substance use and misuse research (e.g., Buckner et al., 2012; Marhe et al., 2013; Piasecki et al., 2011; Serre et al., 2012; Shrier et al., 2013), is a methodology designed to help researchers obtain ecologically valid data about behaviour while avoiding the difficulties presented by laboratory research, such as retrospective recall. It is a diary-based method, which involves the repeated administration of assessments at particular times of the day (that are relevant to the phenomenon being studied) (Moore et al., 2013) and occurs within the individuals' natural environment (i.e. within real-life settings). Particular times of the day can be chosen because they represent areas of interest (e.g., eating episodes throughout the individuals' day), or they may be chosen at random, in order to gain a representative sample of a person's day. The use of EMA methods within the substance use literature have been successful at helping to demonstrate the processes that are involved in drug use and relapse (Shiffman, 2009). According to Shiffman (2009), the detailed data and analyses brought about by the repeated assessments of EMA would not have been possible without employing this form of methodology. Although diary studies are criticised for their lack of degree of control, similar to EMA, this type of research allows a wide variety of complex behaviours to be assessed that may be reflective of the participants' typical behaviour, and which may not occur within laboratory conditions.

2.1.5.1 Diary methodology

Repeated observations using diaries and recalls can be used to measure the variability in an individual's eating behaviour (Schlundt, 1995). Food intake involves much more than simply an individual's average intake of calories; it involves a variety of behaviours that contribute to each eating episode. Food intake is also dependent upon time of day, context, social setting and mood amongst a variety of other factors. It is the use of a food diary that allows the researcher to address each and every aspect of a person's eating behaviour.

The use of food diaries is a way of noting down what and how much has been consumed, as well as a number of other details such as where food was consumed. These details should preferably be recorded straight away, as the food is eaten, or immediately afterwards (Schlundt, 1995) in order to avoid such difficulties as memory/recall bias. The difficulties with diaries however, include inaccuracies or missing information, with participants forgetting to complete the diary until the end of the day or perhaps failing to record certain eating episodes or even certain foods. However, the use of self-report diaries is unavoidable in certain areas of research. For example, exploratory research investigating areas such as social context or emotional eating would require the use of such methods as there is no appropriate alternative (Schlundt, 1995). Questionnaires can be used as an alternative to diaries in certain contexts, but as these are used as a way of measuring specific eating behaviours they would not be appropriate as the sole means of data collection in exploratory research. A combination of the use of both diaries and questionnaires would be the most useful.

An inability to ensure the participant follows the correct guidelines for completing the diary and difficulties controlling for the affect that keeping a diary may have on the participants' behaviour are potential difficulties. A participant may be more aware of their food choices through the process of completing a diary, and may therefore deviate from their normal choices. They may also omit or only include certain information, wishing to portray a socially acceptable image to the researchers (Schlundt, 1995). Additional difficulties include carrying the diary around and also trying to complete the relevant sections if in a social context, for example having a meal with friends or family. These difficulties all contribute to the potentially intrusive nature of a diary.

These various difficulties involved in the use of diary self-monitoring techniques have made some researchers question the consistency and reliability of the data derived from such methods, but as Schlundt (1995) points out, if diaries are designed carefully and appropriately, and participants are properly trained and motivated, accurate self-monitoring is possible. Also, despite each of the limitations, participants who keep diaries record each and every aspect of their food intake and the behaviours that occur during eating episodes and the information gained from this method of data collection has occurred in a natural environment (Tomiyama et al., 2009). Studies such as that conducted by Gersovitz et al. (1978) have shown a high degree of validity when tested empirically. They asked participants to keep a 7-day diary of the amount of food consumed, while the researchers secretly measured the actual amount of food the participants consumed during lunch. They found good agreement between the amount of food recorded by participants in the diary and the actual amount of food consumed.

Tuomisto et al. (1998) note that the use of diaries only reveals people's attributions; however, in their investigation of reasons for eating using a 24-hour diary, in which participants were required to choose the main reason for starting and stopping an eating episode, the accuracy of this self-reported data was improved through requiring participants to complete the diary at the time of eating. These diaries also included visual analogue scales for participants to record their mood prior to and immediately following food consumption.

To summarise, the lack of control in diary studies does present problems, potentially making the identification of causal factors or salient variables difficult. However, the use of diaries allows the participants to record what foods are eaten each day without limitations, and also avoids the problems associated with retrospective reporting. This type of methodology, in the same way as EMA, is also ecologically valid in that the data recorded within a diary reflects the actual behaviours that take place within a natural setting. The lack of control that is exerted over participants taking place in a diary study allows for more flexible generalisation of this behaviour within a real-life setting. It is clear from the evidence provided that there are a number of varied reasons why people choose to eat. As demonstrated by Tuomisto et al. (1998), these patterns can vary from person to person and even within individuals, therefore highlighting the importance of identifying the most common reasons for eating. By employing a self-report diary methodology, participants can record their day-to-day reasons for eating that are influenced by everyday life, without constraints or controls over their natural environment. The current study aims to investigate this within a naturalistic setting in order to determine the most common, or typical, reasons for eating other than hunger, for which a diary study would be most appropriate.

Given that there is some complexity behind the reasons why people choose to eat, it is somewhat surprising that research is very limited in this area and that there are no measures to assess the reasons why people eat. In 1994, Allison conducted a review of all measures and inventories that were related to eating behaviours and disorders and found that none of the 100 plus reviewed measured the motivation to eat. A small number of questionnaires included one or two scales that assessed emotional motivations to eat (i.e. The Emotional Eating Scale by Arnow et al., 1992 and the Dutch Eating Behaviour Questionnaire by van Strien et al., 1986) and disinhibition of control as a reason for eating (i.e. the Three Factor Eating Inventory by Stunkard & Messick, 1985), but as concluded by Jackson et al. (2003), although "...there are scales related to psychological motivations to eat, none are theoretically derived for measuring exclusively a range of motivations to initiate eating" (Jackson et al., 2003, pg 298). Since these reasons could be very important for the development of interventions aimed at reducing overweight and obesity, it is critical that further research is conducted in order to provide more insight to the most appropriate factors that would benefit the development of these interventions.

Furthermore, it is surprising that although research has been conducted into each of the individual factors mentioned in this review, these have been investigated in isolation and no research aside from that of Tuomisto et al. have investigated all of these factors in relation to non-disordered eating in a natural setting. Jackson et al. (2003) validated a measure of psychological motivations to eat that was based on a model of motivations to consume alcohol and analyses demonstrated that this model was important for understanding eating behaviours, however this research was in relation to disordered eating, particularly restrictive eating, bingeing and purging. Furthermore, no research (apart from Tuomisto et al.) has examined potential gender differences, again within a natural environment. The current study was conducted with a view to contribute further to this important area of research and expand upon the work of Tuomisto et al. in four ways:

1) A 5-day food diary was employed covering three week days and both weekend days in order to gain a more representative view of a person's week, as opposed to the 24 hour diary that Tuomisto et al. (1998) gave to their participants.
2) Participants in the current study were not part of any 'formal' weight control programme as they were in the Tuomisto et al. study. Whilst the study did not exclude anyone who was currently dieting, there were no controls or restrictions placed on what participants chose to eat and they were not under the influence of any therapeutic advice. Participants were free to continue on their current eating plan and follow as 'normal' a routine as they would in their own natural environment, as it could be suggested that people may give different reasons for eating if they are following a strict weight control programme.
3) This study also included emotional-type reasons for initiating eating, which were not included by Tuomisto et al. (1998).
4) Foods in the current study were categorised into 'healthy versus unhealthy'. Specifically foods were coded into main meals, healthy and unhealthy snacks in order to address the consumption of foods that may be attributable to weight gain and therefore would have implications for weight interventions.

2.2 Pilot Study

The aim of the first study was to employ a diary methodology in order to determine the frequency with which males and females eat for reasons other than hunger when it comes to (a) main meals, (b) healthy snacks and (c) unhealthy snacks, and to examine whether males and females report different reasons for eating. However, prior to developing the diary materials it was considered important to gain open-ended responses from participants with regards to their reasons for eating to ensure that subsequent categories provided to participants were ecologically valid. A pilot study was therefore conducted, with the aim of exploring people's perceived reasons for eating.

2.2.1 Method

2.2.1.1 Participants

A total of 23 participants were recruited, 15 female and 8 male. These included 17 undergraduate students, 3 postgraduate students, and 3 members of staff. Undergraduate students were recruited via the Electronic Management System (EMS) at Swansea University Psychology Department, and remaining participants were recruited via word of mouth. Undergraduate students received six course credits for taking part, and the postgraduates and staff volunteered for the study. Inclusion criteria were English as a first language and aged 18 or over. The mean age of the sample was 22.43 years (SD = 4.78, range 18-35).

The mean BMI of the sample was 23.20 (SD = 2.29, range 19.3-29). Eight females were attempting to lose weight (35%), and the strategies they employed to lose weight consisted of exercising, eating less, eating more healthily, counting calories and not snacking between meals. All participants were informed of the nature of the study and provided written consent. The study was approved by the ethics committee at Swansea University's Psychology Department.

2.2.1.2 Procedure

Participants were asked to visit the Psychology Department in order to answer a small number of pre-study questions, which included age, sex, self reported height and weight, whether they were dieting and if so what strategies they were employing (See Appendix A). They were then required to complete the food diary for a period of one day. In the diary they were required to record what, when and why they ate, and why they did not stop eating sooner than they did (See Appendix B). Participants were required to do this every time they ate (for all main meals and snacks). Fourteen participants completed the diary on a weekday (61%) and the remaining 9 participants completed it on a weekend day (39%).

After completion of the diary participants were required to return to the Psychology Department where they were also asked a number of open-ended post-study questions. These included whether they had any difficulties with the diary, whether they understood the questions and instructions, how they found the layout of the diary, whether they were able to fit the task into their schedule and carry the diary with them throughout the day, and how many consecutive days they felt future participants would be willing to complete the diary for (See Appendix C). The aim of these questions was to inform the development of the diary for the main study.

2.2.1.3 Diary

The diary (See Appendix B) consisted of a small number of questions to be completed each time the participant ate something. These questions related to a) time of day, b) what was eaten, c) the time they started eating, d) the time they finished eating, e) where they were when eating, f) reasons for initiating eating, and g) reasons for not stopping sooner than they did. Since participants were required to complete these questions each time they ate something, they were repeated a total of 15 times. At the end of the day participants were also asked to recall the type and total number of drinks consumed throughout the day, as well as complete brief questions on the type of physical activity they engaged in during a typical 7-day week.

2.2.2 Reasons for Eating: Results and Discussion

The total number of eating episodes was 106. The mean number of eating episodes reported per participant was 4.61 (SD = 1.34, range 3-7), with a mean of 4.47 for females (SD = 1.06, range 3-6) and of 4.88 for males (SD = 1.73, range 2-7). All participants ate at least two main meals, and 19 out of 23 (83%) participants (13 female, 6 male) had at least one in-between meal snack. Of all eating episodes 66% took place at home, whilst 9% took place outdoors (walking to university, garden, etc), 5% took place at a café/restaurant/canteen, 11% took place at work, and 9% took place at a friend/boyfriend/girlfriend/parents house. A number of additional questions included in the diary addressed overeating, but these results are not included here.

2.2.2.1 Themes

A total of 173 reasons for eating were provided by participants, many of which were repeated throughout. However, it was not possible to devise discrete categories to code participants' reasons for eating as in many instances participants' responses were ambiguous with respect to several possible reasons. As a result a looser, more thematic approach was taken whereby reoccurring themes were identified and approximate numbers of responses corresponding to each theme calculated. Table 2.1 displays the themes identified for reasons for eating as well as how many times each of those themes occurred and approximate proportion of each theme as a percentage of the total number of eating episodes.

Theme	Examples	Frequency of Occurrence
Hunger	I was hungry; I was very hungry.	75 (71%)
Time of Day	It was lunchtime; Time of day.	17 (16%)
Routine	Probably routine more than anything; Part of routine first thing in the morning.	13 (12%)
Fuel/Prevent Hunger	Knew I was going to be exercising within two hours of eating and would need the fuel; The need to eat before my 2 hour lecture at 3, to prevent being too hungry and/or ill in the lecture.	11 (10%)
Sociability	Being sociable because I had come home to visit my family and boyfriend; To be social with my friends.	9 (8%)
Boredom	Probably because I'm bored; Mainly because I was bored.	7 (7%)
Convenience/Obligation	Convenience for partner; My parents had prepared it so felt obliged to eat it.	6 (6%)
Temptation	Saw an ice cream and fancied it; I saw an advert for chocolate on the television.	6 (6%)
Use up Food	It was in the fridge to be finished; I had made a lot of pasta earlier so wanted to eat the rest of it.	2 (2%)
Other	I needed a break; I wanted to eat on the Swansea to London train but there was someone sitting next to me and I felt uncomfortable, so waited until I was on this train.	29 (27%)

Table 2.1 Frequency of reasons given for eating and approximate proportion of reasons as a percentage of total eating episodes.

Nine themes were created from the responses given, with the most frequent of these being hunger, accounting for 71% of all eating episodes. Only one theme relating to emotional eating was observed, which was labelled boredom, and similarly one theme relating to external eating, labelled temptation.

Boredom (emotional eating) occurred as a reason for eating in 7% (seven occurrences) of eating episodes, and temptation (external eating) occurred as a reason in 6% (six occurrences) of episodes. Of the seven occurrences of boredom, five took place at the participants' home, and two at work. Six of these occurrences were reported by 5 females (four occurrences at home and two at work), two of which were dieters. Three out of the six occurrences where temptation was stated as the reason for eating took place at the participants' home, one at a friend's house, one at a bus stop and one at a coffee shop. All six episodes of temptation were reported by 4 females, two of which were dieters.

One of the main findings was the relative infrequency with which participants reported eating for emotional and external reasons relative to other reasons such as hunger or routine. This may be due to a lack of insight on the part of participants with regards to their reasons for eating, which will be addressed by the closed question format of the main study and the use of mood scales. It may also be due to the particular sample employed, which consisted of mainly normal weight and not dieting participants. It may be that emotional and external eating occur more frequently amongst very overweight individuals and/or those who are attempting to lose weight. An additional important finding is that the only emotion provided was boredom, and that no one reported eating in response to stress or feeling down for example. This is particularly surprising given that the study was conducted during exam time which can be a period of great stress and emotional instability. Again this may be due to a lack of insight on the part of participants or to the characteristics of the sample employed.

2.2.3 Post-Study Interview: Results and Discussion

The pilot diary was developed to gain open-ended responses from participants with regards to their reasons for eating to ensure that subsequent categories provided to participants were ecologically valid. However, it came to light during the post-study interview, and also in some responses given by participants, that there was a lack of insight with regards reasons for eating. Participants appeared to have difficulty identifying the triggers that had influenced them to eat. For example, when asked 'What prompted you to eat?' a number of participants provided multiple answers, saying that they were hungry but also that they had seen others eating, which could imply that participants were uncertain of their reasons for eating/overeating. The main study attempts to address this issue by providing participants with tick box categories, which are based on those reasons provided in this pilot study as well as those identified in previous research. It also includes a series of mood scales to assess participants' emotional states immediately prior to eating.

In terms of layout, structure, fitting the diary into participants' daily schedule and carrying the diary around, participants had no difficulty. It was suggested that the diary be in A5 format to make it easier to carry around throughout the day, but otherwise participants found the diary easy to use and follow, and fit into their daily schedule. Participants had no difficulty understanding the instructions they were given, and aside from the question relating to overeating, they were able to follow all other questions. Participants suggested that others may be willing to complete the diary for between 3 and 5 days, including one weekend day.

2.2.4 Main Observations

The main finding is the relative infrequency with which participants reported eating for emotional and external reasons relative to other reasons such as hunger or routine. This may be due to a lack of insight on the part of participants with regards to their reasons for eating, which should in part be addressed by the closed question format of the main study. It may have also occurred due to the particular sample employed, which consisted of mainly normal weight and not dieting participants. An additional important finding is that the only emotion provided was boredom, and that no one reported eating in response to stress or feeling down for example, especially during exam time which can be a period of great stress and emotional instability.

2.3 Study 1 Method

2.3.1 Participants

Sixty participants took part in the current study (30 male; 30 female). The ages of participants ranged from 25 to 65 (M=41.72, SD=11.09). The sample had a mean BMI of 29.11 (SD=3.44; range=25.08 to 41.33), and 21 participants (6 male and 15 female) were attempting to lose weight (35%). Participants were recruited from staff and postgraduates at Swansea University and staff at Bridgend College south Wales, via email and advertisement posters and flyers. As incentive to take part participants were entered into a prize draw to win £100 in High Street vouchers, and offered the opportunity to receive an 'eating behaviour profile', which gave a brief summary of the individual data they provided. An email was sent out to all staff and postgraduates of the University that contained details of the research and provided a link to the study advertisement. The link also contained details of the financial incentive and eating profile provided to participants.

Inclusion criteria were age 25 and over, English as first language, and a BMI of 25 and over (i.e. overweight or obese). Exclusion criteria were existing medical or physical conditions that affected what the participant ate and pregnancy. Participants provided informed consent and the study was approved by the ethics committee at Swansea University's Psychology Department.

2.3.2 Measures and Procedure

The study employed a food diary, which participants were required to complete every time they ate for 5 days (three weekdays and two weekend days). Half of the participants were required to complete the diary on Saturday to Wednesday, and the other half on Wednesday to Sunday.

Participants initially attended the Social Psychology Laboratory where they were given a background questionnaire that enquired about participants' date of birth, sex, occupation, highest level of education, whether they had dieted in the last year (and if so how many times), whether they were currently dieting (and if so for how long and how much weight they had lost) (See Appendix D). Participants then had their height measured using the SECA Portable Leicester Height Measure and their weight using the Weight Watchers Heavy Duty Precision Electronic Weighing Scale, model number 8967U, in order to determine BMI. Participants were then given full details of the diary, which included information on what the participant was required to do, what details they needed to include in each section, when they should fill in the details, to also include snacks and drinks in the diary, what to do if they were unable to fill in the diary at the time of eating, what to do if they missed a meal, how to complete the *End of Day* section, what they needed to do once they had completed the diary and finally what would happen with the information they provide (See Appendix E). A date was then arranged for participants to return to the Psychology Department for debrief and to return the diary, and to complete the questionnaires.

The diary consisted of a number of closed format questions which related to the reasons why people eat. Initial questions for each eating episode enquired about a) time of day, b) the time they started eating, c) the time they finished eating, d) where they were when eating, e) what was eaten, and f) the type of eating episode (e.g. breakfast). A visual analogue scale was then provided for participants to indicate how hungry they were prior to eating, and asked subsequent questions relating to their mood at this time. The latter were 15 adjectives from three mood states (depression, fatigue and tension), extracted from the Profile of Mood States (POMS) Brief Questionnaire. All items related to negative emotions. Items were rated on a 5-point scale where *1=not at all* and *5=extremely* (McNair, Lorr, Heuchert, and Droppleman, 2003).

Closed format questions then asked participants to provide reasons for initiating eating. Participants were provided with 13 reasons for eating and were required to rate the extent to which they agreed or disagreed with each of the reasons provided. Items were rated on a 5-point scale where *1=Disagree a lot* and *5=Agree a lot.* These reasons were devised from the results of the pilot study, as well as from background information identified in previous research (e.g., Geliebter and Aversa, 2003; Mela, 2001; Nguyen-Rodriguez et al., 2008; Spoor et al., 2007; Tomiyama, Mann and Comer, 2009; Tuomisto et al., 1998; Young et al., 2009). Examples of reasons for initiating eating included *'I decided to eat because I was hungry', 'I decided to eat because the food looked / smelt so tempting', 'I decided to eat because I was feeling fed up', 'I decided to eat because I was bored', 'I decided to eat because I was stressed', 'I decided to eat because I felt obliged to',* and *'I don't* *recall deciding to eat – I just found myself eating'* (See Appendix F for full list of reasons). Finally, participants were again provided with a visual analogue scale to indicate how full they were after eating and also asked about their mood following eating. The latter were the same as those used previously. As participants were required to complete these questions every time they ate something, each set of questions were repeated a total of eight times for each of the five days. A number of additional questions included in the diary also related to overeating but these data are not included here.

At the end of each day, participants were asked to recall the type and total number of drinks consumed throughout the day (including alcoholic drinks), and were asked to indicate their reasons for consuming this alcohol. Participants were provided with 15 reasons for consuming alcohol, and were required to rate the extent to which they agreed or disagreed with each of the reasons provided. Items were rated on a 5-point scale where *1=Disagree a lot* and *5=Agree a lot.* These reasons were devised from information identified in previous research (Kuntsche et al., 2005; McCarty & Kaye, 1984; Abbey, Smith & Scott, 1993; Cooper et al., 1992; Cooper et al., 1995). Examples of reasons for drinking alcohol included *'I decided to drink alcohol because I was thirsty', 'I decided to drink alcohol because it looked so tempting', 'I decided to drink alcohol because I was fed up', 'I decided to drink alcohol because I was stressed', 'I decided to drink alcohol to enjoy the taste or add to the enjoyment of a meal',* and *'I decided to drink alcohol to increase my confidence'* (See Appendix G for a full list of reasons). Again, these data are not included here. Finally, the Daily Hassles and Uplifts Scale (DeLongis, Folkman, & Lazarus, 1988) was included, which measured participants' attitudes towards daily situations defined as 'hassles' or 'uplifts'. Participants were asked to rate on a 4-point scale where *0=none/not applicable* and *3=a great deal*, how much of a hassle or an uplift items or events were during their normal daily routine. Items on this scale relate to family, work, money, health and social matters.

After completing the 5-day diary participants were then required to return to the Psychology Department to return the diary and to complete a number of questionnaires. Questionnaires that were given to participants after completion of the diary were the Dutch Eating Behaviour Questionnaire (DEBQ) (Van Strien, 2002), the Perceived Stress Scale (PSS) (Cohen, Kamarck, Mermelstein, 1983), the Godin Leisure-Time Exercise Questionnaire (Godin and Shephard, 1985), the Eating Disorder Examination Questionnaire (EDE-Q) (Fairburn and Cooper, 1993), the Food Cravings-Trait Questionnaire (Cepeda-Benito et al., 2000) and finally the Binge Eating Scale (Gormally, Black, Daston and Rardin, 1982). Each of these questionnaires is described below. Participants were fully debriefed and provided with debrief forms and details of staff and student counselling services should any issues have arisen from taking part in this study.

2.3.2.1 Dutch Eating Behaviour Questionnaire (DEBQ)

The DEBQ (Van Strien, 2002) is an assessment of an individual's structure of eating, or eating type. It consists of three separate scales that assess emotional eating (13 items), external eating (10 items) and restrained eating (10 items). The emotional eating scale assesses eating in response to emotions, the external eating scale measures eating in response to external food cues such as the sight and smell of food, and restrained eating examines the cognitively mediated attempt to resist urges and limit food intake in an effort to control body weight. These three eating types are based on three theories of overeating. Psychosomatic theory and externality theory attribute weight gain and obesity to overeating, whilst restraint theory attributes overeating and weight gain to dieting.

The DEBQ questionnaire is quick and easy to administer, taking approximately 10 minutes to complete, and has high internal consistency and factorial validity (Van Strien, Schippers & Cox, 1995). Raw scores are obtained by summing the scores on each of the three independent scales and then dividing them by the number of items to give a mean score for each of the three factors.

2.3.2.2 Perceived Stress Scale (PSS)

The PSS (Cohen, Kamarck and Mermelstein, 1983) is the most widely used instrument for measuring the perception of stress. It is used as a more general measure of perceived stress in relation to current, objective events over the past month and so measures the degree to which situations in a person's life are appraised as stressful over that particular period. The PSS was designed for use with community samples, and has good established reliability and validity (Cohen, Kamarck & Mermelstein, 1983). The items are easy to understand and the questions are quite general in nature. There are three versions of the PSS (14-, 10- and 4-item versions), and the version used for this particular study was the 14-item scale. The scores for this version are obtained by reversing the scores on the 7 positive items (items 4, 5, 6, 7, 9, 10 and 13) (e.g. 0=4, 1=3, 2=2, 1=4), and then summing the scores on all 14 items of the questionnaire.

2.3.2.3 Godin Leisure-Time Exercise Questionnaire (GLTEQ)

The GLTEQ (Godin and Shephard, 1985) was devised as a simple questionnaire to measure a person's leisure time exercise over a typical week. It was designed to be a reliable and valid measure that could be completed very quickly and easily, and without any need for a more detailed or in-depth analysis of levels of exercise. The GLTEQ assesses the frequency, on average, that a person engages in strenuous, moderate and mild levels of exercise for durations of greater than 15 minutes over the week prior to completing the questionnaire. The questionnaire is scored by obtaining a MET (metabolic equivalent) score. This is obtained by multiplying the estimated rate of energy expenditure for each level of activity by the actual reported frequency of engagement in each of the three levels of activity. Therefore, strenuous exercise is multiplied by 9, moderate by 5, and mild by 3, and then the total leisure time activity is calculated by summing these three activity levels (Carron, Hausenblas and Estabrooks, 2003).

2.3.2.4 Eating Disorder Examination Questionnaire (EDE-Q)

The EDE-Q (Fairburn and Cooper, 1993) is a self-report version of the Eating Disorder Examination, which was used in this study to screen for eating disordered behaviour. It allows the researcher to gain information on key behavioural features of eating disorders in terms of the number of episodes of the behaviour and also the number of days on which the behaviour occurred. It is measured on 4 sub-scales, which are *Restraint, Eating Concern, Shape Concern* and *Weight Concern*. To obtain the individual sub-scale scores, the ratings for the relevant items for each of the sub-scales are summed and then divided by the number of items forming that particular sub-scale. To then obtain an overall (or 'global') score, the 4 sub-scale scores are summed and divided by the number of sub-scales (i.e. four). These sub-scale scores can then be reported as means and standard deviations.

2.3.2.5 Food Cravings-Trait Questionnaire (FCQ-T)

The FCQ-T (Cepeda-Benito et al., 2000) was used to assess food cravings. This self-report measure of food cravings assesses how cravings are typically manifested in any given individual in either a clinical or non-clinical population and has good internal consistency and construct validity and excellent test-retest reliability (Cepeda-Benito et al., 2000). It measures the intention to consume food, the anticipation of positive reinforcement gained from eating, the anticipation of relief from negative states and feelings following food consumption, lack of control over eating, thoughts or preoccupation with food and emotions experienced before and after eating. Participants completing this questionnaire are required to rate the extent to which each of the items provided are generally true for them. Each of the 21 items are rated on a 6-point scale where *1=Never/Not Applicable* and *6=Always.*

2.3.2.6 Binge Eating Scale (BES)

The BES (Gormally, Black, Daston and Rardin, 1982) was developed to assess binge eating behaviour indicative of an eating disorder amongst overweight and obese persons. It was used in this particular study as a screening tool to assess behavioural manifestations and feelings or cognitions surrounding a binge episode in order to exclude those participants who may exhibit binge eating disordered behaviour. The questions are based on behavioural characteristics, such as the amount of food eaten, as well as emotional characteristics, such as guilt or shame. The questionnaire is scored by summing each of the 16 items and the interpretation is based on three levels. Scores of less than 17 indicate non-binging behaviour, scores of 18-26 reflect moderate binging, and scores of 27 and above indicate severe binging behaviour.

2.4 Study 1 Results

2.4.1 Overview

Sixty participants took part in this study; however 4 participants failed to return their diary. Of the 56 participants who returned their diaries, 55 recorded eating episodes on all 5 days of the food diary. One participant failed to complete a full day of the diary (day 5), but was still included in the analysis. Another participant failed to provide a full account of all the foods that were eaten on each day over the 5 days. Upon returning the diary this participant verbally reported that he had failed to record all of the meals and snacks eaten on each of the days, therefore not providing a full and accurate account of foods eaten on all days of the diary. He reported that this was due either to not having access to the diary at the time of eating or because he simply forgot. As such he was excluded from the analysis. Therefore a total of 55 participants were included in the analysis, and a total of 1084 episodes were recorded across these 55 participants. Across these 1084 eating occasions, in 23% participants recorded details immediately, in 9% they recorded them within the first 5 minutes, in 22% within 30 minutes, in 10% within 1 hour, and in 18% over 1 hour. Across the 1084 episodes, in 18% participants failed to record any times.

2.4.2 Categorisation of snacks

In the diary participants provided information about exactly what foods were eaten in as much detail as possible. It was deemed necessary to develop a coding scheme for these foods, in order to determine the type that was consumed. The foods were therefore coded into those that were low/medium in fat and sugar, high in fat only, high in sugar only, or high in both fat and sugar. It was considered appropriate to code only snacks as opposed to all meals (i.e. breakfast, lunch and dinner), due to the difficulty involved in coding a whole meal. Whole meals could include both healthy and unhealthy items of food, thereby making it difficult to code those entire episodes as either healthy or unhealthy. In addition, Grogan et al. (1997) found significant differences between male and females' predicted intentions to eat sweet snacks and suggested that females' intended reasons for consuming sweet snacks would differ from males', therefore providing further justification for including this as an area of investigation. Unhealthy snacks (i.e. those high in sugar, fat or both) are also an important contributor to weight gain (Grogan et al., 1997) and may be a good target for intervention.

Snacks were coded using McCance and Widdowson's The Composition of Foods (Food Standards Agency, 2002). This is a widely acknowledged key reference tool for the nutritional value of foods commonly consumed in the UK. It contains food composition tables that provide information on the protein, fat, carbohydrate, starch, sugar, dietary fibre, energy (kcal and kJ), fatty acid, cholesterol and vitamin content of a large number of fresh and manufactured foods. All nutrient values of foods are expressed per 100g edible portion.

To code the snacks for this study, each individual food item was located in the food composition tables and a note of their level of fats and sugars per 100g made in an excel database. The food items were then coded as low/medium in fat and sugar (coded as 0), high in fat (1), high in sugar (2) or high in both fat and sugar (3) based on the Food Standards Agency's (FSA) criteria for low/high fats/sugars. According to the FSA (http://www.eatwell.gov.uk/), foods high in fat are those that contain more than 20g of fat per 100g, and those that are low contain 3g or less per 100g. Foods that are high in sugar contain more than 15g of sugar per 100g, and those low contain 5g or less per 100g. Anything that falls in between these values is classed as a medium level of sugar and fat.

For those food items that could not be located in McCance and Widdowson's food atlas, an additional online source was used. Nutrition Data is an online source of nutritional data that was launched in 2003 (http://nutritiondata.self.com/). The information in the database comes from the United States Department of Agriculture's National Nutrient Database and is supplemented by information from restaurants and food manufacturers. Some participants provided the actual brands of the foods that were eaten, and at these times the nutritional information was obtained from the brand website, or from Tesco and Sainsbury supermarkets. For example, information for *'Wagonwheel chocolate biscuit'* was obtained from www.burtonsfoods.com, and 'Pringles' was obtained from www.pringles.co.uk (See Appendix H) for full list of foods and sources not obtained from McCance and Widdowson or Nutrition Data).

2.4.2.1 Inter-observer reliability

In order to assess the consistency of this coding scheme, inter-observer reliability (IOR) was employed. A detailed schedule of the coding procedure was produced for the independent observer (IO), which can be found in Appendix I. A list of participants to be selected for coding by the independent observer was generated using Excel. A random number between one and ten was generated using this method, and every tenth participant from this was then selected, which constituted approximately 10% of the data. If any of the participant numbers were missing from the data file, or the participant had not eaten any snacks over the 5 days, then the participant immediately prior to that one was selected instead. Once this coding was completed by the IO, the figures were analysed using Cohen's Kappa, which is a measure of agreement that ranges generally from 0 to 1.0 where large numbers mean better reliability and values near to, or less than, zero suggest that agreement is attributable to chance alone. The results of the inter-observer reliability analysis are Kappa = 0.967 ($p<0.001$), indicating a very high level of agreement between coders.

2.4.3 Data Screening

Participants were screened for eating disorders using the Eating Disorder Examination Questionnaire (EDE-Q) (Fairburn and Cooper, 1993) and the Binge Eating Scale (BES) (Gormally, Black, Daston and Rardin, 1982), which assesses behavioural manifestations, and feelings or cognitions surrounding a binge episode. All participants scored within the low-moderate level of severity of binge eating on the BES, and were therefore all included in the analysis. Similarly, all participants scored below 4 on the EDE-Q, and were therefore included on this basis also (scores above 4 on the EDE-Q lie within the clinically disordered eating range).

2.4.4 Demographics and Questionnaire Scores for Males and Females

Demographic and questionnaire data for males and females were examined for sex differences. Details of how questionnaires were scored can be found in the method section. Sex differences in age, BMI and questionnaire data were examined using independent t-tests and the frequency of males and females currently dieting and having dieted in the last 12 months were examined using the chi square test of independence. These were examined to inform later analysis of sex differences in demographics and self-reported data. Sex differences were expected in DEBQ reported emotional eating (Burton et al., 2007; Conner et al., 1999; Larsen et al., 2006; Van Strien et al., 1986 and Wardle, 1987), with higher scores expected for females, but no differences were expected in DEBQ reported external eating (Burton et al., 2007; Van Strien et al., 1986 and Wardle, 1987). Table 2.2 displays the percentages, means and standard deviations of the demographic and questionnaire data for males and females in this study.

Characteristic	**Male (n=28)**	**Female (n=27)**	***p* value**
Currently Dieting (%)	18	52	0.008[a]*
Dieted in last Year (%)	33	85	0.000[a]*
Age (mean, SD)	41.14 (11.72)	42.19 (11.04)	0.736 (ns)[b]
BMI (mean, SD)	29.17 (3.61)	28.93 (3.4)	0.804 (ns)[b]
Binge Eating (mean, SD)	7.71 (5.42)	12.30 (5.18)	0.002[b]*
Food Cravings (mean, SD)	44.18 (15.83)	65.04 (19.03)	0.000[b]*
Perceived Stress (mean, SD)	36.14 (6.82)	40.78 (8.51)	0.030[b]*
DEBQ Emotional Eating (mean, SD)	1.93 (0.68)	2.96 (0.69)	0.000[b]*
DEBQ External Eating (mean, SD)	2.99 (0.57)	3.40 (0.57)	0.010[b]*
DEBQ Restraint (mean, SD)	2.53 (0.77)	2.92 (0.62)	0.043[b]*
Total Leisure Time Activity (mean, SD)	38.44 (30.36)	28.50 (16.36)	0.144 (ns)[b]

[a] Chi square

[b] *t*-test

* Significant $p<0.05$

Table 2.2 Comparison of demographic and questionnaire data for males and females.

Significant sex differences were observed in the percentages of participants who were currently dieting and in those who had dieted in the last year. More females than males were dieting at the time of completing the diary and females engaged in a higher number of dieting episodes than males in the previous year. Females reported significantly higher levels of restraint on the DEBQ than males, therefore suggesting that they attempt to limit their food intake more frequently than males. There was also a significant difference between males and females' reported levels of binge eating, with females engaging in significantly more binge type eating on average than males. Females also reported significantly more food cravings than males, experienced significantly more reported stress in the month prior to the study and more reported emotional and external eating than males. Since females reported higher levels of stress than males in the month prior to the study, more emotional eating in females would be expected. No significant differences existed between males' and females' age and BMI, which highlights the homogeneous nature of the sample. There were also no significant sex differences in reported leisure time activity.

2.4.5 Comparison of Food Types Consumed Across Males and Females

The relative proportions of main meals and snacks consumed across males and females were examined to determine whether any noteworthy sex differences existed in the proportions of main meals and snacks consumed that may warrant further investigation. Of further interest, in specific relation to snacks, was whether any sex differences existed in the proportions of *healthy versus unhealthy* snacks eaten. Table 2.3 provides descriptive information of the foods consumed by participants, displaying the percentage of eating occasions that were main meals compared to snacks across males and females. Snacks were divided into those that were healthy versus unhealthy and the table displays what percentage of snacks eaten were healthy and what percentage were unhealthy. Also provided is the percentage of unhealthy snacks across males and females that were high in sugar only, high in fat only or high in both.

Meal Type	Male (n=28)	Female (n=27)
Breakfast (%)	21	21
Lunch (%)	24	20
Evening Meal (%)	25	23
Snacks (%)	30	36
- Healthy Snacks (%)	*22*	*20*
- Unhealthy Snacks (%)	*78*	*80*
- unhealthy snacks high in fat (%)	*27*	*14*
- unhealthy snacks high in sugar (%)	*21*	*41*
- unhealthy snacks high in both (%)	*52*	*45*

Table 2.3 Relative frequencies of breakfasts, lunches, evening meals and snacks consumed by males and females, together with the percentage of healthy versus unhealthy snacks and the percentage of unhealthy snacks that were high in fat only, high in sugar only and high in both fat and sugar.

Of the 1087 eating episodes, there appeared to be very little difference between the proportions of main meals and snacks (in general) consumed between males and females. Furthermore, when snacks were divided into healthy and unhealthy types, there was no noteworthy difference between males and females in terms of the proportion of snacks consumed that were healthy and unhealthy and also very little difference between males and females for consumption of unhealthy snacks high that were high in sugar, high in fat or high in both fat and sugar. Therefore there was no notable difference between the frequency with which males and females consumed snacks, or in the relative proportions of those that were healthy versus unhealthy across sexes.

2.4.6 Comparison of Locations in which Foods were consumed across Males and Females

The locations in which all meal types were consumed were examined across males and females to determine whether any noteworthy differences existed in the locations at which participants consumed main meals. This was examined as it is unclear from previous research in which contexts certain types of eating are most likely to occur and whether any differences between sexes exists. It was therefore deemed necessary to examine this data to determine whether, from preliminary observations, further analysis was warranted. The frequency of occurrence of main meals and snacks in each of the reported locations are displayed and described below. Table 2.4 displays the location in which main meals were consumed as a percentage of the number of total main meals consumed, for both males and females.

Location	**Male (n=28)**	**Female (n=27)**
Home (%)	65	64
Another's Home (%)	6	5
Restaurant/Café/Coffee House/Pub (%)	9	10
Work/University (%)	14	13
En Route to Destination (%)	2	1
Other (%)	2	3
Missing (%)	2	4

Table 2.4 Location in which main meals were consumed as a percentage of main meals consumed, for both males and females.

There were very little notable differences observed between males and females in terms of the location in which main meals were consumed. Unsurprisingly, the majority of main meals were consumed at home, and accounted for more than half of the occurrence of main meals. Perhaps unsurprisingly again, the lowest number of main meals were consumed en route to the participants destination, and this percentage was solely accounted for by 'lunch', which implies participants may have been simply eating a sandwich on the way to work or university, for example.
Table 2.5 provides descriptive information of the location in which snacks were consumed by participants. This information was examined to determine whether any noteworthy differences existed in the locations at which males and females consumed snacks; specifically healthy and unhealthy snacks. This was examined as again, it is unclear from previous research in which contexts certain types of eating are most likely to occur and whether any differences between sexes exists. The table displays the percentage of snacks (further divided into the percentage of snack episodes at each location that were healthy and unhealthy) that were consumed at

each of the reported locations. These are displayed as a percentage of each type of snack consumed, for both males and females.

Location	**All Snacks**	**Healthy Snack**	**Unhealthy Snack**
Home (%) (male, female)	55 *(53, 56)*	47 *(53, 46)*	55 *(54, 59)*
Another's Home (%) (male, female)	4 *(7, 3)*	5 *(10, 2)*	4 *(6, 3)*
Restaurant/Café (%) (male, female)	5 *(7, 3)*	8 *(6, 8)*	4 *(7, 2)*
Work/University (%) (male, female)	21 *(23, 20)*	25 *(21, 34)*	19 *(23, 16)*
En Route (%) (male, female)	7 *(7, 7)*	8 *(10, 8)*	6 *(6, 7)*
Other (%) (male, female)	8 *(3, 11)*	1 *(0, 2)*	9 *(4, 13)*

Table 2.5 Location in which snacks were consumed as a percentage of each type of snack consumed, for both males and females.

Of the 358 snacks that were coded (it was not possible to code three of the snacks as the participants had not recorded what was eaten); very few differences were observed between healthy and unhealthy snacks. The percentages show that the majority of snacks were consumed at the participants' home. Following participants' homes, snacks were consumed at work or university, and very few snacks were consumed at *other* people's homes, at eating venues or even en route to the individuals' destination. There were also very little differences in the relative proportions of snacks (i.e. healthy and unhealthy) at each of these destinations across males and females. On further examination of differences between males and females, the differences are minimal at each of the locations.

2.4.7 Perceived Reasons for Eating

Prior to the main analyses, correlations between reasons for eating at the eating occasion level were first explored in order to determine the main types of reasons for eating that occurred. Pearson's correlations suggested four main reasons for eating (see Table 2.6). These were *'Eating for Psychological Control'*, which included emotional reasons such as feeling fed up (reason 4), boredom (reason 5) and stress (reason 6), as well thoughts (reason 7) and awareness of eating (reason 13). *'Planned Eating'* included hunger (reasons 1 and 2), routine (reason 9) and the need for energy (reason 10). *'Temptation Eating'* referred to external reasons for eating (reason 3) and was not found to correlate with any other reason, and the final type of eating behaviour observed was *'Obligation Eating'*, which included social reasons (reason 8), feelings of obligation (reason 11) and avoiding waste (reason 12).

Reason	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13
R1	1												
R2	0.359[b]	1											
R3[c]	0.092	0.085	1										
R4	0.087	-0.003	0.119	1									
R5	0.018	-0.059	0.089	0.665[a]	1								
R6	0.084	0.009	0.087	0.749[a]	0.599[a]	1							
R7	0.163	0.054	0.184	0.446[a]	0.39[a]	0.417[a]	1						
R8	-0.017	-0.014	0.283	0.062	0.016	0.057	0.112	1					
R9	0.228[b]	0.395[b]	0	-0.072	-0.107	-0.029	-0.004	0.121	1				
R10	0.403[b]	0.462[b]	0.103	0.139	0.063	0.17	0.216	0.026	0.269[b]	1			
R11	-0.006	0.087	0.165	0.18	0.151	0.176	0.172	0.509[d]	0.153	0.139	1		
R12	0.074	0.127	0.214	0.203	0.182	0.22	0.165	0.265[d]	0.149	0.191	0.38[d]	1	
R13	-0.123	-0.089	0.042	0.325[a]	0.371[a]	0.338[a]	0.287[a]	0.084	-0.053	0.007	0.176	0.21	1

Key

[a]Eating for Psychological Control
[b]Planned Eating
[c]Temptation Eating
[d]Obligation Eating

R1	*I decided to eat because I was feeling hungry*
R2	*I decided to eat to avoid being hungry later*
R3	*I decided to eat because the food looked/smelt so tempting*
R4	*I decided to eat because I was feeling fed up*
R5	*I decided to eat because I was bored*
R6	*I decided to eat because I was stressed*
R7	*I decided to eat because I couldn't stop thinking about food*
R8	*I decided to eat to keep somebody else/other people company*
R9	*I decided to eat because I usually eat at this time*
R10	*I decided to eat because I felt I needed the energy*
R11	*I decided to eat because I felt obliged to*
R12	*I decided to eat because I wanted to avoid food going to waste*
R13	*I don't recall deciding to eat - I just found myself eating*

Table 2.6 Correlations between reasons for eating at the eating occasion level.

Due to the additional structure that these data possess, in that eating occasions were nested within participants, these groupings were investigated further using multilevel correlations. Table 2.7 shows the multilevel correlations for 'Psychological Control' at the eating occasion and participant levels, Table 2.8 displays the correlations for 'Planned Eating', and Table 2.9 for 'Obligation Eating' at the eating occasion and participant levels.

Eating Occasion Level	*Fed up*	*Boredom*	*Stress*	*Thoughts*	*Unawareness*
Fed up	1				
Boredom	0.538	1			
Stress	0.624	0.425	1		
Thoughts	0.249	0.22	0.238	1	
Unawareness	0.087	0.149	0.065	0.057	1
Participant Level	*Fed up*	*Boredom*	*Stress*	*Thoughts*	*Unawareness*
Fed up	1				
Boredom	0.908	1			
Stress	0.956	0.9	1		
Thoughts	0.716	0.619	0.621	1	
Unawareness	0.689	0.724	0.729	0.566	1

Table 2.7 Multilevel correlations for 'Psychological Control' at the eating occasion and participant levels.

Eating Occasion Level	Hunger	Avoid hunger	Routine	Energy
Hunger	1			
To avoid hunger	0.312	1		
Routine	0.271	0.413	1	
Energy	0.318	0.342	0.229	1
Participant Level	*Hunger*	*Avoid hunger*	*Routine*	*Energy*
Hunger	1			
To avoid hunger	0.466	1		
Routine	0.065	0.378	1	
Energy	0.604	0.682	0.379	1

Table 2.8 Multilevel correlations for 'Planned Eating' at the eating occasion and participant levels.

Eating Occasion Level	Company	Obligation	Avoid Waste
Company	1		
Obligation	0.434	1	
Avoid Waste	0.159	0.267	1
Participant Level	*Company*	*Obligation*	*Avoid Waste*
Company	1		
Obligation	0.691	1	
Avoid Waste	0.538	0.576	1

Table 2.9 Multilevel correlations for 'Obligation Eating' at the eating occasion and participant levels.

The correlations observed in Tables 2.7, 2.8 and 2.9 were higher at the participant level than at the eating occasion level. These correlations at the participant level referred to correlations across *individuals*, and as such demonstrated that across individuals a high correlation suggested that people who are high in one type of eating were also likely to be high in another type. For example, with reference to 'Psychological Control', a high correlation was seen between reason 13 ('I don't recall deciding to eat – I just found myself eating') and reasons 4 ('I decided to eat because I was feeling fed up') (0.689), 5 ('I decided to eat because I was bored') (0.724), 6 ('I decided to eat because I was stressed') (0.729) and 7 ('I decided to eat because I couldn't stop thinking about it') (0.566) at the participant level which suggested that individuals who scored highly on unawareness/automaticity also scored highly on emotional eating behaviours.

The correlations at the eating occasion level were lower than those at the participant level and provided a mixture of medium to high effects. These correlations referred to those across *eating occasions*, and therefore tell us that for the average individual, eating occasions that were high in one type of eating were also likely to be high in another type. For eating occasions then, it may be that for the average individual, different eating behaviours occurred on different eating occasions. If we compare the correlations for 'Psychological Control' at the eating occasion level to the correlations at the participant level described above for example, at the eating occasion level, the correlation between reason 13 and reasons 4, 5, 6 and 7 are 0.087, 0.149, 0.065 and 0.057 respectively. This therefore suggested that even though unawareness and emotional eating behaviours correlated at the participant level, they tended to vary independently across eating occasions, therefore this suggested that 'unawareness' would form a separate type of eating to 'Psychological Control'.

To summarise, reasons for eating were grouped using Pearson's correlations, which suggested the four main types of eating discussed above. The reasons that correlated with one another were grouped into the categories of *'Eating for Psychological Control'*, *'Planned Eating'* *'Temptation Eating'* and *'Obligation Eating'*. On closer inspection using multilevel correlations, it was deemed necessary to separate reason 13, which was 'unawareness', from *'Psychological Control'* as these correlations suggested that even though unawareness and emotional eating behaviours are correlated at the participant level, they tend to vary independently across eating occasions. A fifth grouped reason for eating was therefore observed, namely *'Automaticity'*.

2.4.8 Comparison of Reported Reasons for Eating

The relative frequency with which overweight males and females eat for reasons other than hunger when it comes to (a) main meals, (b) healthy snacks and (c) unhealthy snacks were calculated. Table 2.10 shows the approximate proportion of eating episodes for each food type (i.e. main meals, healthy snacks and unhealthy snacks) for which participants reported reasons related to Psychological Control, Automaticity, Planned Eating, Temptation and Obligation. Percentages were calculated for each participant first and then an overall mean taken for main meals, healthy snacks and unhealthy snacks. Prior to calculating the percentages, the ratings for reasons for eating were re-coded. Ratings that represented disagreement (1-2) and neutral responses (3) were re-coded as 0 and ratings representing agreement (4-5) were re-coded as 1. A total score for agreement (i.e. '1') for each of the grouped reasons, across the eating episodes for each participant was obtained and calculated as a percentage. An overall mean percentage score was then calculated for main meals, healthy and unhealthy snacks. It was predicted that external/environmental reasons for eating (such as habitual patterns, time of day or sight and smells of food) would be reported more frequently than any other reason for initiating eating (Tuomisto et al., 1998). In terms of the grouped reasons here this refers to the group 'Temptation' (sights and smells of foods) and also could relate to 'Planned Eating' which includes reasons of hunger, to avoid hunger, routine and the need for energy. It was also predicted that there would be a high frequency of reported emotional reasons for eating (given that there is a strong relationship between emotional eating and external eating, e.g., Van Strien et al., 1985; Van Strien, et al., 1986; Van Strien & Bergers, 1988, whereby a high degree of emotionality is considered to enhance reactions to external cues, e.g., Schachter & Rodin, 1974), and therefore the grouped reason 'Psychological Control' (feeling fed up, bored, stressed or cannot stop thinking about food) will be as frequent in occurrence as Temptation and Planned Eating. No predictions were made for the groups 'Obligation' and 'Automaticity'.

Reported Reason	**Main Meals (n=55)**	**Healthy snacks (n=37)**	**Unhealthy snacks (n=53)**
Psychological Control (%)	19	41	36
Automaticity (%)	2	5	7
Planned Eating (%)	97	72	60
Temptation (%)	37	50	58
Obligation (%)	35	20	24

Table 2.10 Frequencies of reported reasons for eating main meals, healthy snacks and unhealthy snacks, displayed as a percentage of total eating episodes.

Of the 726 main meals consumed, a substantial number of eating episodes were attributed to Planned Eating (97%). Temptation (37%) was also responsible for a sizeable proportion of episodes, which was reported as frequently as Obligation (35%). A considerable difference was observed between the reported frequencies of Planned Eating and those reasons of Temptation and Obligation (as well as remaining reasons of Psychological Control and Automaticity), suggesting that Planned Eating was a key reason for individuals when consuming main meals. Psychological Control (19%) represented a relatively large proportion of the reasons; however Automaticity (2%) was reported as a reason for consuming main meals very infrequently.

A similar pattern of results was observed for healthy snacks, with Planned Eating (72%) accounting for a considerable proportion of these episodes. Temptation (50%) and Psychological Control (41%) were also common reasons for consuming healthy snacks. Although not as frequently reported here as with main meals, Obligation (20%) still represents a sizeable proportion. Again, Automaticity (5%) was reported fairly infrequently during healthy snack consumption.

Planned Eating (60%) and Temptation (58%) were reported equally as often during the consumption of unhealthy snacks. The frequency of Planned Eating during unhealthy snacks is slightly less than that of healthy snacks and main meals, suggesting that this type of eating is a less common reason during the consumption of unhealthy snacks than it is during main meals and healthy snacks. However Temptation has increased, suggesting that the sight and smell of unhealthy snacks is a more common reason for eating this type of food that healthy snacks or main meals. Psychological Control (36%) and Obligation (24%), although not as common as Planned Eating or Temptation, are still of sizeable proportions, and again although infrequent, Automaticity (7%) has slightly increased in reported frequency.

In order to control for the possibility that the results from these percentages might be confounded by the number of items within each grouped reason for eating, mean ratings of reported reasons for eating were assessed. Table 2.11 shows the mean ratings of reported Psychological Control, Automaticity, Planned Eating, Temptation or Obligation for each food type (i.e. main meals, healthy snacks and unhealthy snacks). Ratings were calculated for each participant first and then an overall mean taken for main meals, healthy snacks and unhealthy snacks

Reported Reason	**Main Meals (n=55)**	**Healthy Snacks (n=37)**	**Unhealthy snacks (n=53)**
Psychological Control (mean)	1.44	1.79	1.67
Automaticity (mean)	1.24	1.42	1.43
Planned Eating (mean)	3.54	2.46	2.23
Temptation (mean)	2.89	3.05	3.25
Obligation (mean)	1.88	1.49	1.50

Table 2.11 Mean ratings of agreement/disagreement for reported reasons on a scale of 1-5 for main meals, healthy and unhealthy snacks.

The mean ratings demonstrate the average level of agreement or disagreement by participants for each of the reasons for eating main meals, healthy or unhealthy snacks. On average, participants reported greater Planned Eating than any other reason for eating main meals, but greater Temptation for eating healthy and unhealthy snacks. The relative frequencies (mean percentages) suggest that Planned Eating is a more common reason for eating healthy and unhealthy snacks than Temptation. Automaticity was the least common reason for all three types of food as demonstrated by both the mean ratings and percentage frequencies. The mean ratings in Table 2.11 are therefore consistent with the relative percentages calculated in Table 2.10, with the exception of Planned Eating and Temptation for healthy and unhealthy snacks. The relative frequencies highlight the importance of Planned Eating for each of the three food types (i.e. main meals, healthy and unhealthy snacks), whereas the mean ratings demonstrate that for healthy and unhealthy snacks Temptation is the key reason for consuming these types of food.

2.4.9 Factors Associated with Reasons for Eating Main Meals and Snacks

Pearson's correlations were calculated to determine whether there were any associations between the grouped reasons for eating and a selection of the questionnaire measures, as well as BMI[1]. These were carried out to determine whether any of the reasons for eating correlated with existing validated measures, in order to validate the reasons for eating. In order to run the correlations, it was necessary to calculate mean values for each participant on each of the grouped reasons for eating across main meals (range of eating occasions = 6 to 18), healthy snacks (range = 1 to 6) and unhealthy snacks (range = 1 to 13). One mean for each participant was calculated to avoid mixing up food level and people level variance. A total score for each of the reasons associated with the groupings identified from the multilevel correlations (e.g. 'fed up', 'boredom', 'stress' and 'thoughts' for 'Psychological Control') across eating episodes for each participant was obtained, and a mean score calculated. Pearson's correlations were employed to identify the factors associated with reasons for eating, and to inform later sex differences analysis. Table 2.12 displays the correlations between the grouped reasons for eating and questionnaires and BMI for both main meals and snacks. The correlations between 'Psychological Control' and DEBQ emotional eating, as well as between 'Temptation' and DEBQ external eating are also displayed. It was considered unnecessary to carry out correlations between DEBQ emotional or external eating with any other variable as the aim was to determine whether the diary measures of emotional (Psychological Control) and external eating (Temptation) correlated with those of the DEBQ.

[1] Where variables were skewed, Spearman's correlations were also employed. The results of these tests did not differ in terms of significance from the Pearson's correlations with the exception of 'Food Cravings (FCQ-T) and Automaticity' for main meals, which became significant (r=0.35), 'DEBQ external eating and Temptation' for main meals, which became non-significant (r=0.26), and 'DEBQ Restraint and Planned Eating' (r=0.36) for healthy snacks, which became significant after running Spearman's.

Main Meals (n=55)	Psychological Control	Automaticity	Planned Eating	Temptation	Obligation
BMI	- 0.19 (ns)	- 0.17 (ns)	- 0.44*	- 0.23 (ns)	- 0.19 (ns)
Binge Eating (BES)	0.38*	0.28*	- 0.19 (ns)	0.19 (ns)	0.30*
FCQ-T	0.42*	0.26 (ns)	0.12 (ns)	0.39*	0.32*
DEBQ Restraint	- 0.10 (ns)	- 0.18 (ns)	- 0.02 (ns)	- 0.07 (ns)	0.01 (ns)
DEBQ Emotional Eating	0.31*				
DEBQ External Eating				0.32*	
Healthy Snacks (n=35)					
BMI	0.03 (ns)	- 0.14 (ns)	0.02 (ns)	- 0.37*	0.02 (ns)
Binge Eating (BES)	0.39*	0.43*	0.11 (ns)	0.02 (ns)	0.23 (ns)
FCQ-T	0.54*	0.47*	0.23 (ns)	0.27 (ns)	0.39*
DEBQ Restraint	0.20 (ns)	0.18 (ns)	0.33 (ns)	- 0.10 (ns)	0.06 (ns)
DEBQ Emotional Eating	0.52*				
DEBQ External Eating				0.07 (ns)	
Unhealthy Snacks (n=53)					
BMI	0.22 (ns)	0.11 (ns)	- 0.24 (ns)	- 0.13 (ns)	- 0.14 (ns)
Binge Eating (BES)	0.40*	0.23 (ns)	- 0.03 (ns)	0.13 (ns)	0.09 (ns)
FCQ-T	0.52*	0.23 (ns)	0.15 (ns)	0.19 (ns)	0.24 (ns)
DEBQ Restraint	0.04 (ns)	0.10 (ns)	0.03 (ns)	0.05 (ns)	0.09 (ns)
DEBQ Emotional Eating	0.58*				
DEBQ External Eating				0.14 (ns)	

* Significant $p<0.05$

Table 2.12 Pearson's correlations between grouped reasons for eating and a selection of questionnaires and BMI for main meals and snacks.

Significant positive correlations were observed between Psychological Control and binge eating (r=0.38, r=0.39, r=0.40), food cravings (r=0.42, r=0.54, r=0.52) and DEBQ emotional eating (r=0.31, r=0.52, r=0.58) for main meals, healthy and unhealthy snacks respectively. This demonstrates that individuals who were high on reported binge eating, food cravings and DEBQ emotional eating, when it came to main meals, healthy and unhealthy snacks, also showed high levels of psychological reasons for eating. The positive association observed between DEBQ emotional eating and the diary measure of Psychological Control could reflect the accuracy of Psychological Control as a measure of emotional eating.

Automaticity was positively correlated with binge eating (r=0.28) only for main meals and for binge eating (r=0.43) and food cravings (r=0.47) for healthy snacks, but not correlated with any variable for unhealthy snacks. Therefore, individuals who reported high levels of binge eating for main meals and high levels of binge eating and food cravings when it came to healthy snacks showed high levels of automaticity, but these associations did not apply to unhealthy snacks.

Planned Eating was inversely related to BMI (r=-0.44) for main meals, therefore individuals who had a high BMI reported low levels of planned eating (i.e. eating at specific times of the day or eating to sustain energy levels), but this correlation did not apply to healthy or unhealthy snacks. Planned eating was not correlated with any variables for healthy or unhealthy snacks.

Temptation was positively correlated with DEBQ external eating (r=0.32) for main meals, which could suggest that the grouped reason of external eating categorised from reasons in the food diary is an accurate reflection of this type of eating. Temptation was also positively correlated with food cravings (r=0.39) for main meals, demonstrating that individuals who were high on reported food cravings with specific regard to main meals (but not healthy or unhealthy snacks), also showed high levels of temptation. Temptation was also negatively correlated with BMI (r=-0.37) for healthy snacks. This demonstrates that individuals who had a high BMI had low levels of temptation when it came to healthy snacks, but this association did not apply when it came to main meals and unhealthy snacks. This result could also suggest, for this particular study at least, increased temptation for healthy snacks is a good predictor of low BMI, because as temptation for healthy snacks increases, BMI decreases.

Finally, obligation was positively associated with binge eating (r=0.30) when it came to main meals, suggesting that individuals who were high on reported binge eating also reported high levels of eating out of obligation when it came to main meals, but not for healthy and unhealthy snacks. Obligation was also associated with food cravings (r=0.32) for main meals and healthy snacks, again demonstrating that individuals who were high on food cravings also demonstrated high levels of obligation when it came to eating main meals and healthy snacks, but not unhealthy snacks. Planned eating, Temptation and Obligation were not correlated with any variables for unhealthy snacks.

2.4.10 Factors Associated with Mood prior to Eating Main Meals and Snacks

Pearson's correlations were again calculated to determine whether there were any associations between mood prior to eating and DEBQ reported levels of emotional eating and BMI[2]. These correlations were examined to identify the factors associated with mood prior to eating, particularly in relation to whether negative mood (i.e. tension, depression and fatigue) is associated with increased BMI. Stress-induced or emotional eating is associated with an increased consumption of high fat/sugar snack foods (Oliver & Wardle, 1999 and Oliver et al., 2000) and unhealthy snacks may be an important contributor to weight gain (Grogan et al., 1997). Therefore it was expected that BMI and mood prior to eating would be significantly correlated, particularly in unhealthy snacking behaviour. Correlations between DEBQ emotional eating and negative mood of the POMS used in the diary were examined to assess the validity of the two measures and it was expected that these two measures would correlate. Table 2.13 displays these correlations for main meals and snacks.

[2] Where variables were skewed, Spearman's correlations were also employed. The results of these tests did not differ in terms of significance from the Pearson's correlations with the exception of 'BMI and depression prior to eating' in unhealthy snacks, which became non-significant (r=0.25) after running Spearman's.

Variable	Tension prior to eating	Depression prior to eating	Fatigue prior to eating
Main Meals (n=55)			
DEBQ Emotional Eating	0.27*	0.21 (ns)	- 0.00 (ns)
BMI	0.19 (ns)	0.16 (ns)	- 0.15 (ns)
Healthy Snacks (n=35)			
DEBQ Emotional Eating	0.46*	0.45*	0.16 (ns)
BMI	0.10 (ns)	0.12 (ns)	- 0.10 (ns)
Unhealthy Snacks (n=53)			
DEBQ Emotional Eating	0.24 (ns)	0.29*	- 0.03 (ns)
BMI	0.20 (ns)	0.28*	- 0.10 (ns)

* Significant $p<0.05$

Table 2.13 Pearson's correlations for mood prior to eating main meals and snacks.

For main meals, DEBQ emotional eating was positively correlated with tension (r=0.27) and depression (r=0.21) prior to eating. For healthy snacks, a positive correlation was observed for tension (r=0.46), depression (r=0.45) and fatigue (r=0.16) prior to eating this type of food. Finally DEBQ emotional eating was positively associated with tension (r=0.24) and depression (r=0.29) prior to eating unhealthy snacks. In terms of BMI, a similar pattern of results can be seen. For main meals, BMI was positively associated with tension (r=0.19) and depression (r=0.26), for healthy snacks BMI was positively associated with tension (r=0.10), depression (r=0.12) and fatigue (r=0.16) prior to eating and finally positive associations were seen for tension (r=0.20) and depression (r=0.28) prior to eating unhealthy snacks. Although these associations are not particularly strong, the pattern of results are as predicted for tension and depression, suggesting that a) people who report high emotional eating also report high levels of tension and depression prior to eating main meals and snacks, and b) people who have a high BMI also report high levels of tension and depression prior to eating main meals and snacks.

These results also go some way towards providing support for the validity of the two measures (i.e. DEBQ emotional eating and the negative mood states of the POMS).

The fact that some of the correlations are not significant may point towards issues of power. It may be that this study was underpowered and future research is necessary in order to confirm that these associations are robust.

2.4.11 Sex Differences in Unhealthy Snack Consumption

Of the 1084 eating episodes, 283 of these were unhealthy snacks (26% of the total number of episodes). Unhealthy snacks were those that were coded as high in fat only, high in sugar only, or high in both fat and sugar. Participants therefore consumed a higher percentage of unhealthy than healthy snacks over the 5 days. They consumed between 1 and 13 unhealthy snacks over the 5 days, with a mean of 5.4 (S.D=3.26). Table 2.14 shows the number and cumulative percentages of males and females that consumed between 1 and 13 unhealthy snacks.

Number of Unhealthy Snacks	**Male (n=27)**	**Cumulative %**	**Female (n=26)**	**Cumulative %**
One	6	22	2	8
Two	5	41	1	12
Three	1	44	1	15
Four	4	59	2	23
Five	0	59	4	38
Six	4	74	6	62
Seven	2	81	2	69
Eight	1	85	2	77
Nine	1	89	3	88
Ten	1	93	1	92
Eleven	0	93	1	96
Twelve	1	96	1	100
Thirteen	1	100	0	100

Table 2.14 The number and cumulative percentages of males and females who ate the different numbers of unhealthy snacks over 5 days.

Initial observations of the number of unhealthy snacks consumed by males and females illustrated that a larger number of males consumed smaller numbers of unhealthy snacks over the 5 days. The number of females consuming a greater number of unhealthy snacks increased and although not considerably different from males, females generally consumed more unhealthy snacks than males over the 5 days. The mean number of unhealthy snacks consumed by males over the 5 days was 4.63 (SD=3.51) and for females was 6.19 (SD=2.83). Therefore, females consumed more unhealthy snacks than males on average over the 5 days.

Very little is known about sex differences and the reasons for eating, as well as any potential factors surrounding, or contributing to, these potential differences that have been suggested by previous research. Unhealthy snacks were examined to determine whether any sex differences existed in the reasons for eating unhealthy snacks, mood prior to eating, hunger prior to eating and hunger following consumption of unhealthy snacks. This analysis was initially conducted for *all* participants who consumed unhealthy snacks (n=53) however, to ensure that the number of unhealthy snacks analysed were representative of these data, the analysis was then repeated using only those participants who had consumed more than one unhealthy snack over the 5 days (n=45), then for those who had consumed more than two (n=39) and finally for those who consumed more than five (n=27). These additional analyses did not change the significance of the results; therefore the findings reported here are based on *all* participants who consumed unhealthy snacks.

A mixed ANOVA was initially considered to examine sex differences in grouped reasons for eating unhealthy snacks. Here Mauchly's test showed that the assumptions of sphericity had been violated and that Levene's test was significant for a number of the grouped reasons. Therefore multiple t-tests were employed. A log transformation was carried out on skewed variables, and parametric t-tests re-run for those variables that the log transformation resolved. This resulted in a mixture of parametric and non-parametric (Mann-Whitney U) tests being used[3]. Significant differences between males and females were expected in relation to Psychological Control (emotional-type eating) and Temptation (external-type eating). Females

[3] Non-parametric results for reasons for eating unhealthy snacks did not differ from parametric results in terms of significance with the exception of 'Automaticity' which became significant (p=0.034) when using the non-parametric equivalent.

were expected to report more Psychological Control (Burton et al., 2007; Conner et al., 1999; Larsen et al., 2006; Van Strien, 2002 and Wardle, 1987), particularly in relation to unhealthy snacks (Ganley, 1989; Lyman, 1982; Oliver et al., 2000), as this type of eating is associated with the consumption of high fat/sweet foods. Males were expected to report more Temptation (Tuomisto et al., 1998). No predictions were made for Automaticity or Obligation. All results in Table 2.15 are parametric and it displays the means, standard deviations and significance values for the mean ratings of each of the grouped reasons for eating unhealthy snacks. The ratings for each of the grouped reasons for eating were on a scale of 1-5, where 1 represents disagree a lot and 5 represents agree a lot.

Reason	**Male (n=27)**	**Female (n=26)**	***t* value**
Psychological Control (mean, SD)	1.51 (0.56)	1.84 (0.88)	1.62 (ns)[a]
Automaticity (mean, SD)	1.25 (0.63)	1.61 (0.85)	1.78 (ns)[b]
Planned Eating (mean, SD)	2.17 (0.87)	2.30 (0.74)	0.56 (ns)[c]
Temptation (mean, SD)	3.09 (1.14)	3.43 (0.82)	1.25 (ns)[d]
Obligation (mean, SD)	1.32 (0.43)	1.69 (0.67)	2.42 (ns)[e]

[a] $p = 0.113$; [b] $p = 0.082$; [c] $p = 0.579$; [d] $p = 0.217$; [e] $p = 0.019$

Table 2.15 Comparison of grouped reasons for eating unhealthy snacks across males and females using t-tests.

No significant differences were observed using Bonferroni adjusted levels of 0.01 per test (0.05 / 5) between males and females when consuming unhealthy snacks. The expectation was that males and females would differ significantly in terms of Psychological Control and Temptation, which was not the case here. Given that the difference in the means are in the predicted direction for Psychological Control, the fact that no significant differences were observed here could be due to the lack of power (i.e. the sample size was not big enough). For Temptation on the other hand, as the means were not in the predicted direction it could suggest that males lack insight when it comes to external reasons for choosing to eat, or perhaps that females over-report external reasons for eating. Also on average, females reported higher levels of all types of reasons; therefore the differences could be explained more in terms of sex differences in the tendency to report rather than any real differences in reasons for eating.

A mixture of parametric and non-parametric (Mann-Whitney U test) tests were employed[4] to examine sex differences in mood prior to eating unhealthy snacks. All results displayed in Table 2.16 are parametric and it shows the means, standard deviations and significance values for each type of mood prior to eating main meals. Significant differences across sex were expected here, with females engaging in more emotional eating than males (Burton et al., 2007; Conner et al., 1999; Larsen et al., 2006; Van Strien, 2002 and Wardle, 1987). Females were therefore expected to experience higher levels of negative mood/emotions prior to eating. These differences are particularly expected during the consumption of this type of food as emotional eating is associated with the consumption of high fat/sugar snacks (Ganley, 1989; Lyman, 1982; Oliver et al., 2000). Mood prior to eating was measured on a 4-point scale, where *0 = 'not at all'* and *4 = 'extremely'*.

Mood	**Male (n=27)**	**Female (n=26)**	***t* value**
Tension (mean, SD)	1.05 (1.55)	1.24 (1.77)	0.43 (ns)[a]
Depression (mean, SD)	0.86 (1.35)	0.91 (1.46)	0.14 (ns)[b]
Fatigue (mean, SD)	2.56 (2.64)	2.57 (2.32)	0.02 (ns)[c]

[a] $p = 0.673$; [b] $p = 0.890$; [c] $p = 0.988$

Table 2.16 Comparison of mood prior to eating unhealthy snacks across males and females using t-tests.

No significant differences were observed between males and females' mood prior to eating unhealthy snacks. Again, this was not in line with previous expectations, but as no differences were observed between males and females in terms of Psychological Control and Temptation, perhaps these particular findings in terms of the results for the reasons for eating unhealthy snacks may not be that surprising, or again, perhaps it is to do with the lack of power (i.e. small sample size).

[4] Non-parametric results for mood prior to eating unhealthy snacks did not differ from parametric results in terms of significance; therefore parametric results are reported here.

Individual t-tests were carried out to examine whether any sex differences existed in hunger prior to eating and also following consumption of healthy snacks. Again, if differences were found to exist, this could be used to inform later analysis to determine whether any differences in hunger could explain any differences observed in reasons for eating unhealthy snacks and also provide a comparison of the frequency with which overweight males and females eat for emotional and external reasons relative to hunger. Table 2.17 shows the means, standard deviations and significance values for hunger prior to eating and hunger following consumption of main meals. The scores were measured on a visual analogue scale in millimetres, with scores close to 0mm representing 'not hungry at all / couldn't eat another bite' and those closer to 70mm representing 'extremely hungry'.

Hunger	**Male (n=27)**	**Female (n=26)**	***t* value**
Hunger prior to eating (mean, SD)	35.69 (18.20)	32.47 (11.59)	0.77 (ns)[a]
Hunger following consumption (mean, SD)	27.35 (14.93)	24.03 (9.72)	0.96 (ns)[b]

[a] $p = 0.448$; [b] $p = 0.344$

Table 2.17 Comparison of hunger prior to eating and hunger following consumption of unhealthy snacks across males and females using t-tests.

No significant differences were observed across sex for hunger prior to consuming, or hunger following consumption of unhealthy snacks.

2.4.12 Sex Differences in Healthy Snack Consumption

Of the 1084 eating episodes, 75 of these were healthy snacks (7% of the total number of episodes. Healthy snacks were those that were coded as low/medium in fat and sugar. Participants consumed between one and six healthy snacks over the 5 days, with the mean number of those consumed over the 5 days being 2.05 (S.D=1.33). Table 2.18 shows the number and cumulative percentages of males and females that consumed between one and six healthy snacks.

Number of Healthy Snacks	**Male (n=19)**	**Cumulative %**	**Female (n=18)**	**Cumulative %**
One	10	53	8	44
Two	4	74	4	67
Three	3	89	2	78
Four	2	100	2	89
Five	0	100	1	94
Six	0	100	1	100

Table 2.18 The number and cumulative percentages of males and females who ate different numbers of healthy snacks over 5 days.

A large number of both males and females ate a relatively small number of healthy snacks over the 5 days that they were required to complete the food diary. More than half of the males and females ate less than two healthy snacks over the 5 days. The mean number of healthy snacks consumed by males over the 5 days was 1.84 (SD=1.07) and for females was 2.28 (SD=1.56). Therefore, on average, females consumed more healthy snacks than males.

Healthy snacks were examined in the same manner as unhealthy snacks, to determine whether any sex differences existed in the reasons for eating healthy snacks, mood prior to eating, hunger prior to eating and hunger following consumption of healthy snacks. Again, this analysis was conducted as very little is known about such differences. As with unhealthy snacks, significant differences between males and females were expected in relation to Psychological Control (emotional-type eating) and Temptation (external-type eating). No predictions were made for Automaticity or Obligation. Females were expected to report more Psychological Control (Burton et al., 2007; Conner et al., 1999; Larsen et al., 2006; Van Strien, 2002 and Wardle, 1987), whilst males were expected to report more Temptation (Tuomisto et al., 1998). A mixture of parametric and non-parametric tests were used[5], and all results in Table 2.19 are parametric and it displays the means, standard deviations and significance values for the mean ratings of each of

[5] Non-parametric results for reasons for eating healthy snacks did not differ from parametric results in terms of significance; therefore parametric results are reported here.

the grouped reasons for eating healthy snacks. The ratings for each of the grouped reasons for eating were on a scale of 1-5, where 1 represents disagree a lot and 5 represents agree a lot.

Reason	**Male (n=18)**	**Female (n=17)**	***t* value**
Psychological Control (mean, SD)	1.27 (0.61)	2.22 (1.31)	2.71 (ns)[a]
Automaticity (mean, SD)	1.00 (0.00)	1.86 (1.20)	2.97[b*]
Planned Eating (mean, SD)	2.40 (0.83)	2.60 (1.02)	0.66 (ns)[c]
Temptation (mean, SD)	2.46 (1.52)	3.67 (1.10)	2.70 (ns)[d]
Obligation (mean, SD)	1.34 (0.76)	1.83 (0.98)	1.66 (ns)[e]

[a] $p = 0.013$; [b] $p = 0.009$; [c] $p = 0.517$; [d] $p = 0.011$; [e] $p = 0.107$

* Significant $p<0.01$

Table 2.19 Comparison of grouped reasons for eating healthy snacks across males and females using t-tests.

Significant sex differences were observed using Bonferroni adjusted levels of 0.01 per test (0.05 / 5) for Automaticity when consuming healthy snacks, with females scoring significantly higher than males. This suggests that females were more unaware than males as to why they were eating healthy snacks, suggesting that this behaviour is more of a habit for females than males. Differences were expected between males and females in terms of Psychological Control and Temptation; however this was not the case. Furthermore, it was predicted that males would report more Temptation than females, which again was not the case here. As with unhealthy snacks, on average, females reported higher levels of all types of reasons; therefore any differences could be explained more in terms of sex differences in the *tendency to report* rather than any real differences in reasons for eating. No predictions were made for Automaticity due to the fact that no literature or evidence existed in terms of sex differences and food cue reactivity (i.e. 'automatic' eating). Therefore without such evidence, it was not possible to predict that differences existed between males and females' unawareness of eating. No sex differences were observed for Planned Eating or Obligation.

A mixture of parametric and non-parametric (Mann-Whitney U test) tests were employed[6] to examine sex differences in mood prior to eating healthy snacks. Again, the results in Table 2.20 are all parametric and it shows the means, standard deviations and significance values for each type of mood prior to eating healthy snacks. Significant differences across sex were expected here, with females engaging in more emotional eating than males (Burton et al., 2007; Conner et al., 1999; Larsen et al., 2006; Van Strien, 2002 and Wardle, 1987). Females were therefore expected to experience higher levels of negative mood/emotions prior to eating. Mood prior to eating was measured on a 4-point scale, where *0 = 'not at all'* and *4 = 'extremely'*.

Mood	**Male (n=18)**	**Female (n=17)**	***t* value**
Tension (mean, SD)	0.45 (0.69)	2.48 (4.34)	1.90 (ns)[a]
Depression (mean, SD)	0.39 (1.19)	1.81 (3.81)	1.51 (ns)[b]
Fatigue (mean, SD)	2.30 (3.23)	2.99 (2.72)	0.68 (ns)[c]

[a] $p = 0.075$; [b] $p = 0.140$; [c] $p = 0.502$

Table 2.20 Comparison of mood prior to eating healthy snacks across males and females using t-tests.

Given that differences were observed in the reasons for eating healthy snacks, particularly with females reporting more Psychological Control and Temptation, you may expect to see a difference in mood levels prior to eating, with females scoring higher than males. It is surprising here again, not to see differences across sex in mood, as females reported more Psychological Control than males, and you would therefore expect females to experience higher levels of depression prior to eating. It could again perhaps, highlight a lack of insight into prior mood on the part of male participants, or a tendency to over-report emotional eating on the part of the females. However, given that there are differences in the means in the predicted direction, the fact that no differences were observed here could be due to the lack of power (i.e. the sample size was not big enough).

[6] Two non-parametric results for mood prior to consuming healthy snacks differed from parametric results in terms of significance, namely 'tension prior to eating' (p=0.020) and 'depression prior to eating' (p=0.005), which both became significant when using non-parametric equivalent.

Individual t-tests were carried out to examine whether any sex differences existed in hunger prior to eating and also following consumption of healthy snacks[7]. If differences were found to exist, this could be used to inform later analysis to determine whether any differences in hunger could explain any differences observed in reasons for eating healthy snacks and also provide a comparison of the frequency with which overweight males and females eat for emotional and external reasons relative to hunger. Table 2.21 shows the means, standard deviations and significance values for hunger prior to eating and hunger following consumption of healthy snacks. The scores were measured on a visual analogue scale in millimetres, with scores close to 0mm representing 'not hungry at all / couldn't eat another bite' and those closer to 70mm representing 'extremely hungry'.

Hunger	**Male (n=18)**	**Female (n=17)**	***t* value**
Hunger prior to eating (mean, SD)	43.92 (12.76)	40.10 (18.44)	0.72 (ns)[a]
Hunger following consumption (mean, SD)	26.62 (14.52)	26.35 (13.40)	0.06 (ns)[b]

[a] $p = 0.480$; [b] $p = 0.954$

Table 2.21 Comparison of hunger prior to eating and hunger following consumption of healthy snacks across males and females using t-tests.

No significant differences were observed across sex for hunger prior to consuming or hunger following consumption of healthy snacks. Males and females are equally as hungry prior to eating and equally as full following consumption of healthy snacks. Given that differences were observed in the reasons for eating healthy snacks, with females reporting more Psychological Control, Temptation and Automaticity, you may expect to see a difference in hunger levels, with males perhaps more hungry than females prior to eating and less hungry following consumption. The observation of no significant differences observed here could be due to the lack of power (i.e. the sample size was not big enough).

[7] Non-parametric results for hunger prior to eating and following consumption of healthy snacks did not differ from parametric results in terms of significance; therefore parametric results are reported here.

2.4.13 Sex Differences in Main Meal Consumption

Of the 1084 eating episodes, 726 of these were main meals (67% of the total number of episodes). Main meals (i.e. breakfast, lunch and dinner) were not coded in the same way as snacks (i.e. into healthy or unhealthy foods) due to the difficulty involved in coding a whole meal. Whole meals could include both healthy and unhealthy items of food, thereby making it difficult to code those entire episodes are either healthy or unhealthy. Participants consumed between 6 and 18 main meals over the 5 days, with the mean number consumed over the 5 days being 13.2 (S.D=1.98). Table 2.22 shows the number and cumulative percentages of males and females that consumed between 6 and 18 main meals.

Number of Main Meals	Male (n=28)	Cumulative %	Female (n=27)	Cumulative %
Six	0	0	1	4
Seven	0	0	0	4
Eight	0	0	0	4
Nine	2	7	0	4
Ten	2	14	0	4
Eleven	1	18	2	11
Twelve	3	29	5	30
Thirteen	7	54	4	44
Fourteen	5	71	8	74
Fifteen	7	96	7	100
Sixteen	0	96	0	100
Seventeen	0	96	0	100
Eighteen	1	100	0	100

Table 2.22 The number and cumulative percentages of males and females who ate different numbers of main meals over 5 days.

Initial examination of the number of main meals consumed by males and females illustrated unsurprising observations in terms of the number of main meals consumed over the 5 days. A large number of the participants (both male and female) consumed around 14 or 15 main meals over the 5 days, which reflects the expected average consumption of 3 meals per day. Overall there were very little differences between the number of main meals consumed between males and females. The mean number of main meals consumed by males was 13.18 (SD=2.06) and for females was 13.22 (SD=1.93).

Multiple t-tests were employed to examine sex differences in grouped reasons for eating main meals, with a mixture of parametric and non-parametric tests being used. Significant differences between males and females were expected in relation to Psychological Control (emotional-type eating) and Temptation (external-type eating). Females were expected to engage in more Psychological Control (Burton et al., 2007; Conner et al., 1999; Larsen et al., 2006; Van Strien, 2002 and Wardle, 1987) whilst males were expected to engage in more Temptation (Tuomisto et al., 1998). No predictions were made for Automaticity or Obligation. All results reported in Table 2.23 are parametric[8] and it displays the means, standard deviations and significance values for the mean ratings of each of the grouped reasons for eating main meals. The ratings for each of the grouped reasons for eating were on a scale of 1-5, where 1 represents disagree a lot and 5 represents agree a lot.

Reason	**Male (n=28)**	**Female (n=27)**	***t* value**
Psychological Control (mean, SD)	1.33 (0.35)	1.56 (0.62)	1.71 (ns)[a]
Automaticity (mean, SD)	1.16 (0.31)	1.32 (0.62)	1.17 (ns)[b]
Planned Eating (mean, SD)	3.41 (0.62)	3.68 (0.70)	1.53 (ns)[c]
Temptation (mean, SD)	2.65 (1.02)	3.14 (0.78)	2.02 (ns)[d]
Obligation (mean, SD)	1.71 (0.64)	2.05 (0.72)	1.87 (ns)[e]

[a] $p = 0.094$; [b] $p = 0.242$; [c] $p = 0.133$; [d] $p = 0.049$; [e] $p = 0.067$

Table 2.23 Comparison of grouped reasons for eating main meals across males and females using t-tests.

Across males and females, no significant differences were observed using Bonferroni adjusted levels of 0.01 per test (0.05 / 5) for reasons for eating main meals. As with unhealthy and healthy snacks, females on average reported higher

[8] Non-parametric equivalent results for reasons for eating main meals did not differ from parametric results in terms of significance; therefore parametric results are reported here.

levels of all types of reasons; therefore it is possible that there may be sex differences in the *tendency to report* rather than any real differences in reasons for eating. No differences were observed between males and females for Psychological Control, which was not in line with predictions. However, the means for Psychological Control are in the expected direction, which could suggest that the fact no differences were observed here could be due to the lack of power (i.e. the sample size was not big enough).

The results displayed in Table 2.24 are parametric and it shows the means, standard deviations and significance values for each type of mood prior to eating main meals[9].
The results displayed in Table 2.24 are parametric and it shows the means, standard deviations and significance values for each type of mood prior to eating main meals.
Significant differences across sex were expected here. Previous research suggests that females engage in more emotional eating than males (Burton et al., 2007; Conner et al., 1999; Larsen et al., 2006; Van Strien, 2002 and Wardle, 1987), therefore it was expected that females would experience higher levels of negative mood/emotions prior to eating. Mood prior to eating was measured on a 4-point scale, where *0 = 'not at all'* and *4 = 'extremely'*.

Mood	**Male (n=28)**	**Female (n=27)**	***t* value**
Tension (mean, SD)	1.05 (1.41)	1.51 (2.19)	0.93 (ns)[a]
Depression (mean, SD)	0.76 (1.25)	0.70 (0.69)	0.22 (ns)[b]
Fatigue (mean, SD)	2.61 (2.19)	2.54 (2.26)	0.12 (ns)[c]

[a] $p = 0.358$; [b] $p = 0.823$; [c] $p = 0.904$

Table 2.24 Comparison of mood prior to eating main meals across males and females using t-tests.

Across males and females, no significant differences were found for tension, depression or fatigue prior to eating main meals. This is not in line with prior expectations, and is particularly surprising, given that females tend to report more Psychological Control than males and also score higher on the emotional eating scale

[9] Non-parametric results for mood prior to eating main meals did not differ from parametric results in terms of significance; therefore parametric results are reported here.

of the DEBQ (Van Strien, 2002). We would have expected to see significant sex differences in mood levels prior to eating, however, it may not necessarily be that surprising in relation to main meals, as perhaps negative mood/affect may lead people to snack more than to engage in main meal consumption. It could though, perhaps highlight a lack of insight into prior mood on the part of male participants, or a tendency to over-report emotional eating on the part of the females.

Individual t-tests were carried out to examine whether any sex differences existed in hunger prior to eating and also following consumption of main meals. If differences were found to exist, this could be used to inform later analysis to determine whether any differences in hunger could explain any differences observed in reasons for eating main meals and also provide a comparison of the frequency with which overweight males and females eat for emotional and external reasons relative to hunger. Table 2.25 shows the means, standard deviations and significance values for hunger prior to eating and hunger following consumption of main meals. The scores were measured on a visual analogue scale in millimetres, with scores close to 0mm representing 'not hungry at all / couldn't eat another bite' and those closer to 70mm representing 'extremely hungry'.

Hunger	**Male (n=28)**	**Female (n=27)**	***t* value**
Hunger prior to eating (mean, SD)	46.28 (7.12)	47.46 (9.69)	0.51 (ns)[a]
Hunger following consumption (mean, SD)	21.75 (10.82)	17.40 (5.16)	1.89 (ns)[b]

[a] $p = 0.609$; [b] $p = 0.063$

Table 2.25 Comparison of hunger prior to eating and hunger following consumption of main meals across males and females using t-tests.

No significant differences were observed across sex for hunger prior to consuming or hunger following consumption of main meals. With regard to main meals, this may not necessarily surprising, as main meal consumption is a habitual act, and hunger levels could be assumed to be similar in males and females. Therefore we would not necessarily expect to see a difference in hunger levels between males and females.

2.4.14 Summary of key findings

The current study aimed to address two main questions. What is the frequency with which overweight males and females eat for reasons other than hunger when it comes to (a) main meals, (b) healthy snacks and (c) unhealthy snacks? Also, do males and females report different reasons for eating?

With regard to unhealthy snacks, Planned Eating (60%) and Temptation (58%) were reported equally as often. Psychological Control (36%) and Obligation (24%), although not as common as Planned Eating or Temptation, were still of sizeable proportions, and again although infrequent, Automaticity (7%) increased in reported frequency during unhealthy snack consumption.

Planned Eating (72%) accounted for a considerable proportion of healthy snack episodes, again representing the most common motivation for engaging in this type of food consumption. Temptation (50%) and Psychological Control (41%) were also common reasons and Obligation (20%) represented another sizeable proportion, however Automaticity (5%) was reported infrequently.

Finally, in relation to main meals, participants reported greater Planned Eating (97%) than Temptation (37%) or Obligation (35%), which were reported equally as often. A considerable difference was observed between the reported frequencies of Planned Eating and remaining reasons, suggesting that Planned Eating was a key motivation for individuals when consuming main meals. Psychological Control (19%) represented a relatively large proportion of the reasons; however Automaticity (2%) was reported very infrequently.

Therefore, across all food types, the most common reasons for eating were Planned Eating and Temptation. Obligation and Psychological Control also represent sizeable proportions, but differ in the frequencies which they are reported for main meals and snacks. Automaticity did not appear to be as important a motivator for individuals to eat.

Do males and females report different reasons for eating? With regard to main meals and unhealthy snacks, no significant differences in reasons, mood or hunger were observed. When examining healthy snacks, females reported more Automaticity than males prior to eating. No differences in any other reasons, mood or hunger existed. Finally, females reported more feelings of obligation than males when consuming unhealthy snacks, but although approaching significance, there was no significant difference between males and females in terms of Obligation for consuming unhealthy snacks.

The analysis demonstrated that Planned Eating and Temptation are key motivators for overweight participants when consuming main meals, healthy and unhealthy snacks. Obligation and Psychological Control also represent sizeable proportions, but differ in the frequencies which they are reported for main meals and snacks. When looking specifically at sex differences, males and females differ in the frequency with which they report unawareness of eating, with females reporting higher levels than males. This sex difference seems to depend on the type of food (i.e. main meals, healthy or unhealthy snacks) being consumed.

2.5 Discussion

2.5.1 Summary

The aim of the first study was to employ a diary methodology in order to determine the frequency with which males and females eat for reasons other than hunger when it comes to (a) main meals, (b) healthy snacks and (c) unhealthy snacks. Also, do males and females report different reasons for eating? The main findings demonstrate that Planned Eating (i.e. hunger, to avoid hunger, routine and the need for energy) and Temptation (i.e. the sight and smell of food) are key motivators for overweight participants when consuming main meals, healthy and unhealthy snacks. Obligation (i.e. keeping others company, eating out of obligation and avoiding waste) and Psychological Control (i.e. feeling fed up, bored, stressed or cannot stop thinking about food) also represent sizeable proportions, but differ in the frequencies which they are reported. The frequency with which Automaticity was recorded as a reason here was also particularly interesting, as this unawareness of eating (particularly with unhealthy snacks) could have important implications for the development of interventions. When looking specifically at sex differences, males and females differ in the frequency with which they report unawareness of eating healthy snacks, with females reporting higher levels than males. This sex difference seems to depend on the type of food (i.e. main meals, healthy or unhealthy snacks) being consumed. For the purposes of this discussion, the main focus will be on the results obtained for unhealthy snack consumption, as these are important from an intervention point of view. Snacks are an important contributor to weight gain (Grogan et al., 1997) and therefore a good target for intervention. Each of the grouped reasons for eating identified from the results of this study will be discussed in order of frequency of occurrence, with specific focus on the observations of unhealthy snack consumption.

The hypotheses made in this study in terms of the frequencies of reasons for initiating eating were primarily based on those observed by Tuomisto et al. (1998). Tuomisto and colleagues identified the primary reasons for initiating eating by counting and converting them into percentages and produced 'intuitive clusters' of reasons for initiating eating, which fell into 5 separate groups. These were 'Environmental events or activities' (e.g. habitual patterns, time of day or sight and smells of food), 'Hunger and other sensations' (e.g. feelings of hunger and feelings of weakness), 'Reasons based on self-assessment and cognitions' (e.g. regular lifestyle, preventing hunger and thoughts of food), 'Social reasons' (e.g. need to be with others and feelings of obligation) and finally 'Other reasons' (e.g. problems, need for relaxation and others). The categories of grouped reasons for eating in this study that were produced using Pearson's correlations do not match those of Tuomisto et al.'s (1998) 'intuitive clusters' in all respects, providing the groupings 'Planned Eating' (hunger, avoid hunger, routine and energy), 'Temptation' (smells and sights of food), 'Psychological Control' (boredom, stress, fed up and thoughts), 'Obligation' (company, obligation, avoid waste) and 'Automaticity' (unawareness of eating).

2.5.2 Planned Eating

A substantial number of unhealthy snacking episodes were attributed to Planned Eating (60%), with this proportion representing the largest frequency of reasons for eating unhealthy snacks and therefore the most common reason for eating this type of food. Based on previous research (Tuomisto et al., 1998) it was predicted that environmental/external reasons (such as habitual patterns, time of day and sights/smells of food) would be reported more frequently than hunger or any other reason for initiating eating.

An interesting difference between the findings in this study and that of Tuomisto et al. is that 'hunger' as a reason for eating correlated with reasons of routine, the need to avoid hunger and the need for energy that made up this grouped reason for eating. Tuomisto and colleagues found that hunger was not reported as the main reason for eating in their study, accounting for only 20% of the cases, whereas environmental/external reasons (such as habitual patterns or time of day) accounted for 32.7% of eating occasions. However, categories in the Tuomisto study were developed into 'intuitive clusters' whereas the groupings devised here were firstly obtained through correlations and then further analysed using multilevel correlations due the additional structure that the data obtained possessed. It is possible that employing this method of analysis would have provided Tuomisto et al. with different clusters to the ones they produced, with the possibility of hunger correlating with other reasons for eating. The multilevel correlations carried out in this study demonstrated that across individuals, those who scored highly on reasons of hunger were also likely to score highly on reasons of routine and the need for energy, but also that eating occasions that were high in reported hunger were also likely to be high in terms of reported routine and energy. Given that the reasons for initiating eating vary from individual to individual and indeed from eating occasion to eating occasion, as previous research and these multilevel correlations demonstrate, using multilevel correlations to determine which of the reasons are associated with one another is an added advantage of this study, as opposed to Tuomisto et al.'s method of devising intuitive clusters based on percentages. It may be then that those occasions where participants reported reasons of routine (i.e. eating because they usually eat at that time) have come to associate those particular times of day with feelings of hunger. Similarly, if people feel lethargic and need a boost of energy, they may also have come to associate these particular feelings with hunger. It is possible that during these times of habitual behaviour or the need for energy people actually misinterpret their feelings of hunger.

It could also be suggested that differences between the current study and that of Tuomisto et al. (1998) are due to the larger number of eating occasions that were analysed in this study. The current diary study ran over a period of 5 days as opposed to the 24 hour period that the diary devised by Tuomisto and colleagues ran over. A 5-day food diary covering three week days and both weekend days provides a more representative view of a person's week and therefore allows for a larger number of occasions to be analysed.

Tomiyama et al. (2009), in their study of triggers of eating, asked participants to complete questions provided in a PDA diary when paged. These questions were related to hunger levels, whether the food they had eaten was a meal or snack, the number of servings consumed, the fat content and also their psychological state prior to the time of eating. They found that participants reported eating because they were hungry in 56% of eating occasions, which demonstrates a substantially higher frequency of eating due to hunger than those findings of Tuomisto et al. (1998). However, this result was in relation to restraint and reflected the importance of the role of hunger in the eating of restrained eaters, which was specific to this type of eater only.

Planned Eating included the need to avoid hunger as well as the need for energy, and these do not fall into the same categories as that of Tuomisto et al. (1998). Tuomisto and colleagues included the need for energy ('I felt weak') in the 'Hunger and other sensations' cluster, whilst the need to avoid hunger ('To prevent hunger coming') fell into 'Reasons based on self-assessment and cognitions'. This again could be a reflection of the fact that categories in the Tuomisto study were developed into 'intuitive clusters' whereas the groupings devised here were firstly obtained through correlations and then further analysed using multilevel correlations.

No significant sex differences were observed in Planned Eating, suggesting that males and females report eating for reasons of hunger, to avoid hunger, routine and the need for energy equally. No predictions were made for the reasons that formed this group as the only research that has examined these types of reasons is that of Tuomisto et al. (1998) and they did not identify any significant sex differences in the reporting of these particular reasons. Tuomisto and colleagues observed that males reported more hunger, the need to avoid hunger and routine than females, whilst females reported the need for energy more than males. Although no significant differences existed in this study as with the Tuomisto study, the mean scores here demonstrated that females reported more Planned Eating than males, so it is possible that given a larger sample size, significant differences may have been observed.

2.5.3 Temptation

For unhealthy snacks, the next most frequently reported reason for eating was 'Temptation' (58%), which relates to external reasons for eating, and could be compared with Tuomisto's description of 'fancying food', and sights and smells of food, which formed part of their intuitive cluster of 'Environmental events or activities'. The frequency of occurrence for external type reasons in this study were much greater than that of Tuomisto et al. (1998), who found that this type of reason accounted for only 8% of their cases. Also, as Tuomisto and colleagues placed this external-type reason within their cluster of environmental events, the results of this study do not correspond with those observations. The external reason of sights and smells of foods on this study (i.e. 'I decided to eat because the food looked/smelled so tempting') formed a 'group' of its own and did not correlate with any other reasons, including those of routine and time of day as found by Tuomisto et al. This again could be reflective of the development of intuitive clusters as opposed to the use of Pearson's and multilevel correlations. Also, these differences could again be due to the larger number of eating occasions that were analysed in this study through the use of a 5-day food diary as opposed to the 24-hour diary of Tuomisto et al. (1998).

Surprisingly, no other research has examined the frequency of reported external type reasons for eating. This is particularly surprising since research has demonstrated that external eaters are unable to resist eating in the presence of food (Braet and Van Strien, 1997) regardless of their state of hunger or satiety (Schachter, Goldman & Gordon, 1968). It follows that this lack of control or inhibition has implications for overweight and obesity, highlighting the importance of identifying the frequency with which people report this type of reason for eating, particularly when it comes to the consumption of unhealthy snacks, in order to inform the development of appropriate interventions.

It was particularly surprising that no sex differences were observed in external type reasons (Temptation) for eating unhealthy snacks, as predicted. Males were expected to report more external reasons for eating this type of food than females, as even though males and females obtain similar scores on the DEBQ external eating scale (Burton et al., 2007; Van Strien, 2002 and Van Strien et al., 1986), Tuomisto et al. (1998) found that males reported more environmental reasons for initiating eating in a diary study than females. As well as no significant sex differences in Temptation, the mean scores showed that females scored higher than males in this type of eating. The results obtained for sex differences in demographic and questionnaire data revealed significant sex differences in DEBQ external eating, with females scoring higher than males. It was also found that significantly more females were dieting at the time of this study and also scored significantly higher levels of restraint on the DEBQ, therefore it is possible that females experienced more external temptations on the DEBQ external eating scale and the mean values for Temptation were higher because they were more sensitive to external cues. Furthermore, sex differences in Temptation were observed for healthy snacks and main meals, with females scoring higher, which could provide further support for the idea that these differences were observed due to dieting status. However, other research has demonstrated that males tend to *stop* eating for external reason (Zylan, 1996), or have found no sex differences at all (Mook & Votaw 1992). Tuomisto et al. argue that the sex differences observed in their study in relation to those results demonstrated by Zylan and Mook and Votaw could be the result of employing a more extensive list of reasons for initiating eating than in previous studies. It therefore follows then that perhaps the current diary did not provide participants with a wide and varied list of external type reasons and may be why, following on from the Pearson's correlations, that this particular 'group' only included the reason *'I decided to eat because the food looked/smelled so tempting'*. The reasons that were devised in this diary however, were developed from a pilot study, in which participants were allowed to provide open-ended responses regarding their reasons for initiating eating. In the pilot, participants only provided one response relating to external eating, which was whether they saw or smelled food, which is why only this reason was provided in the main diary. However, similarly, the reasons that may reflect temptation or external type reasons for eating included by Tuomisto et al. (1998) were *'I had to handle food', 'I saw food', 'I smelled food'*, which also led to the reason *'I decided to eat because the food looked/smelled so tempting'* being the only external-type reason included in the current diary.

No sex differences could also perhaps highlight a lack of insight on the part of male participants. However, it was found following the results of the pilot study that participants lacked insight to various reasons for choosing to eat and in order to address this, closed-format questions were employed in the main diary as opposed to open-ended responses in the pilot diary. It could be suggested then, that this observation was more to do with a lack of choice rather than a lack of insight. Perhaps the use of closed-format questions limited the choice of external-type reasons that could have been made available to participants. It is also possible however, that the lack of expected differences had more to do with the characteristics of the sample employed. All participants in this study were either overweight or obese and 65% of the sample was not dieting. Perhaps then, external eating occurs more frequently amongst those who are not overweight/obese or perhaps occurs more frequently amongst those who are attempting to lose weight. With regard to the latter, this corresponds with the results of the pilot study, whereby there was a relative infrequency of external reasons reported by participants and the majority of participants were not attempting to lose weight. However, the former explanation does not correspond with the results of the pilot study, whereby the sample consisted mainly of normal weight participants. It was suggested that perhaps external-type eating occurred more frequently amongst those who are overweight and therefore a wholly overweight/obese sample was employed for the purposes of the main study. The mean BMI of the main sample was 29.11 however, with the majority of participants being overweight (BMI between 25 and 29) rather than obese (BMI 30+), therefore it could be suggested that those who are obese may report more external reasons rather than those that are simply overweight. Correlations between BMI and Temptation, although not significant, were negatively correlated for unhealthy snacks, suggesting that those with a high BMI experienced low levels of external reasons for consuming unhealthy snacks. Again, perhaps this was due to the weight characteristics of the sample and it could be that external reasons would be reported more by those who are obese. Herman and Polivy (2008) have argued that it is possible to make a distinction between two types of external cues and that people who are obese are affected more by sensory external cues that are hedonic in nature, whereas all other individuals (whether normal weight or overweight) are affected more by normative external cues.

Although no significant difference was observed, the mean value for Temptation was greater for females than for males, which could also suggest a tendency to over-report external eating by females. Adriaanse, de Ridder and Evers (2011) found that when examining whether self-reported emotional eating was a predictor of unhealthy snack consumption, that emotional eating was more a predictor of increasing concerns about this type of eating behaviour. They concluded that emotional eating has more of a tendency to reflect beliefs about the relation between emotions and eating rather than the actual eating behaviour, and that their emotional experiences are over-interpreted and therefore incorrectly reported, bringing about a biased perception of the frequency of the desire to eat in emotional situations. Given that there is argued to be a strong relationship between emotional and external eating (Van Strien et al., 1985; Van Strien et al., 1986; Van Strien & Bergers, 1988), whereby a high degree of emotionality is considered to enhance reactions to external cues, it could be suggested that perhaps the females in this particular study over-interpreted their responses to external cues and therefore over-reported this type of eating behaviour. It could also be suggested however, that given a larger sample size, a significant difference would have been observed, and therefore perhaps overweight females are more responsive to external cues than overweight males. The sample of males and females in the Tuomisto et al. (1998) study were all obese, therefore it could be argued again, that a difference would have been observed if the sample in the current study were all obese as opposed to simply overweight.

These results not only highlight the importance of examining the different reasons for eating between males and females then, but also perhaps between those individuals who are simply overweight or are obese. This may have considerable implications for informing and development appropriate interventions.

2.5.4 Psychological Control

Psychological Control (36%) represents emotional type reasons for eating and was the third most commonly reported reason for consuming unhealthy snacks. This type of reason was not included by Tuomisto et al. (1998) and therefore no predictions were made regarding whether this type of reason would be more or less commonly reported than any other reason. It was predicted however, that a *high* frequency of emotional reasons for eating would be reported, as there is a strong relationship between emotional and external eating (Van Strien et al., 1985; Van Strien et al., 1986; Van Strien & Bergers, 1988). A high degree of emotionality is considered to enhance reactions to external cues (e.g. Schachter & Rodin, 1974); therefore it is reasonable to assume that emotional type reasons would occur as frequently as external type reasons, which is arguably the case here. Tomiyama et al. (2009) demonstrated a high frequency of negative emotions in their study of triggers of eating in everyday life (it is important to note here that the triggers assessed in this study were not done so in relation to any particular food type, such as unhealthy snacks, but were assessed for all foods). They found that of the 137 all female sample (mean BMI 22.31, SD=3.53), participants felt some sort of negative mood 54.2% of the time, whilst 47.8% of eating occasions were attributed to feelings of anxiety. However, these findings were again specific to restrained eaters and therefore cannot be directly related to the results of the current study.

It has been argued that people who engage in emotional eating do so in order to alleviate the feelings associated with negative emotionally arousing situations. Emotional eating has been shown to occur in people of all weights, but has been argued to be more frequent in overweight or obese individuals. Tuomisto et al. (1998) observed an increase in happiness following the consumption of food in a heavier group of obese participants (BMI > 33.65). These participants experienced an increase in positive emotions following eating compared to that of the lighter group of obese participants, whose happiness increased slightly but were more likely to experience a reduction in negative emotions. This therefore could suggest that changes in mood are weight specific. Support for this comes from the differences in results obtained from the pilot study and main diary study. It was surprising to note during the pilot study the relative infrequency with which emotional eating was reported as a reason for eating, however it was suggested that this was due to the sample characteristics. The majority of participants in the pilot were of normal weight, therefore it was suggested that the lack of reported emotional eating may be to do with this. The sample obtained for the main study were all overweight/obese and the high frequency of emotional eating that was reported here adds support for the argument that emotional eating occurs more in overweight or obese individuals.

Macht and Simons (2000) demonstrated that the motivation to eat was increased during times of negative emotions and concluded that negative states may bring about eating in order to regulate or control emotions, and additional research has shown that eating significantly reduces emotions in overweight or obese individuals (Tuomisto et al., 1998). Other research findings into the effects of emotional eating have been mixed however (Schachter, 1968; McKenna, 1972; Van Strien et al., 1985; Wardle et al., 1992; Stice et al., 2002), and Adriaanse, de Ridder and Evers (2011) demonstrated that self-reported emotional eating was not a predictor of actual emotional eating, but more a predictor of increasing concern about emotional eating, therefore leading to an over-interpretation and bias when reporting this type of eating behaviour. With this in mind then, it may be that overweight or obese individuals show an increasing concern for eating in emotional situations and therefore overestimate the extent to which they eat for these types of reasons and therefore the frequency with which participants reported emotional eating in this study should perhaps be interpreted with caution. Larsen (2006) suggests that people may develop poor interoceptive awareness through early learning and are therefore not able to accurately recognise or discern the difference between emotions and feelings of hunger, therefore leading to an increase in eating during emotionally arousing situations. It may also be then that participants in this study have learned to respond to emotional situations by eating, and therefore over-report emotional eating as a reason for consuming unhealthy snacks. However, Evers, de Ridder and Adriaanse (2009) also argue that people may underestimate their actual emotional eating behaviour when completing retrospective emotional eating questionnaires and not in what they term as a 'hot state' (i.e. emotional). This then leads to recall bias and tells us more about the person's *perceived* associations between their emotions and eating rather than their *actual* eating behaviour. Diary studies are therefore an appropriate method of preventing recall bias, and it can be argued that results gained during these real-life settings are more accurate and reflective of the participants' *actual* eating behaviour.

It is also possible that the frequency of emotional eating reported may depend on the level or type of emotion experienced. For example, Ruderman (1983) found that obese individuals ate significantly less when highly anxious than when mildly anxious and Robbins and Fray (1980) that maximum food consumption occurs when moderate levels of anxiety occur. Results from the current study showed that emotional eating (as measured by the DEBQ) was associated with feelings of depression (as measured by the POMS) prior to the consumption of unhealthy snacks, but not associated with tension or fatigue (both also measured by the POMS). It is therefore possible that participants in this study reported greater emotional eating (Psychological Control) when experiencing feelings of depression rather than when experiencing tiredness or tension.

It has also been suggested that stress leads to an increase in emotional eating (Kaplan & Kaplan, 1957), and therefore it is possible that a high frequency of emotional eating was reported in this study due to high levels of stress. Daily hassles such as stressors, events, thoughts or situations that evoke negative feelings has been shown to have an effect on eating behaviour (Conner et al., 1999; O'Connor et al., 2008), such that they are associated with increased consumption of high fat/sugar snacks and that this relationship is significantly stronger in people with high levels of emotional eating. This may provide some insight to the high frequency of reported emotional eating in the current study. It may be that those who reported high levels of emotional eating experienced significantly higher levels of daily hassles than those who did not report this type of eating behaviour.

Nguyen-Rodriguez et al. (2008) argued that emotional eating is more complicated than originally thought and this could be why we have so many mixed and inconsistent results. It may be that emotional eating affects people of all weights, or that people of different weights have different compensatory skills. Perhaps the lives of those people who are of normal weight are not as stressful as those who are overweight or obese, or perhaps those who are of normal weight have simply not yet become overweight and may do so should they continue to eat for emotional reasons.

It was particularly surprising that no sex differences were observed in emotional (Psychological Control) type reasons for eating unhealthy snacks, as predicted. Demographic and questionnaire results showed that females scored significantly higher than males on the DEBQ emotional eating scale, and were expected to report more emotional reasons for eating unhealthy snacks (Burton et al., 2007; Conner et al., 1999; Larsen et al., 2006; Van Strien, 2002 and Wardle, 1987), more so than main meals and healthy snacks, as this type of eating is associated with the consumption of high fat/sweet foods (Ganley, 1989; Lyman, 1982; Oliver et al., 2000). Females were also expected to experience more stress-induced eating than males when consuming unhealthy snacks (Grunberg and Straub, 1992; O'Connor et al., 2008; Oliver and Wardle, 1999 and Pine, 1985) and did score significantly higher than males in reported stress for the month prior to the study, but no sex differences in mood prior to eating were observed. However, the means for both Psychological Control and mood prior to eating (tension, depression and fatigue) were in the predicted directions therefore again, this could be due to the lack of power in the sample.

2.5.5 Obligation

Obligation (24%) was the next grouped reason for eating and can arguably be compared to Tuomisto et al.'s (1998) 'Social reasons' such as the need to be polite or be with other people. The reasons that formed this group were also to keep others company and feelings of obligation, as well as a need to avoid waste and so can be thought of more as 'social obligations' to eat rather than the influence that others may have on the amount eaten as research into social facilitation has examined. Research on social facilitation or social influence has focused more on the amount of food intake and not with why people choose to initiate eating, which is why no predictions were made regarding the social influences on initiating eating. As previous research is lacking in this area, this was a factor that the current study aimed to address.

The frequency of occurrence of obligation in this study is of a sizeable proportion and can be argued to be an important reason for the consumption of unhealthy snacks. It is also interesting to note that similar to Tuomisto et al. (1998), although not significant, females reported more feelings of Obligation than males when consuming unhealthy snacks. Tuomisto et al. (1998) found that although not significantly different, females did report more social reasons for initiating eating than males such as the need to be polite or to be with other people. The difference in the frequency with which Obligation was reported between males and females is approaching significance in the current study however; therefore it may be that Tuomisto et al. achieved non-significant results as the findings were in relation to *all* foods as opposed to only unhealthy snacks as in the current study. It is possible that any differences in the pattern of frequencies observed in the reasons for eating could be due to the fact that the food items in the current study were categorised into main meals, healthy and unhealthy snacks. The foods in the Tuomisto et al. (1998) study were not categorised as such, or assessed in terms of caloric or nutrient value. It therefore follows from this that the foods in the Tuomisto study were a combination of healthy and unhealthy foods and it could be suggested that people have different reasons for initiating the consumption of healthy foods in comparison to unhealthy foods. Also, these differences could again (as with the differences in Planned eating and Temptation) be due to the larger number of eating occasions that were analysed in this study through the use of a 5-day food diary as opposed to the 24-hour diary of Tuomisto et al. (1998).

2.5.6 Automaticity

The fifth and final reason identified in this study was that of Automaticity, which can be described as 'automatic' eating behaviour, or an unawareness of eating. An unawareness of eating is different from that of 'routine', in that those who eat routinely do so because it is their usual mealtime for example, or they usually have a snack at that time of day; it is therefore a habitual behaviour. Unawareness on the other hand is when people are not actually aware that they have decided to eat, or indeed the reasons that led them to start eating in the first place. It is likely however, that both routine and an unawareness of eating would occur together. This factor has not been addressed in previous research in terms of frequency of occurrence; therefore this is the first study in which this has been investigated. Automaticity was reported as a reason for the consumption of unhealthy snacks in 7% of eating occasions, which can be considered a relatively high frequency of unawareness of eating, particularly in comparison to the consumption of healthy snacks. It might be that this high level of unawareness with unhealthy snacks (i.e. in comparison to the frequencies with healthy snacks and main meals) is a reflection of how people are unaware of why they have chosen to eat unhealthily, and therefore cannot accurately report their reasons for choosing to eat this type of food.

It could be suggested that in these situations where people are unaware that they have decided to eat a chocolate bar for example, this will have considerable implications for weight gain, and similarly for the development of interventions aimed at reducing overweight and obesity. No sex differences were observed in terms of Automaticity, but no predictions were made on the basis that no previous research has included this notion of unawareness in their studies. It may be then that unawareness is something that occurs equally in males and females.

2.5.7 Implications for Intervention

The findings of the current study highlight a number of important points when considering implications for interventions. Firstly, this study identified the importance of external-type reasons for initiating eating and noted that it was particularly surprising that this factor was not addressed in previous research due to the inability of external eaters to inhibit their eating in the presence of food regardless of their hunger state. As this has implications for overweight and obesity, it highlights the importance of identifying these frequencies and considering them in the development of appropriate interventions.

Previous research has shown that emotional eaters consume more sweet, high fat foods in response to emotionally arousing situations that non-emotional eaters (Oliver et al., 2000), with the consumption of these foods being associated with elevated mood (Benton &Donohoe, 1999; Rogers, 1995), and the consumption of unhealthy junk foods occurring specifically following the experience if negative emotions (Lyman, 1982). These results are important when considering the development of interventions for overweight and obesity. The high frequency of emotional eating reported in this study provides further support for this, and although no sex differences were found for Psychological Control in the current study, it is possible that given a larger sample size, significant differences would have been observed, particularly given that the means were in the predicted direction. It is also possible that certain personality traits are important to consider when developing interventions. Heaven et al. (2001) found that emotional eaters were not particularly conscientious on the Big Five personality measure, and this was predictive of the susceptibility to this type of eating behaviour. Finally, certain groups of eaters should also be considered. Macht (2008) found that food intake is only increased in restrained eaters and it is also possible that different emotions may increase or decrease intake.

Also from the results of this study, Obligation can be argued to be an important reason for the consumption of unhealthy snacks. Females reported more feelings of Obligation than males and both of these points are particularly interesting from an intervention point of view, as many interventions tend not to address this issue. The frequency with which Automaticity was recorded as a reason could also have important implications, as an unawareness of eating (particularly with unhealthy snacks) could lead to overweight or obesity. Training people to become more aware of what they are eating and why could have considerable advantages if included in weight loss strategies.

2.5.8 Limitations of the Study

Difficulties that may have arisen from the use of the diary methodology in this study include inaccuracies or missing information, an inability to ensure the participant followed the correct guidelines for completing the diary and difficulties controlling for the affect that keeping the diary may have had on the participants' behaviour. Participants may have been more aware of their food choices, which may have in turn affected their usual eating pattern or choices of particular foods, and they may also have omitted certain information in order to portray a more socially acceptable image. Furthermore, Tuomisto et al. (1998) have argued that a number of cues other than hunger have preceded meals and mealtime, and that these have come to be associated with hunger, consequently leading people to believe that the reason they are eating after exposure to these cues is actually due to hunger. This therefore has implications for the self-report method used in the current study, in that participants may have believed (and reported) that they were hungry when in fact there were other cues that preceded the eating episode. In addition to this point regarding reporting bias, given that females tended to report higher levels for all reasons for eating in comparison to males, it could be argued that there was a reporting bias here. It is possible that there was a tendency for females to over-report their reasons for eating.

Additional difficulties may have included carrying the diary around (as participants were required to complete the diary at the time of eating) and also trying to complete the relevant sections if in a social context, for example having a meal with friends or family. An attempt was made to account for these potential difficulties through the careful and appropriate designing of the diary informed by the pilot study, as well as providing participants with full details of the diary and appropriate training. During the post-pilot study interview participants were asked questions regarding the intrusive nature of a diary, such as the layout and structure, fitting the diary into participants' daily schedule and carrying the diary around. Various suggestions were made and from this interview an appropriate layout was developed. The accuracy of the diary was also addressed by asking participants to complete the diary at the time of eating. However, given developments in mobile computing, future studies of this nature may benefit from carrying out more electronic-based methodologies such as Ecological Momentary Assessment (EMA).

The lack of control can make the identification of potential causal factors or salient variables difficult. However, as Schlundt (1995) points out, the use of self-report diaries is unavoidable in certain areas of research, such as in this exploratory study. Studies investigating the factors involved in this study such as social context or emotional eating would require the use of a diary as there is no appropriate alternative. Questionnaires could be used as an alternative to diaries in certain contexts, but as these are used as a way of measuring specific eating behaviours they would not be appropriate as the sole means of data collection in this study. A combination of the use of both diaries and questionnaires would be the most useful, which was an issue addressed here. Not only were participants required to complete the diary, but they were also asked to complete a number of questionnaires that measured specific behaviours such as perceived stress, eating type, leisure time exercise, food cravings, eating disordered behaviour and binge eating behaviour. Although the lack of control in a diary study could make the identification of certain variables difficult, the high degree of control that occurs during laboratory studies could also result in the overestimation or underestimation of the importance of certain variables. As de Castro (2000) argues, this high degree of control that is exerted over participants has resulted in a failure to produce effective interventions for people who are overweight, as certain variables which may actually be an important influence on the outcome of the results may have been eliminated. Despite the criticisms over lack of control of diary studies, this exploratory diary study has assessed a wide variety of behaviours that may not have occurred within a laboratory study, and has also highlighted potential factors that have not previously been addressed in intervention-type research. A similar difficulty here though could be to do with the possibility of not enough choices being made available for participants when deciding why they choose to start eating. According to Schuman and Scott (1987), the absence of an adequate number of and type of alternatives given to participants may affect the frequencies of responses given. The reasons that were devised in this diary however, were developed from the pilot study as well as previous research. It could also be argued that providing participants with too many choices could also affect the responses given.

It may also have been prudent to consider an analysis that would have allowed for stronger statements to be made regarding the importance of the different reasons for eating across each of the different food types (i.e., unhealthy snacks, healthy snacks and main meals). A Multivariate ANOVA (MANOVA) may have been used to examine whether, for each reason for eating, there were significant differences between unhealthy snacks, healthy snacks and main meals. This would then allow for example, statements to be made about the importance of the frequency with which Automaticity was reported for unhealthy snacks in comparison to other food types. This type of analysis was not carried out in the current study as there were such a large number of variables under examination, that this would have considerably increased the chances of obtaining a type 1 error. However, future studies may wish to consider examining a smaller number of variables and making more specific predictions about these.

One final difficulty to note with the current study is the numbers recruited for participation. It is possible that some of the non-significant results obtained were a reflection of the numbers recruited and therefore an extension of this research is required. Recruiting people for participation in applied studies is always difficult however, and time constraints can also contribute to the complexity of obtaining adequate numbers.

2.5.9 Future Research

The main findings demonstrate that in terms of unhealthy snack consumption, Planned Eating and Temptation are key motivators for overweight participants. Eating out of a sense of obligation is also important, but rated as more important by females than males. These findings suggest that a sense of obligation can be an important reason for consuming high-calorie snacks, particularly for women and that future research and weight loss interventions may benefit from addressing this factor in addition to emotional and external eating behaviours. The frequency with which Automaticity was recorded as a reason here was also particularly interesting, as this unawareness of eating unhealthy snacks could have important implications for the development of interventions and should therefore also be included as a focus in future research. It might be that this level of unawareness with unhealthy snacks (i.e. in comparison to the frequencies with healthy snacks and main meals) is a reflection of how people are unaware of why they have decided to eat a chocolate bar for example, and therefore cannot accurately report their reasons for choosing to eat this type of food. This could have important implications for the development of interventions aimed at reducing overweight and obesity, and intervention studies may benefit from employing strategies such as mindfulness to help people become more aware of the reasons why they choose to eat unhealthy snacks. Training people to become more aware of what they are eating and why, could have considerable advantages if included in weight loss strategies.

An increase in the use of diary studies is also required in order to understand and influence eating in everyday life, therefore future research into the reasons why people eat and the development of effective interventions should consider this method of data collection to obtain a picture of people's true-to-life daily eating habits. The most effective means of data collection would be to combine the use of both diaries and laboratory studies/questionnaires. It may also be interesting for future research to consider examination of reasons for the termination of eating, in order to investigate potential reasons for overeating.

The fact that the non-significant results obtained in the current study are in the predicted directions points towards issues of power and therefore suggests that an extension of this research (i.e. recruiting greater numbers of participants) is necessary in order to determine whether the associations that do exist are robust.

2.5.10 Conclusion

Eating can be a source of conflict for individuals who are obese or overweight; therefore the processes involved in meal initiation are very important. Previous research has suggested that there are a variety of psychological and behavioural reasons why people choose to eat, not just because they are hungry; therefore it was important to explore additional reasons for eating and the frequency with which they occur, as they may have important implications for weight management interventions. Although there is very little prior research investigating whether any differences exist in the reasons given for eating between males and females, there have been suggestions that differences do in fact exist, which prompted this particular study. To date, research in eating behaviour has focused mainly on the use of females, and as far as sex differences regarding perceived reasons for eating are concerned, the literature has been particularly lacking. This study has provided evidence for the existence of additional reasons for eating (not just hunger) as well as the existence of sex differences in unawareness of eating unhealthy snacks, which subsequently highlights the need for further research in this area. This study also points towards the importance of categorising different types of foods (i.e. high vs. low fat/sugar foods) when examining sex differences in reasons for eating. Although the frequency of importance of reasons does not vary greatly from main meals to healthy and unhealthy snacks, the differences that exist between males and females when reporting their reasons for eating are important. This study provides an important step towards acquiring an understanding of the factors associated with reasons for eating and the extent to which these factors impact upon eating in everyday life, which is crucial for the development of interventions aimed at promoting healthy eating.

Chapter Three

Reasons for eating as predictors of weight change after one year

3.1 Introduction

There are a number of factors that can contribute to an individuals' change in weight. The number of meals consumed per day, portion sizes, number of calories consumed, the types of foods chosen for consumption as well as a reduction in the amount of physical activity could all contribute to weight gain (increase in BMI). High fat food intake has been shown to predict increases in BMI (French et al., 1994; Klesges, Isbell & Klesges, 1992), as has sedentary activity and low levels of exercise (French et al., 1994). Studies such as that of Klesges et al. (1992) and French et al. (1994) investigating the role of specific diet and physical activity as predictors of weight change have found that these behaviours do play a part in weight changes over time, although the over-consumption of energy-dense, high fat foods or snacks, as well as certain external features that exist within the food environment such as the abundance of fast-food outlets could also arguably contribute to weight gain (Blundell et al., 2005).

Arguably, psychological factors that are associated with the reasons why people eat could be important predictors of weight change. Previous research that has identified the psychological factors associated with reasons for eating have also found that increased high-calorie snack consumption may be associated with certain psychological factors such as social reasons (Clenenden et al., 1994; Hetherington et al., 2006; Redd & de Castro, 1992), emotional eating (Ganley, 1989; Oliver et al., 2000) and stress (Grunberg & Straub, 1992; O'Connor et al., 2008; Oliver & Wardle, 1999; Wallis & Hetherington, 2004), which therefore has implications for overweight and obesity. Investigating the association between reasons for eating and weight change in a sample of overweight participants therefore, is important. Research addressing individual predictors of weight change is very limited and according to Tiggemann (2004) there has been relatively little research investigating predictors (other than age) of weight gain. In light of this and because of the implications for weight loss interventions, further research to identify the psychological factors that contribute to, or predict, weight change is therefore important.

3.1.1 Emotional Eating

Emotional eaters tend to consume more sweet, high-fat foods in response to negative emotions (Benton & Donohoe, 1999; Macht et al., 2003; Oliver et al., 2000; Rogers, 1995), which therefore has implications for overweight and obesity. It follows that any attempt to reduce emotional eating in those who are overweight or obese could assist in more successful weight control or reduction.

Blair, Lewis and Booth (1990) investigated the relationship between changes in participants' reported emotional eating and their level of success at losing weight over at least one year. One hundred and eighty seven participants (with, according to Blair and colleagues, a BMI that "...approximated that of the normal population") completed a questionnaire at baseline and 1 year later, with items relating to dietary restraint, temptations to eat, body image, self-esteem, assertiveness, self-efficacy, beliefs about and personal history of, weight-control related behaviours, weight history, body size and the subset of questions from the Dutch Eating Behaviour Questionnaire (DEBQ) on emotional eating. The expectation was that those individuals who reported a reduction in emotional eating (from an initial high level) would be more successful at losing or maintaining weight loss than those who continued to report relatively high levels of emotional eating. Blair et al. provided support for these expectations and found that emotional eating frequency was associated with poor weight control over a year. They explain that participants who reported initially high frequencies of emotional eating were more likely to be successful at reducing their weight if they markedly reduced their incidence of emotional eating. Similarly, those who reported initially low levels of emotional eating were less likely to reduce their weight if they then reported an increased incidence of emotional eating at the follow-up assessment. These results suggest that emotional eating is predictive of long-term weight change. However, this does not necessarily indicate a causal relationship. Blair and colleagues suggest that other factors such as breaking dieting rules may have an effect on emotional eating. That is, lapses in diet could lead to an increase in emotional eating and hence leading to weight gain.

Difficulties with this study however, lie in the ways in which both weight and emotional eating were measured. Blair, Lewis and Booth (1990) asked their participants to report their current weight and did not obtain any measurements using objective measures, thus bringing into question the accuracy of these measurements. Researchers have argued that evidence exists to suggest that in various cultures, participants generally underestimate their weight particularly if they are overweight (e.g. Stunkard & Albaum, 1981 in the US and Denmark; Stewart et al., 1987 in New Zealand), however Blair and colleagues discuss the findings of PhD research by Lewis (1989), that found that participants' "...recall of their body weight (in some cases up to 1 year later) corresponded fairly closely to their report of body weight at the initial time of weighing" (cited in Blair, Lewis & Booth 1990, pg 156). However, Gorber, Tremblay and Gorber (2007) conducted a systematic review in order to determine what evidence exists in terms of the agreement between subjective and objective measures in assessing height, weight and BMI. Overall they found that the data showed trends of under-reporting for weight and BMI, although these trends did depend upon sex and certain characteristics of the population under investigation. They also reported that large standard deviations indicated that there was a great deal of individual variability in the results. As Gorber et al. argue, the accurate estimation of such variables is important, "...as data from population studies...are often used to generate regional and national estimates of overweight and obesity and are in turn used by decision makers to allocate resources and set priorities in health" (Gorber, Tremblay & Gorger, 2007, pg 307). Therefore, in terms of the implications for Blair et al. employing self-report measurements of weight, this brings into question the accuracy of their weight change measurements and it is consequently difficult to conclude that emotional eating is predictive of long-term weight change.

With reference to the way in which emotional eating was measured, Blair, Lewis and Booth (1990) employed the subset of ten questions from the DEBQ to assess participants' eating in response to emotions. The difficulty with using this self-reported scale of emotional eating is that a retrospective account of participants' emotional eating is required. That is, participants required to complete the Dutch Eating Behaviour Questionnaire (DEBQ) for example, would be required to recall their eating behaviours in particular situations, which could potentially involve a recall bias. As discussed in Section 2.1.1.4 of Chapter Two, Barrett (1997) and

Ready, Weinberger and Jones (2007) have shown that retrospective emotional ratings are highly sensitive to recall bias, and Nordgren, van der Pligt and van Harreveld (2007) have demonstrated how people can underestimate the impact of emotions on their behaviour when they are not in any kind of emotional state. Evers, de Ridder and Adriaanse (2009) also found, using 7-day snack diaries, that people who previously described themselves as emotional eaters on a self-reported scale did not increase their food intake during these emotional situations (i.e. when in a 'hot' state) as compared to controls or those who do not describe themselves as emotional eaters. They therefore underestimate the impact of these hot states on their emotional eating behaviour and this recall bias may tell us more about a person's *perceived* association between their emotions and eating behaviour than between their emotions and *actual* eating behaviour. Evers, de Ridder and Adriaanse suggested that people find it difficult to assess their own emotional eating behaviour retrospectively (when not in a 'hot' state) and that diary studies can therefore be argued to be an appropriate method of preventing recall bias. Results gained during these real-life settings could be more accurate and reflective of the participants' *actual* eating behaviour.

Stressful life events, as well as leading to decreased appetite and eating in some, can also lead to increased eating in others (Van Strien et al., 1986). Stress has been found to affect both the amount of food consumed (Wallis & Hetherington, 2004) as well as the types of foods chosen for consumption (sweet, high-fat snack foods) (Oliver & Wardle, 1998; Zellner et al., 2006) and this increase can lead to a change in body mass index (BMI) (Van Strien et al., 1986). Van Strien et al. (1986) conducted a longitudinal study on the effects of negative life events on change in BMI in males and females that were classed as either high or low emotional eaters, during which they predicted that low emotional eaters would gain less weight and high emotional eaters would gain more, after experiencing negative life events. Van Strien et al. obtained evidence to support part of their hypothesis, particularly in males. The assessments were carried out at two different time points and they found a significant interaction effect on change in BMI 6 months after the first assessment date but not on the second (18 months after the first assessment date) and this result was not replicated with females. They argue that the lack of evidence to support their hypothesis for females and only partly in males could be due to the subjective weightings that people place on stressful life events and therefore their vulnerability to such events. The evidence does go some way though, toward providing support for the effects of emotional eating on weight change. The weightings that people place on certain stressful life events was not accounted for in this study however, as participant were only asked to indicate on the Dutch Life Events Questionnaire which stressful life events had occurred in the previous six months, but not to indicate to what extent these events had caused stress. Unlike Blair, Lewis and Booth (1990), Van Strien et al. (1986) obtained objective measurements of height and weight, therefore accounting for the difficulties posed by Blair and colleagues, in that the accuracy of their weight change measurements could be questioned. However, as with Blair et al. (1990), difficulty could lie in the way in which emotional eating was measured. Van Strien et al. (1986) used the emotional eating subset of questions from the DEBQ and as mentioned, the difficulties here lie in the retrospective reporting of emotional eating, allowing for the possibility of recall bias and could tell us more about *perceived* eating behaviour rather than *actual* eating behaviour, as could be measured if employing a diary methodology.

To summarise, it is possible that emotional eating is associated with long-term weight change. That is, those who engage in high levels of emotional eating may potentially increase their weight over time, whereas those who are classed as low emotional eaters may potentially gain less weight in comparison (or maintain their weight). However, it is difficult to come to this conclusion given the shortcomings of previous studies that have examined whether emotional eating is predictive of weight change, namely the methods by which weight and emotional eating have been measured. This brings into question the accuracy of the results and therefore further research is needed in order to determine whether such a conclusion is warranted. Addressing these issues can help inform interventions that assist in successful weight control or reduction.

3.1.2 External Eating

According to Blundell and Finlayson (2004), there are various individual differences in susceptibility in weight gain, which may have a lot to do with the variability in people's responses to environmental influences or triggers. It has been shown that food cravings are positively associated with excessive overeating (Hetherington &

Macdiarmid, 1995) and BMI (Delahanty et al., 2002), which therefore suggests that food cravings may be an important factor influencing weight change. Burton, Smit and Lightowler (2007) demonstrated a positive relationship between BMI and food cravings (specifically for high fat foods) in males and females at one time-point, and following multiple regression analysis showed externality to be the principal predictor of cravings (this was greater in males than females), therefore suggesting that weight change is mediated through these. It follows from this that an individual's susceptibility to environmental influences or triggers through cravings can lead to weight gain.

Research on the effects of external eating as a predictor of future weight change is very limited. Given that there is some evidence to suggest that external eating is important in predicting weight change and that there is a paucity of such information, highlights the importance of further research in this area.

3.1.3 Restrained Eating

"In modern societies characterised by abundant and accessible foods, restrained eating may become an adaptive behaviour to limit weight gain" (de Lauzon-Guillain et al., 2006, pg. 132). However, according to Herman and Polivy (1991), this excessive restriction of restrained eaters (those who actively restrict their food intake in order to lose or maintain weight) can end up having a counterproductive effect and can actually lead this type of eater to eat more than they normally would when their dieting practices are violated. This fluctuation between restrained eating and violations of dieting practices can therefore lead to binges and ultimately weight gain.

According to Crombie et al. (2009), there are two types of restraint: rigid and flexible, with rigid restraint being associated with elevated BMI and increased levels of disinhibition and the opposite being true of flexible restraint. Disinhibition refers to when an individual experiences loss of control that can lead to overeating, and high levels of disinhibition have been associated with weight gain and obesity (Bellisle, 2003). An area of research in which disinhibition has been demonstrated as a predictor of change in weight outcomes is that of the 'Freshman 15'. This phenomenon is termed the 'Freshman 15' as it refers to a gain of 15lb in body weight during the first year of University. It is thought to occur as a result of a number of lifestyle changes during the first year of University, including a more sedentary lifestyle and a greater number of social events and occasions involving food and alcohol (Crombie et al., 2009). Finlayson et al. (2012) examined whether the 'Freshman 15' phenomenon translated to other cultural contexts, specifically the UK. As well as directly measuring changes in body weight, waist circumference and body composition, the researchers assessed whether disinhibition (amongst other variables) was associated with weight change. They found that disinhibition was positively associated with changes in fat-free mass at two follow-ups (three months and 12 months), thereby demonstrating that disinhibition predicts changes in weight outcomes.

However, Pliner and Saunders (2008) compared groups of freshman students, distinguished by their living arrangements, and found that not all students are equally vulnerable to the freshman weight gain. They conclude from their results that the magnitude of the increase in weight for those students who are high in dietary restraint and living on campus was substantially greater than for any other group. Furthermore, some studies (e.g., Delinsky & Wilson, 2008; Lowe et al., 2006) have examined measures of restrained eating and disinhibition (amongst other variables) as predictors of weight gain during the freshman year and have not found evidence to support this. Despite inconsistencies however, what is clear is from all studies conducted in the freshman year, is that students in their first year of University gain weight, and that disinhibition is important in the first year of University within certain cultural contexts (i.e., the UK; Finlayson et al., 2012). This phenomenon may therefore be important in predicting change in weight outcomes.

Studies such as that of French et al. (1994), McGuire et al. (1999), Korkeila et al. (1999), Juhaeri et al. (2001), Klesges, Isbel and Klesges (1992) and Stice et al. (1999) have demonstrated that restraint is associated with a greater risk of weight gain over periods of between 1 and 15 years, suggesting that restraint has an effect on weight over long periods of time. However some prospective longitudinal studies have not found such an association. For example, Klesges et al. (1991) examined this relationship over a two and a half year period, but found no association between restraint and weight change. They suggest that it is possible that research over a longer period of time may be necessary. Tiggemann (2004) accounted for this in an investigation of dietary restraint and self-esteem as predictors of weight gain over a period of 8 years. She found using hierarchical multiple regression, that although restraint did not predict weight change on its own, that participants who were low or high in both restraint and self-esteem put on the most weight and participants who were low in restraint but high in self-esteem put on the least amount of weight. She therefore concluded from this that these results go some way towards explaining the inconsistency of previous research findings and that these results suggest that restraint is more likely to predict weight gain in samples of people who are high in self esteem. Therefore, differences in sample characteristics are likely to influence the predictive nature of restraint on weight change. Similarly, Van Strien et al. (1997) showed that restrained eaters only experienced lapses in this type of eating when restraint was associated with other eating behaviours such as emotional or external eating, therefore highlighting the importance of additional factors in predicting weight change.

Many longitudinal studies such as that of McGuire et al. (1999) and McGuire et al. (2001) however, have conducted their investigations of the association between restraint and weight change within the context of weight reduction programmes or using participants that are actively attempting to maintain significant weight losses, with very little taking place within the general population (Drapeau et al., 2003; de Lauzon-Guillain et al., 2006). The difficulty here is that research conducted on individuals who are already part of a weight loss programme or attempting to maintain weight losses may be more likely to diet and engage in restrained eating. Juhaeri et al. (2001) investigated weight change amongst self-reported dieters and non-dieters in a general population sample of white and African American males and females over a 6-year period. They found that self-reported dieting was associated with greater weight gain over this period among white males and females and also African American females. Juhaeri et al. note that despite these findings, previous research examining the association between weight change and dieting have been inconsistent, with some studies identifying an association between dieting and weight gain (e.g. French et al., 1994) and other with weight loss (e.g. Bild et al., 1996 and Coakley et al., 1998). Therefore, they state that it is possible self-reported dieters have a propensity to weight gain. That is, those people who have a history of gaining weight may unintentionally report (and engage in) more dieting and may have recently lost weight, with the weight that they gained during this study perhaps reflecting rebound weight gain. Juhaeri et al. also note that the higher weight gain amongst these self-reported dieters was an indication that dieting did not result in long-term weight loss or improved weight maintenance. However, Drapeau et al. (2003) also examined the relation between (amongst other variables) eating behaviours and body weight changes in the general population (i.e. participants not involved in weight loss programmes) and found that in both males and females restrained eating was negatively associated with weight change over a 6-year period. In females, high restraint seemed to promote weight gain whereas for males, restraint was associated with weight loss. They conclude that it is important to consider the gender difference in restrained eating over time in the general population; however, Drapeau et al. did not assess normal versus overweight participants and were therefore unable to determine whether this effect would only be observed only in those that are already overweight.

De Lauzon-Guillain et al. (2006) addressed this potential issue and examined the association between restrained eating and weight change amongst the general population, specifically in normal versus overweight participants, over a 2-year period. They recruited 466 adult and 271 adolescent/young adult participants, who were required to complete an eating behaviour questionnaire and the Revised Three-Factor Eating Questionnaire and also had BMI, waist circumference and body fat percentage measured. De Lauzon-Guillain et al. found that restrained eating was strongly positively associated with BMI in normal weight adult participants but not in overweight adult participants at baseline and that heavier participants show a greater increase in restrained eating over time than slimmer participants, but restraint was not predictive of subsequent weight change over time in either the normal weight or overweight group. On the other hand however, a higher initial BMI was associated with a greater increase in restraint for both the normal weight and overweight adult groups. The results obtained for the adolescent/young adult group were similar to those in the normal weight adult group, suggesting that these eating behaviours were already developed in this younger group of participants. They therefore conclude from their findings that initial restrained eating does not predict subsequent weight gain and suggest that any findings obtained from research on the effects of restrained eating on weight gain should not be linked to normal weight individuals; however, they do also state that this lack of association may be a result of their small sample size.

To summarise, the evidence for restrained eating as a predictor of weight gain still appears inconclusive. Several studies have provided support for this variable as a prospective predictor (French et al., 1994; McGuire et al., 1999; Korkeila et al., 1999; Juhaeri et al., 2001; Drapeau et al., 2003; Klesges, Isbel & Klesges, 1992 and Stice et al., 1999), whilst others have not (Klesges et al., 1991; Tiggemann, 2004 and Van Strien et al., 1985). According to Hill (2004), laboratory studies that assess the role of restrained eating only "…hint at what might lead to weight gain" (pg.S17) and that caution should be exercised when placing emphasis on causal associations between restrained eating and weight gain, as there may be other important predictive variables of weight gain.

3.1.4 Conclusions of Literature Review

3.1.4.1 Summary

There are a number of factors that can contribute to an individual's change in weight. Recently however, research has placed an emphasis on the importance of examining psychological predictors of long-term weight change (Wadden, Brownell and Foster, 2002). Predictors of future weight change have implications for the development of interventions and the lack of evidence in this area (especially that of external eating, which is particularly lacking), highlights the importance of conducting further research. The evidence that does exist, as well as being sparse, is inconsistent and inconclusive. Whilst emotional eating (Blair, Lewis & Booth, 1990; Van Strien et al., 1986) and external eating (Burton, Smit & Lightowler, 2007) have been shown to go some way towards being associated with weight change, the findings for restrained eating are more inconsistent, providing evidence both for and against this type of eating as predictive of future weight gain. Each of these points highlights the importance and need for further examination of the predictors of long-term weight change in order to inform successful weight control interventions.

3.1.4.2 Addressing the gaps

To explore the issues addressed above, the present study is designed as a follow-up to study one (5-day diary study), with the aim of determining what factors predict weight change amongst a group of overweight and obese males and females. Based on the literature available on predictors of weight change provided in this review (Blair, Lewis & Booth, 1990; Van Strien et al., 1986), the following predictions were made:

1) Emotional eating, as assessed by emotional-type items from the 5-day food diary at baseline (i.e. Psychological Control), will significantly predict weight gain after one year (Blair, Lewis & Booth, 1990).

Due to the lack of existing literature and evidence, predictions cannot be made as to whether external eating will significantly predict weight change after one year. Similarly, the inconsistency in results of restrained eating and lack of evidence regarding other psychological factors that are associated with reasons for eating, presents difficulties and therefore predictions cannot be made here.

This study is a follow-up to Study 1 (5-day diary study), and participants were required to have their height and weight re-measured, to answer questions relating to their dieting practices over the previous year and to complete a number of questionnaires that they completed at time 1 following the completion of the 5-day diary.

The current study was conducted with a view to contribute further to this important area of research and expand upon previous work in the following ways:

1) Previous studies (where they exist) that have examined types of eating as predictors of weight change have focussed solely on emotional, external or restrained eating as measured by the DEBQ. The current study expanded upon these types of eating and examined the groups of reasons for eating identified in the 5-day diary study as potential predictors of weight change. These included emotional-type reasons (Psychological Control), external-type reasons (Temptation) as well as social-type reasons (Obligation and Planned Eating) and an unawareness of eating (Automaticity).
2) Participants were not part of any 'formal' weight control programme as they were in studies such as that of McGuire et al. (1999) and McGuire et al.

(2001) and could be described as being recruited from the 'general population'.

3) All participants in the current sample were overweight or obese at the time of the baseline measure. The results will have particular relevance to the development of weight loss interventions.
4) The current study extended that of Van Strien et al. (1986), as a diary methodology was employed as well as the sub-set of questions relating to emotional eating in an attempt to account for recall bias, which may produce more accurate results. Similarly, the study extends the work of Blair, Lewis and Booth. (1990), again through the use of a diary, but also through the use of objective measures of height and weight. Addressing these issues may go some way towards helping to determine whether the hypotheses that emotional eating is a predictor of weight change is warranted.

3.2 Study 2 Method

3.2.1 Participants

Thirty participants (54%) returned to take part in this follow-up study (9 male; 21 female). The ages of participants ranged from 25 to 65 (M=45.53, SD=11.84). The sample had a mean BMI of 28.75 (SD=3.39; range=25.03 to 39.82), and 14 participants (2 male and 12 female) were attempting to lose weight (47%). The self-reported range of weight loss of the 14 participants that were attempting to lose weight was between 3 and 17lbs (1.4 to 7.7kg) (M=7.11lbs/3.2kg; SD=4.85lbs/2.2kg). Twenty out of 30 participants had attempted at least once to lose weight over the previous year since baseline (67%), five of which were male (17%) and 15 female (50%). Participants were recruited as a follow-up to the 5-day diary study previously carried out (Study 1), and were staff and postgraduates at Swansea University and staff at Bridgend College South Wales. An email was sent out to all participants of the diary study asking whether they would be willing to return to the Psychology Department and take part in the follow-up. The email also provided them with details of what the follow-up would entail.

Inclusion and exclusion criteria were the same as that of Study 1 and participants were informed during the first study that they would be contacted after a year and asked to take part in the follow-up. Their participation in the first part of the study was not dependent on taking part in the second. Participants had previously provided informed consent to be contacted after a year when consenting to take part in the diary study and this was approved by the ethics committee at Swansea University's Psychology Department.

3.2.2 Measures and Procedure

For the follow-up, participants were required to have their height and weight re-measured and to complete a number of questionnaires that were also filled in at time 1 following the completion of the 5-day diary. Participants returned to the Social Psychology Laboratory where they were asked whether they had dieted in the last year (and if so how many times) and whether they were currently dieting (and if so for how long and how much weight they had lost) (See Appendix J). Participants then had their height measured using the SECA Portable Leicester Height Measure and their weight using the Weight Watchers Heavy Duty Precision Electronic Weighing Scale, model number 8967U, in order to determine BMI.

Participants were then required to complete the Dutch Eating Behaviour Questionnaire (DEBQ) (Van Strien, 2002) and the Godin Leisure-Time Exercise Questionnaire (Godin and Shephard, 1985), each of which are described in the Method Section (Sections 2.3.2.1 and 2.3.2.3) of Chapter Two. Participants were debriefed regarding the nature of the follow-up and informed that this study was being carried out in order to determine what factors predict weight gain and weight loss in overweight or obese individuals.

3.3 Study 2 Results

3.3.1 Overview

All 30 participants were included in the analysis of this study. All participants returned between 351 and 392 days after taking part in the 5-day diary study (M=370.8; SD=9.58). Of the 30 participants that took part in the follow-up, 13 people had actually lost weight (i.e. *not* self-reported weight loss) since baseline (5 male and 8 female) and 7 people had actually gained weight (1 male and 6 female). Ten participants had actually maintained their weight (i.e. had not gained or lost more than 1kg/2.2lbs in the previous year), three of these being male and seven female. No universal definition of weight maintenance has been established (Ball, Brown &Crawford, 2002), with studies defining weight maintainers as those having weight change of less than 5lbs over 5 years (St Jeor et al., 1995) or classifying participants as maintainers if their BMI at baseline was within 5% of their BMI at follow-up 4 years later (Ball, Brown & Crawford, 2002). However, few people gain more than 2lb to 5lb each year, thereby leading the classification of weight maintainers in this study to be those who changed weight by no more than 1kg (http://www.bbc.co.uk/health/treatments/healthy_living/your_weight/medical_why.shtml). The weight loss range for males was 2.1 to 4.9 kg (M=2.17; SD=2.51) and for females was 2.2 to 6.8kg (M=1.73; SD=2.49). The weight gain range for males was 0 to 3kg (M=0.33; SD=1) and for females was 1.26 to 8.3kg (M=0.91; SD=1.98). The one participant that had not provided a full account of all information required in the 5 day diary and subsequently not included in the baseline analysis, was not contacted to take part in the one-year follow-up.

3.3.2 Comparison of Demographic and Questionnaire Scores across Returnees and Non-Returnees

Differences in dieting status, gender, age, BMI and questionnaire scores at baseline of those participants that returned to take part in the follow-up and those that did not were examined to determine whether the results could provide us with a profile of participants that returned. Details of how questionnaires were scored can be found in the Method Section of Chapter 2. Differences in age, BMI and questionnaire data were examined using independent t-tests and the frequency of returnees and non-returnees currently dieting and having dieted in the last 12 months, as well as the frequency of males and females, were examined using the chi square test of independence. Differences between the reported reasons for eating at baseline of those participants who returned and those who did not were also examined using independent t-tests, again to determine whether these psychological factors could provide any additional information about the participants that returned. Table 3.1 displays the percentages, means and standard deviations of the demographic and questionnaire data for those participants that returned to take part in the follow-up study and those that did not.

Characteristic at T1	**Returned (n=30)**	**Not Returned (n=25)**	***p* value**
Dieting (%)	37	32	0.717 (ns)[a]
Dieted Year Prior (%)	33	44	0.418 (ns)[a]
Gender (% male, % female)	30 (70)	76 (24)	0.001[a]*
Age (mean, SD)	44.53 (11.84)	38.20 (9.74)	0.037[b]*
BMI (mean, SD)	29.01 (3.70)	29.10 (3.27)	0.925 (ns)[b]
Binge Eating (mean, SD)	10.53 (5.81)	9.28 (5.70)	0.425 (ns)[b]
Food Cravings (mean, SD)	60.10 (21.00)	47.60 (17.35)	0.021[b]*
Perceived Stress (mean, SD)	38.90 (7.20)	37.84 (8.94)	0.628 (ns)[b]
DEBQ Emotional (mean, SD)	2.64 (0.88)	2.19 (0.78)	0.053 (ns)[b]
DEBQ External (mean, SD)	3.32 (0.58)	3.03 (0.60)	0.076 (ns)[b]
DEBQ Restraint (mean, SD)	2.83 (0.65)	2.58 (0.79)	0.201 (ns)[b]
Total Leisure Time Activity (mean, SD)	27.78 (16.01)	40.56 (31.38)	0.079 (ns)[b]
Psychological Control (mean, SD)	1.63 (0.71)	1.41 (0.41)	0.157 (ns)[b]
Automaticity (mean, SD)	1.27 (0.54)	1.34 (0.50)	0.593 (ns)[b]
Planned Eating (mean, SD)	3.31 (0.62)	3.01 (0.67)	0.084 (ns)[b]
Temptation (mean, SD)	3.10 (0.91)	2.82 (0.89)	0.242 (ns)[b]
Obligation (mean, SD)	1.83 (0.66)	1.67 (0.51)	0.311 (ns)[b]

[a] Chi square

[b] *t*-test

* Significant $p<0.05$

Table 3.1 Comparison of demographic and questionnaire data at Time 1 (T1) for participants that took part in the follow-up and those that did not.

Significant differences between participants that returned to take part in the follow-up study and those that did not were observed in gender, age and food cravings. A significantly higher percentage of those that returned were female, and those participants that did return were significantly older and reported significantly more food cravings at baseline than participants who did not return. The difference observed in food cravings could be to do with the high number of females that returned. Significant differences in food cravings were found between males and females at baseline, with females scoring significantly higher than males (see Chapter Two, Section 2.4.4). No significant differences were observed in dieting status, BMI, binge eating or reported stress in the month prior to baseline. Although no statistically significant differences were observed in self-reported DEBQ emotional, external or restrained eating, the means were higher for participants that returned. It could be suggested that this lack of difference could be due to a lack of power and small sample size, or because the majority of participants that retuned were female (9 male and 21 female). Roughly equal numbers of males and females took part in the diary study (Study 1), and significant differences were observed in these three variables, with females scoring higher than males (see Chapter Two, Section 2.4.4). No significant differences were observed between participants who returned and those that did not, in the reasons they gave for eating at baseline. Finally, no significant differences were observed between returnees and non-returnees in levels of total leisure time activity.

3.3.3 Associations between Questionnaire Scores at Time 1 (T1) and Weight Change

Pearson's correlations were calculated to determine whether there were any associations between the questionnaire scores at T1 and weight change. These were examined in order to inform later analysis of variables associated with weight change. Table 3.2 displays the correlations between the questionnaire scores at Time 1 (T1) and weight change.

	Binge Eating (BES)	Food Cravings (FCQ-T)	Perceived Stress (PSS)
Weight Change	0.020 (ns)	0.115 (ns)	-0.192 (ns)

Table 3.2 Pearson's correlations between questionnaire scores at Time 1 (T1) and weight change.

No significant associations were observed between weight change and the Binge Eating Scale, the Food Cravings-Trait Questionnaire and Perceived Stress Scale scores at T1. This could suggest that binge eating, cravings and perceived stress at baseline are not predictive of changes in weight at follow-up, or the lack of significant association could be to do with issues of power.

3.3.4 Associations between DEBQ Change Scores and Weight Change

Pearson's correlations were calculated to determine whether there were any associations between weight change and changes in DEBQ emotional, external and restrained eating scores of participants who returned to take part in the follow-up. A positive association between weight change and change in emotional eating was expected, as poor weight control has been demonstrated to be associated with this type of eating (Blair, Lewis & Booth, 1990). Table 3.3 displays the correlations for each of the DEBQ sub-scale factors.

	Emotional Eating Change	External Eating Change	Restrained Eating Change
Weight Change	-0.137 (ns)	0.102 (ns)	-0.146 (ns)

Table 3.3 Pearson's correlations between weight change and changes in DEBQ emotional, external and restrained eating scores.

No significant associations were observed between weight change and changes in scores on the emotional, external or restrained factors of the DEBQ. As well as no significant association between weight change and emotional eating, the direction of the correlation suggests that as emotional eating increases weight decreases, which was not in line with expectations.

3.3.5 Associations between Total Leisure Time Activity Change and Weight Change

Pearson's correlations were calculated to determine whether there were any associations between weight change and changes in Total Leisure Time Activity levels of participants who returned to take part in the follow-up. Associations were expected as it can be assumed that increases in physical activity can lead to weight loss and decreases in activity can lead to weight gain. No significant association was observed between weight change and changes in leisure time activity levels ($r=0.205$), which was not in line with expectations. Also, the direction of the correlation here suggests that weight increases as physical activity increases, which again, is not in line with expectations.

3.3.6 Associations between Reasons for Eating and Weight Change

Pearson's correlations were calculated to determine whether there were any associations between the grouped reasons for eating that were devised from the results of the diary study and weight change of participants who returned to take part in the follow-up. These were calculated to establish to what extent each of the reasons are associated with weight changes from baseline to follow-up, in order to identify the factors that predict, or are associated with, weight change. A positive association between weight change and emotional (Blair, Lewis & Booth, 1990) type reasons for eating (i.e. Psychological Control) was expected, as weight change has been demonstrated in the literature to be associated with this type of eating. Table 3.4 displays the correlations between the grouped reasons for eating and changes in weight for all foods (as opposed to main meals, healthy and unhealthy snacks as in Study 1).

	Psychological Control	**Automaticity**	**Planned Eating**	**Temptation**	**Obligation**
Weight Change	-0.037 (ns)	0.091 (ns)	-0.122 (ns)	-0.130 (ns)	-0.065 (ns)

Table 3.4 Pearson's correlations between grouped reasons for eating and weight change.

No significant associations were observed between the grouped reasons for eating and weight change, which could suggest that the reasons given for eating at baseline are not predictive of changes in weight at follow-up. As well as no significant association between weight change and Psychological Control, the direction of the correlation suggests that as Psychological Control (emotional eating) increases weight decreases, which corresponds with those findings of the association between weight change and the DEBQ emotional eating sub-scale but again was not in line with prior expectations.

3.3.7 Summary of Findings

The aim of this study was to determine whether perceived reasons for eating predicted weight change after one year. No significant associations were observed between the grouped reasons for eating and weight change, which could suggest that the reasons given for eating at baseline are not predictive of changes in weight at follow-up. The lack of associations observed could be to do with issues of power, and had a larger sample size been employed it is possible that some of the reasons may have reached significance. However, given that some of the correlations are not in the predicted direction, even with a larger sample size, if the correlations did reach significance they would still be in the opposite direction to predictions.

3.4 Discussion

The present study was designed as a follow-up to Study One (5-day diary study) and the aim was to determine whether perceived reasons for eating predicted weight change amongst a group of overweight and obese males and females after one year. It was expected that there would be significant associations between emotional-type reasons for eating and weight gain (Blair, Lewis & Booth, 1990; Van Strien et al., 1986) (i.e. Psychological Control) and that emotional eating (i.e. Psychological Control) would significantly predict weight gain after one year (Blair et al., 1990). No significant associations were observed between any of the grouped reasons for eating and weight change, which could suggest that the reasons given for eating at baseline are not predictive of changes in weight at follow-up. As well as being non-significant, the direction of the correlation between weight change and Psychological Control and also between DEBQ Emotional Eating and weight change was negative, suggesting that as emotional eating increased weight decreased, which was not in line with expectations.

The hypothesis made in this study with regard to Psychological Control (emotional-type eating) as a predictor of weight change after one year was based primarily on the findings of Blair, Lewis and Booth (1990), who found that participants who reported initially high frequencies of emotional eating were more likely to be successful at reducing their weight if they markedly reduced their incidence of emotional eating (mean change in factor score of emotional eating as measured by the emotional eating sub-scale of the DEBQ was 0.43, SD=0.58) and that those who reported initially low levels of emotional eating were less likely to reduce their weight if they then reported an increased incidence of emotional eating (mean=0.26, SD=0.44) at the follow-up assessment. This may suggest that emotional eating was predictive of long-term weight change, which led to the hypothesis for this particular study. In comparison to the change in emotional eating in the study by Blair and colleagues however, the current study observed a mean change score of -0.03 (SD=0.63), which could suggest that perhaps the lack of association found in this follow-up was due to participants simply not demonstrating enough change in emotional eating. Or, given that Blair et al. used a different method of data collection and analysis to those used in the current study, this could also explain the difference observed.

The current study extended the work of Blair, Lewis and Booth (1990) by employing objective measurements of weight and in so doing improving the accuracy of the measurements of weight change taken. It also extended the work of both Blair et al. and Van Strien et al. (1986) through the use of a diary methodology. Research has shown that retrospective emotional ratings are highly sensitive to recall bias (Barrett, 1997; Ready, Weinberger & Jones, 2007) and that people can underestimate the impact of emotions on their behaviour when they are not in any kind of emotional state (Evers, de Ridder & Adriaanse, 2009; Nordgren, van der Pligt & van Harreveld, 2007). By using this method of data collection recall bias can be avoided as diaries measure actual behaviours at the time they occur, could potentially improve the accuracy of the results obtained and go some way towards helping to determine whether the hypotheses that emotional eating is a predictor of weight change is warranted. However due to the lack of control that unfortunately comes with diary methodologies, there is no guarantee that participants did fill in the diary at the time of eating and this could perhaps suggest that the lack of significant associations reflected poor insight if participants were not in an actively emotional state when recording this type of reason for eating. It could also still be argued, based on the findings by Adriaanse, de Ridder and Evers (2011) of self-reported emotional eating being a better predictor of increasing concerns about emotional eating, that participants were still reporting their *perceived* reasons for eating rather than *actual* reasons. It could possibly be suggested then, that the lack of association between weight change and emotional eating could reflect the participants' inability to accurately report this type of eating.

These points may also raise issues of sample characteristics. Perhaps certain individuals show an increased concern for eating in emotional situations and therefore overestimate the extent to which they eat for these types of reasons. Blair, Lewis and Booth (1990) employed a sample of equally mixed normal weight (47%) and overweight/obese (49%) participants, who were assessed on their degree of success at subsequently maintaining weight loss. They found that participants who reported initially high frequencies of emotional eating increased their likelihood of success at attempts to reduce weight if they reduced levels of emotional eating. Similarly, they found that participants who reported initially low levels of emotional eating were less likely to be successful at weight reduction if they increased their levels of emotional eating. Given this, and the fact that participants in the current study were all overweight/obese and a negative association was observed between emotional eating and weight change, it could be suggested that the high incidence of emotional eating reported in participants who were less likely to be successful at reducing their weight in Blair's study may not be to do with weight status but be more of a reflection of their concerns for controlling their weight than their actual eating behaviour. This could explain the lack of correlation and/or explain why the correlation did not demonstrate a positive relationship between emotional eating and weight change (i.e., was not in the predicted direction). Unfortunately Blair and colleagues did not report the mean values of the emotional sub-scale of the DEBQ; therefore we are unable to comment on any comparisons between the two.

Another point relating to sample characteristics is that the majority of participants who returned to take part in the follow-up study were female (70%). Roughly equal numbers of males and females took part in the baseline study but 21 of the 30 participants that returned were female. Chiriboga et al. (2008) observed differences in weight change (although non-significant) with males tending to gain weight and females tending to lose weight after one year. They suggested that perhaps the females may have responded to their participation in the study by altering their behaviour and therefore modifying the expected weight gain. They further reported that from subgroup analyses, obese participants, particularly obese females, tended to lose more weight during the study period, leading the researchers to conclude that changes in physical activity and dietary patterns can attenuate age-related gains in weight. Given that 70% of participants in the current study were overweight/obese females, that 67% had attempted at least once to lose weight over the previous year (50% of which were female) and that 70% of those that returned to this one-year follow-up maintained or lost weight (although there were no significant differences in BMI between returnees and non-returnees suggesting returnees were all still overweight/obese), it could be suggested that participants in the current study behaved comparably to the female returnees in the Chiriboga et al. study. That is, females may have responded to participation by altering their behaviour and modifying the expected weight gain, which could have subsequently encouraged them to return to the follow-up. Consequently if the male participants had gained weight over the previous year they may have been unwilling to return for this reason.

However, when differences between the reported reasons for eating at baseline of those participants who returned and those who did not were examined for the current study, no differences were observed. This was carried out in order to determine whether the results may provide support for the notion that the emotional type reasons did not predict weight gain because the majority of people that returned either lost or maintained their weight. However, this was not the case and so it is still unclear whether weight loss/maintenance at follow-up had an effect on the correlations.

The current study found no significant association between weight change and changes in leisure time activity levels, and also the direction of the correlation suggested that weight increases as physical activity increases, both of which were not in line with expectations. It was predicted that there would be a negative association between physical activity and weight change, as you would expect that the more activity an individual engages in the lower their weight. Some research has suggested that physical activity is not always successful for weight loss due to individuals developing 'compensatory mechanisms' in the form of increased energy intake. King et al. (2008) provide quotes from Mayer (1954) and Epstein and Wing (1980) that demonstrate this point. They state "Mayer claimed that *'the regulation of food intake functions with such flexibility that an increase in energy output due to exercise is automatically followed by an equivalent increase in caloric intake'*" and that "Epstein and Wing also stated that *'...exercise may stimulate the appetite so that persons who exercise increase their eating and do not lose as much weight as expected'*" (cited in King et al., 2008, pg 178). There is also evidence from King et al. (2005) and Drapeau et al. (2006) that weight loss is associated with increased motivation to eat following longer term negative energy balance interventions, which could therefore explain the results obtained here.

Given the gender differences that have been observed by some researchers (e.g. Drapeau et al., 2003; Oliver et al., 2000) it may have been helpful to look at gender differences at follow-up. Unfortunately this study would not allow for such analysis to be carried out due to the low numbers of participants that returned. Oliver et al. (2000) found that women generally assess themselves more strongly as emotional eaters than men do and this provides a further possible reason for the correlations being non-significant/in the opposite direction to predictions because the majority of the sample in the current study were female. Also, Drapeau et al. (2003) found some gender differences, including the suggestion that females avoided more fattening foods, used more strategic dieting behaviour and were more influenced by emotional susceptibility to eat than males over a 6-year period. If females are more susceptible to emotional eating, are more likely to use more strategic dieting behaviour and avoid fattening foods, given that the majority of returnees in this study were female and dieters, it is possible that these factors affected the results. It may also be possible that the act of completing the diary at baseline made participants more aware, and led them to adapt their behaviour accordingly through the act of dieting, for example. It is possible that when they returned a year later, they still held concerns about their emotional eating behaviour and reported accordingly, but had engaged in behaviours that reduced their weight over the previous year.

It is also possible that the positive correlation observed between Automaticity and weight change, and the negative correlations observed between the remaining four grouped reasons for eating and weight change suggest that when people are unaware of their reasons for eating (Automaticity) they are more likely to gain weight, but when they are more aware of the reasons for eating (Psychological Control, Temptation, Obligation and Planned Eating) they are more likely to actively attempt to lose weight. In the particular case of this study it might be that those who were aware they ate for emotional, external or social reasons actively changed this behaviour in order to lose weight in time for the 1-year follow-up study, but those who were unaware of their reasons for eating were unable to change their behaviour accordingly and this is therefore represented in the positive correlation obtained here. An appropriate means of assessing this would be to repeat the diary measure at the one-year follow-up.

The current discussion has attempted to provide possible explanations as to why correlations were non-significant and also in some cases in the opposite direction to predictions. Despite these results, it must be noted that there is limited previous research on the psychological reasons for eating as predictors of weight change, and the current study did employ more objective measures of weight change and avoided recall bias through the use of diaries. However, changes in emotional eating were minimal, and it could be suggested that either these variables are not good predictors of weight change or that we simply still do not have enough information to know whether emotional eating is a predictor of weight change.

3.4.1 Limitations of the Study

One of the most noteworthy difficulties with studies such as the current one is the lack of control over participants returning to take part in the follow-up. Difficulties always lie within obtaining sufficient numbers for applied research; however, obtaining sufficient numbers from those who took part at baseline to return is even more challenging. There are a number of potential reasons why participants may not wish to return. These include a form of social desirability, whereby participants may feel that they cannot return to take part in the follow-up if they believe they haven't fulfilled the requirements of the study. In the particular case of this study, participants who gained weight over the year since baseline may have been disinclined to return because of this, whereas those who maintained or lost weight may have been more willing to return. This is indicative in the numbers of participants who returned to take part in the current study; 30% of participants who returned had gained weight whilst the remaining 70% had maintained or lost weight. The sample in this study was only a sub-set of the original sample, therefore it is possible that the study was underpowered and future research would benefit from employing greater numbers. However, although obtaining greater numbers of participants here may have provided significant results, the correlations would still have been in the opposite direction to predictions.

It is possible that participants were not given enough variety of choice in terms of the reasons for eating at baseline and also that this follow-up study should have considered looking at reasons for eating as predictors of weight change in specific reference to unhealthy eating. However, Adriaanse, de Ridder and Evers (2011) conclude from their research that studies should look at overall food intake rather than just snacks so as to more stringently address the effects of emotional eating. The majority of participants that returned were female (70%), which could perhaps suggest that females are more willing to return to take part in follow-up research than males. Significant differences were observed at baseline between males and females with females scoring higher (i.e. more agreement), in one of the grouped reasons for eating unhealthy snacks (Obligation), in three of the grouped reasons for eating healthy snacks (Psychological Control, Automaticity and Temptation) and in one of the grouped reasons for eating main meals (Temptation); therefore as the majority of participants that returned were female, it may be possible that the results obtained for reasons as predictors of weight change are a reflection of this.

3.4.2 Future Research

Research addressing individual psychological predictors of weight change is very limited. Studies such as that of Blair, Lewis and Booth (1990) and Van Strien et al. (1986) go some way towards providing information on the factors that may predict weight change. Although the accuracy of some of their measurements is questionable it does provide some insight and highlights the importance of future research in the area of long-term psychological predictors of weight change. Also, as there is some evidence to suggest that external eating is also important (Burton, Smit and Lightowler, 2007), further research is warranted here, particularly because there is such a paucity of information in this area. In light of this and because of the implications for weight loss interventions, further research to identify the psychological factors that contribute to, or predict, weight change is important.

No significant associations were observed between the grouped reasons for eating and weight change in the current study. The lack of associations observed could be to do with issues of power, or because the majority of participants that returned were female and dieting. Future research in this area then may benefit from employing a larger sample size (although this may not have an effect on the direction of the results) and making attempts to ensure that equal numbers of males and females are recruited for any follow-up studies and possibly excluding dieters from the sample. It is also possible that participants were not given enough variety of choice in terms of the reasons for eating at baseline and future studies could consider increasing the variety and number of reasons made available to participants.

3.4.3 Conclusion

Although the current study extended previous studies through the use of objective weight change measurements and also the use of diaries to prevent recall bias, the results did not conclusively demonstrate whether reasons for eating are associated with weight change. Due to the factors discussed here it is still unclear whether psychological reasons for eating are predictive of weight change. It is possible that we still do not have enough information regarding this or that psychological reasons for eating are perhaps more complicated than originally thought and future research needs to be conducted in order to determine whether predictions are warranted.

Difficulties in this type of study lie with obtaining adequate numbers to take part in the follow-up. Controlling for issues such as social desirability and peoples' interpretations of what researchers are looking for in their studies is very difficult, and peoples' opinions and beliefs may affect whether they return to take part. Particular personality characteristics or traits may also have an effect and so perhaps examination of these particular areas may be of benefit to future studies.

Chapter Four

Exploratory Randomised Controlled Trial of a Mindfulness and Implementation Intention Intervention to Target Physical Activity and BMI

4.1 Introduction

Weight loss is difficult to achieve and even more difficult to maintain. According to Byrne (2002) a body of evidence exists demonstrating that the two most widely employed strategies for reducing obesity (behavioural and pharmacological) can produce weight loss in the region of 5-10% of initial body weight, but that this weight loss will only have physical and psychological benefits if it is maintained. This modest weight loss demonstrates the difficulty that people may face in achieving it, but what is also clear is that maintaining the weight loss is even more difficult, with less than 5% of those who lose weight maintaining the losses after 4-5 years. Unfortunately weight loss is almost always regained over time (Byrne, 2002), but researchers such as Klem, Wing, McGuire, Seagle & Hill (1997) and French et al. (1994; 1996) have demonstrated that long-term weight loss maintenance is possible; determining how successful people are and how success is achieved though, is complex.

Physical activity is defined by the World Health Organisation (WHO) as any bodily movement produced by skeletal muscles that requires energy expenditure. It has been employed in a wide range of studies in an attempt to promote weight loss amongst overweight and obese individuals (e.g., Epstein & Wing, 1980; Graham, Taylor, Hovell & Siegel, 1983; Pavlou, Krey & Steffee, 1989; Jakicic, Wing, Butler & Robertson, 1995; Miller, Koceja & Hamilton, 1997; Rippe et al., 1998; Jeffrey, Wing, Sherwood & Tate, 2003). It is important, as a lack of physical activity is an independent risk factor for chronic diseases and overall is estimated to cause 3.2 million deaths globally (WHO, 2012, Physical activity: A global health problem). Physical activity has a number of health, social and mental benefits, and it is recommended that individuals engage in adequate levels throughout their lives. The World Health Organisation (WHO) (2011) generally recommend (for 18-64 years olds) engaging in 150 minutes of moderate intensity or 75 minutes of vigorous intensity aerobic physical activity throughout the week, or an equivalent combination of moderate and vigorous intensity activity.

There is evidence to suggest that physical activity may not always have the desired weight loss effects however, with some people responding to exercise by eating more or reducing the amount of activity during non-exercise periods (e.g. Kempen, Saris & Westerterp, 1995; Leibel, Rosenbaum & Hirsch, 1995; King, Tremblay & Blundell, 1997; Westerterp-Plantenga et al., 1997; Blundell & King, 1998; King, 1998; Blundell et al., 2003; Melzer, Kayser, Saris & Pichard, 2005; King et al., 2008; Finlayson et al., 2011; Evero et al., 2012; King et al., 2012). According to Epstein and Wing (1980), "…exercise may stimulate the appetite so that persons who exercise increase their eating and do not lose as much weight as expected" and "…exercise may decrease non-exercise activity. For example, a person who exercises in the early evening may go to sleep earlier or require more rest in the evening with the result that a deficit in caloric expenditure is produced" (Epstein & Wing, 1980, p. 385). Epstein and Wing carried out a review of research on activity level differences in lean and obese individuals, energy balance and intake/expenditure, and found that people did not typically lose as much weight as predicted through physical activity. They concluded from their review that following the comparison of physical activity to other methods of weight loss, that weight losses due to physical activity were quite small.

However, Fogelholm and Kukkonen-Harjula (2000) conducted a systematic review of data on associations between physical activity and weight gain, and reported that a large number of studies found an inverse association between physical activity and long-term weight gain; therefore people who engage in continuous physical activity are less likely to gain weight over time. They also added that based on observational studies, increases in physical activity were associated with improved weight maintenance, therefore highlighting the importance of physical activity for weight loss maintenance rather than short-term or immediate weight loss.

Additionally, Hill and Wyatt (2005) state "Although physical activity does not appear to contribute significantly to weight loss, it is critical for maintenance of weight loss" (Hill & Wyatt, 2005, p. 765). They highlight several studies that have demonstrated how high levels of physical activity were found to predict success in long-term weight loss maintenance and also report that data are consistent in their findings that approximately 60-90 minutes per day of moderate intensity activity is required to maintain significant weight loss. Hill and Wyatt cite a study by Schoeller, Shay and Kushner (1997), who found that the risk of weight regain was significantly reduced if participants maintained their physical activity level above 1.75, which was the equivalent of 80 minutes per day of moderate intensity physical activity (such as brisk walking), or 35 minutes per day of vigorous exercise (such as jogging). According to Hill and Wyatt, Schoeller et al. then went on to recommend an energy expenditure of 2500 kcal per week for successful weight maintenance.

Wing and Hill (2001) have also argued that a decrease in physical activity is a predictor of weight regain over time. Pronk and Wing (1994) conducted a review and found evidence for the consistency in which studies reported physical activity to be a determinant of long-term weight loss maintenance. They also noted that these benefits were observed in a wide range of different types of populations, diets and exercise interventions and conclude the importance of finding ways in which to promote exercise adherence. Why physical activity is critical for weight loss maintenance is not clear, but what is clear is the success of high levels of exercise for the success of long-term weight loss maintenance effects. Given this importance then, the current study aimed to implement an intervention to promote physical activity in individuals who are attempting to get fit and wishing to increase their current levels of activity. The study will also have the secondary aim of reducing (as well as BMI) body fat percentage relative to controls, as Hill and Wyatt (2005) suggest that increased physical activity could also have beneficial effects on body composition. They report that physical activity appears to slightly enhance fat-free mass, and it is possible that this may then consequently enhance resting energy expenditure.

4.1.1 Weight Maintenance through Physical Activity

There is evidence to suggest that by increasing physical activity and weekly structured exercise programmes, rebound weight gain could potentially be avoided (e.g., Graham, Taylor, Hovell & Siegel, 1983; Sikand, Kondo, Foreyt, Jones & Gotto, 1988; Pavlou, Krey & Steffee, 1989; Hartman, Stroud, Sweet & Saxton, 1993). Pavlou, Krey and Steffee (1989) showed that participants who engaged in structured physical activity following weight loss, on average stopped the weight regain that was seen in participants who did not exercise. One hundred and sixty male police officers aged between 25 and 52 years were assessed on a number of measures and required to attend weekly educational sessions on behaviour modification, diet, general nutrition and exercise. In addition, half the participants were required to attend a supervised exercise session three times per week. The remaining half that did not participate in the exercise programme were asked to continue normal daily activities and not to participate in any form of physical activity during the study. Participants that did not exercise regained approximately 60% and 92% of their weight loss at a 6- and 18-month follow-up respectively. Their results showed that participants who maintained an active lifestyle by exercising at least three times per week, to the caloric equivalent of 1500kcal/wk, were the people who were successful in maintaining their weight loss. Pavlou, Krey and Steffee reported that participants who exercised did in fact return to their pre-intervention eating habits, but they inhibited weight regain through physical activity, therefore suggesting that exercise should be a key component of treatment programmes for both weight loss and maintenance.

Sikand, Kondo, Foreyt, Jones & Gotto (1988) have also shown after a two-year follow-up that exercisers had less weight regain than non-exercisers. In their study they examined the effect of exercise in a very-low-calorie diet (VLCD) programme in 30 obese females aged 21 to 60 over a 4-month period, arguing that the inclusion of a structured exercise programme would lead to better weight loss maintenance. All participants were placed on the VLCD, but were then also allocated to one of two groups. One of these groups involved engaging in aerobic exercise twice a week and participants in this group were also encouraged to exercise on additional days, while the remaining group received neither encouragement nor discouragement to exercise. All participants were seen on a weekly basis over the four months for medical consultations, nutritional counselling and a class which involved encouragement of group support and discussion of behaviour modification methods. Body composition tests were carried out at baseline, two months and four months, and a final follow-up to determine weight was carried out two years post-study. Both groups lost weight during the course of the study (over the four months) but the overall weight loss between groups was not significant. A significant difference was observed, though this was only during the second half of the weight loss programme (i.e. the final two months). At the two year follow-up, Sikand et al. found that the non-exercise group had regained almost 96% of their weight loss and the exercise group only regained 58%, and although these results did not reach significance they argue that they do demonstrate a clear trend. Unfortunately it is not clear whether participants in the exercise group were still engaging in physical activity at the two-year follow-up as Sikand and colleagues only report follow-up weight and no objective measure of physical activity was obtained. It is therefore unclear whether these long-term effects were due to physical activity per se. Nevertheless the results do go some way to suggest that adding an element of physical activity can produce better long-term effects than not including it.

Additional intervention studies that have demonstrated the success of physical activity as a weight maintenance tool include Graham, Taylor, Hovell & Siegel (1983) and Hartman, Stroud, Sweet and Saxton (1993), who found correlations between long-term weight loss maintenance and physical activity. Graham et al. (1983) assessed 60 participants four and a half years after they were enrolled in a behavioural weight loss programme and found that the most successful weight loss maintainers were those that were more physically active and also reported adhering to the behavioural strategies provided. Hartman et al. (1993) assessed 102 originally obese participants two-three years following intervention. They found that participants who reported high levels of physical activity were more successful at maintaining their weight loss than those who reported little or no exercise. Another example of a study that demonstrated the benefits of regular physical activity is that of Kayman, Bruvold and Stern (1990), who demonstrated that weight-loss maintainers were more likely to engage in regular physical activity (as well as consuming a low-fat diet) than were participants who were unsuccessful at weight maintenance. Studies such as these highlight the importance for the development of strategies that promote long-term regular physical activity as a weight maintenance tool. The use of such strategies would be an important addition to a long-term healthy eating programme.

As shown from the literature described above, interventions aimed at increasing levels of physical activity have demonstrated how physical activity can be a useful tool for long-term weight maintenance. However, weight maintenance is difficult, and previous research has suggested that the reason people struggle to maintain weight losses is due to the individual not only failing to stick to their healthy eating habits but also their exercise habits (McGuire et al., 1999; Byrne 2002). For example, in a study by McGuire et al. (1999) of predictors of weight gain versus maintenance, researchers found evidence to suggest that several years of successful weight maintenance increased the probability of future weight maintenance and that weight regain was due to failure to adhere to behaviour change strategies.

According to Gollwitzer (1999), behaviour consists of two phases, namely a motivational phase and a volitional phase. The motivational phase is the process by which individuals engage in intention formation, whereby the person decides what they want to do, and the volitional phase involves intention realisation, which is when the individual plans how they will go about achieving this. The reason why people often fail to achieve their goals or intended behaviour is often due to the process by which those intentions are actually translated into action. According to Adriaanse Vinkers, de Ridder Hox and de Wit (2011), being strongly motivated to perform an action is not enough, and one of the reasons for this may be that successful goal-striving depends on psychological resources such as memory, attention and self-control. Because these are limited, depletion of these resources hinders goal achievement. For example, it may be that if we are tired or focused on other activities (and not our intended goals), we may fail to remember our intentions or miss opportunities to act on them (Webb & Sheeran, 2007; Adriaanse et al., 2011). Often it is the case that people do not think through exactly how they will achieve their goals and this is where implementation intentions may help. Implementation intentions link the motivational and volitional phases and help narrow the intention-behaviour gap. They are statements that allow an individual to attain personal goals; they are plans to perform a behaviour at a particular time and place and when phrased in an 'if-then' format are more effective at enabling people to achieve their goals (Sheeran, Milne, Webb & Gollwitzer, 2005). Whereas a behavioural intention takes the form 'I will go running', an implementation intention will take the form 'If it is 9am on Monday then I will go running round the park for 15 minutes', and therefore contain a specific action plan concerning when, where and how an intended goal will take place.

The current study was designed as a three-arm randomised controlled trial in order to examine whether mindfulness strategies may help to promote physical activity. However it is possible that the mindfulness strategy may not work if participants do not make any plans (i.e. devise implementation intentions) to exercise, as even if participants are highly motivated to engage in physical activity but do not employ strategies that link their motivation and the actual behaviour they intend to engage in, they are likely to fail to achieve this intended behaviour. In this case then, the study will include a mindfulness plus implementation intentions group as well as an implementation intentions only group. The implementation intentions only group will be included in order to determine whether the combined mindfulness plus implementation intentions intervention is more effective than an implementation intentions strategy alone. The strategies employed in the current study are both volitional. Participants will be recruited on the basis that they are already attempting to get fit through physical activity and it can therefore be reasonably assumed that these individuals will already be motivated. For this reason then, the motivational phase of behaviour change will not be targeted here and the focus will be on the volitional phase of behaviour change in order to promote physical activity. The current study has two aims, primarily to increase individual's current levels of physical activity, and secondly to reduce BMI and body fat percentage relative to controls.

4.1.2 Mindfulness

Kabat-Zinn (2003) defines mindfulness as 'the awareness that emerges through paying attention on purpose, in the present moment, and non-judgementally to the unfolding experience moment by moment' (p.145). Similarly, Brown and Ryan (2003) refer to a definition of mindfulness by Kabat-Zinn (1990), as bringing attention to the experiences of the present moment in a non-judgemental or accepting way (cited in Brown & Ryan, 2003). Mindfulness is a form of meditation that has its roots in Buddhist spiritual practices and can be enhanced through the regular practice of meditation, which in turn increases the positive qualities of awareness and insight, amongst others (Baer et al., 2006).

Mindfulness has been used in a wide range of behaviour change studies, demonstrating the effectiveness of this approach in promoting and enhancing positive behaviours. For example, mindfulness has been successful in producing significant decreases in weight, eating disinhibition and binge eating in obese individuals (Dalen et al., 2010); in enhancing performance on working memory, response inhibition and decision making measures in alcohol and polysubstance abusers suggesting that mindfulness may be effective at reducing executive and decision making deficits in these users and therefore enhancing their ability to achieve and maintain abstinence (Alfonso, Caracuel, Delgado-Pastor & Verdejo-Garcia, 2011); in reducing smoking amongst high frequency heart rate variability patients (Libby, Worhunsky, Pilver & Brewer, 2012); in improving sexual functioning (Brotto et al., 2012); increasing specific future goals post treatment in chronically depressed patients with a history of suicidality (Crane, Winder, Hargus, Amarasinghe & Barnhofer, 2012); as well as producing improvements in eating behaviour (Daubenmier et al., 2012).

Very few studies have demonstrated the effects of mindfulness in promoting physical activity however. Those that have addressed this area include Chatzisarantis and Hagger (2007), who examined the moderating effects of mindfulness in the intention-behaviour relationship using the theory of planned behaviour. Two hundred and twenty six male and female students were recruited and were assessed at two different time points five weeks apart. Measures of leisure time physical activity (Godin's Leisure-Time Activity Questionnaire), physical activity intentions, attitudes towards physical activity, perceived controllability of physical activity, habit and mindfulness were obtained at baseline, and measures of leisure-time activity only were collected at the 5-week follow-up. They found that mindfulness moderated the intention-behaviour relationship such that intentions predicted physical activity amongst those who were mindful and not amongst those who were not. They state that these findings suggest that individuals who are mindful are more likely to carry out their intentions than those who are not. They also note that interaction analysis showed that non-habitual exercisers were more likely to translate their intentions into actions than habitual exercisers, therefore showing that individuals who act more mindfully and non-habitually are more likely to act on their intentions than those who are habitual and not mindful. Chatzisarantis and Hagger conclude that the results of their research demonstrate that heightened awareness to, and attention of, preset moment to moment experiences is beneficial for translating intentions into behaviour.

Goodwin, Forman, Herbert, Butryn and Ledley (2012) have also demonstrated the effects of mindfulness in promoting physical activity. They found positive changes in diet and physical activity amongst cardiac patients following mindfulness skills training. Sixteen participants were given 90 minutes of either a range of mindfulness metaphors and experiential exercises to promote acceptance of previously avoided internal thoughts and experiences or distress-tolerance skills training, of which the mindfulness training was successful at increasing adherence to a 'heart-healthy' lifestyle. Participants in the acceptance group were also given strategies to promote cognitive defusion. This study was designed as a small pilot to assess the feasibility, acceptability and initial effectiveness of this brief Acceptance-Based Behaviour Therapy intervention to promote behaviour change, therefore the study did not include a control group or any long-term follow-ups. The results of this study were also specific to a clinical population, therefore it is possible that these participants were highly motivated and this was the reason for the positive results. Furthermore, given the wide range of mindfulness, acceptance and cognitive defusion techniques provided to participants it is difficult to determine which of these techniques was the most successful at promoting behaviour change, and finally physical activity was measured through self-report, which, according to Jakicic, Polley and Wing (1998), have only moderate reliability.

The current study examines a component of Acceptance and Commitment Therapy (ACT), which is a mindfulness-based therapy. ACT includes a number of different components and core processes, but one of the important aims of ACT that is most relevant to this study is to encourage cognitive defusion. Cognitive defusion attempts to address how our minds can sometimes become fused with our thoughts and mistake them for the truth rather than just seeing them as simply thoughts and not necessarily something that should be paid attention to or acted on (Hayes et al., 1999; Lundh, 1999). It can be achieved through mindfulness-based exercises that expose the individual to aversive thoughts, feelings, sensations and memories, and encourage a willingness to experience these negative thoughts and feelings. They require people to see their thoughts simply as thoughts and help individuals to recognise that they do not necessarily have to be followed. These exercises reduce the 'verbal regulation' of behaviour and ultimately encourage the individual to use a more open and non-judgemental stance when observing their immediate experiences (Hayes et al., 1999; Lundh, 1999). Cognitive defusion attempts to alter the undesirable functions of thoughts by altering the context in which they occur, rather than altering their frequency or sensitivity and attempts to change the way people actually interact with their thoughts (Masuda et al., 2004; Hayes et al., 2006) with the emphasis being on changing awareness of and relationship to thoughts (Segal, Teasdale & Williams, 2004; cited in Masuda et al., 2004). It therefore helps individuals to relate differently to their thoughts and feelings, and allows them to choose to act in accordance with their goals and values.

Failure to stick to plans could be brought about by particular thoughts of, for example, feeling too tired to exercise and the rationalisation of being more conscientious the following day after breaking these exercise plans. This therefore involves cognitive fusion, whereby the individual has become fused or 'tangled' in the thoughts of not wanting to exercise and justifying not taking part in physical activity by doing more the following day, therefore ultimately following these thoughts and behaving accordingly. Cognitive defusion techniques could be beneficial for these individuals in order to see their thoughts simply as thoughts and not necessarily something that have to pay attention to or act upon. In the case of physical activity, cognitive defusion may promote adherence to exercise goals and plans by helping individuals to realise that they can act in accordance with their goals and not be influenced by their thoughts. Therefore the individual can follow their exercise plans without placing any emphasis on, or following and behaving in accordance with, negative thoughts or feelings. Evidence for the effectiveness of cognitive defusion in promoting increases in physical activity comes from Tapper et al. (2009). This exploratory randomised controlled trial found that the most successful part of a mindfulness intervention for promoting physical activity was the cognitive defusion component and therefore recommend applying this component in future research aimed at promoting increases in levels of physical activity.

There are a range of cognitive defusion techniques that can be applied in clinical and non-clinical settings. Participants may be asked to repeat a negative thought out loud until it loses all meaning, to thank their mind for an interesting thought, or to label their thoughts (for example, 'I am having the thought that I am too tired to go for a run today'). By engaging in exercises like these, participants are able to reduce the literal quality of their thoughts and the result is usually a decrease in the believability of, and attachment to that thought rather than the participant actually avoiding the valued behaviour or goal (Hayes et al., 2006).

One way in which the current study extends previous research is to add to the limited area of promoting physical activity through mindfulness strategies. Studies that examine the effectiveness of mindfulness for promoting particular behaviours appear to employ a number of exercises which make it difficult to determine which component is affecting the behaviour change. Support for this comes from Masuda et al. (2004), who argued that defusion techniques only tended to be used as part of a more complex therapeutic package, and therefore the role of the defusion techniques in itself was unknown. Given that the use of mindfulness and cognitive defusion techniques to increase physical activity are limited, this argument cannot be applied here, however the evidence for the inclusion of brief cognitive defusion techniques in behaviour change studies does exist. Masuda et al. carried out a study in which they provided support for the role of a brief cognitive defusion technique (specifically repeating a word aloud) in reducing the believability of negative thoughts. From a series of case study designs comparing the defusion technique to a distraction task and a thought control task, they found that the discomfort and believability of negative thoughts was reduced more so using the cognitive defusion technique than the other techniques, thereby reducing their negative emotional impact and providing an effective means of altering the undesirable functions of thoughts. Studies such as these allow us to determine the role of very brief defusion techniques in reducing the believability of negative thoughts. The current study will therefore examine a brief intervention in order to determine whether this can influence behaviour change and allow us to confidently conclude that cognitive defusion can promote physical activity.

4.1.3 Mediators of Mindfulness

Mediators are the mechanism(s) by which the independent variable influences the dependent variable. They describe *why* a relationship works and in relation to the current study, would tell us how mindfulness strategies work (Baron and Kenny, 1986). Potential mediators of mindfulness include self-regulation (Masicampo & Baumeister, 2007) and attentional control (Valentine & Sweet, 1991; Bishop et al., 2004; Anderson et al., 2007). It is important to identify mediators in order to understand how an intervention works. If an intervention is effective and we are then able to develop an understanding of how it has worked through the inclusion of mediators, this will then allow us to extend the intervention to other settings and populations for example, or even to adapt the intervention for use in other behaviour change studies.

4.1.3.1 Self-regulation

According to Masicampo and Baumeister (2007) there is some theoretical overlap between mindfulness and self-regulatory processes. As Baumeister, Gailliot, DeWall and Oaten (2006) state, self-regulation is the process by which individuals attempt to exert control over their thoughts, feelings, impulses and task performance. Muraven and Baumeister (2000) assert that self-regulation (or self-control) relies on a limited resource, such that exerting self-regulatory processes uses up strength and therefore reduces the amount of strength available for subsequent self-regulation attempts. In this way self-regulation has been likened to a muscle in that it becomes tired after exertion, resulting in reduced power or capacity (Baumeister et al., 2006; Masicampo & Baumeister, 2007). Research has therefore examined the idea that regular self-regulatory exercise can in fact strengthen self-regulation and therefore the capacity to exert control over thoughts, feelings, impulses and task performance. Studies have employed physical exercise, regulation of posture, studying and money management in an attempt to increase participants' capacity for self-regulation and have demonstrated a reduced susceptibility to self-regulation fatigue and a better management of for example, household chores, substance use, healthier diets and study habits (e.g., Muraven, Baumeister, & Tice, 1999; Oaten & Cheng, 2006; Oaten & Cheng, 2007).

Brown and Ryan (2003) provided evidence that mindfulness is associated with heightened self-knowledge, which is a key element of self-regulation. They examined mindfulness as a predictor of day-to-day self-regulation and well-being, arguing that mindfulness plays an important role in self-regulation and emotional experience. In their study, Brown and Ryan measured self-regulated behaviour (autonomy) and emotional state multiple times a day over a period of weeks and hypothesised that the Mindful Awareness Attention Scale (MAAS) would predict more autonomous activity over time (as well as higher levels of emotional well-being). They found that both state and trait mindfulness predicted more autonomous activity (self-regulation) in day-to-day life, demonstrating the importance mindfulness serves as a self-regulatory function (Brown & Ryan, 2003).

It is possible then, that mindfulness interventions may be a useful tool for regular self-regulation exercise as they appear to share a number of key features. For example, they both involve the careful regulation of thoughts and behaviours, both involve daily adherence to exercises and also both involve commitment to these exercises over an extended period. Studies involving mindfulness and self-regulation (separately) have been reported to produce similar results. Examples of such include improvements in emotional regulation and physical health (Masicampo & Baumeister, 2007). In terms of emotional regulation, previous studies have often argued that changing or avoiding emotions leads to impaired self-regulation (e.g., Baumeister, Bratslavsky, Muraven, & Tice, 1998). Therefore Alberts, Schneider and Martijn (2012) conducted a study to determine to what extent acceptance-based coping may be a more efficient strategy in terms of self-regulatory resources and found that participants who were required to accept their emotions (and to stay in contact with the emotional experience from moment-to-moment) during a sad video performed better on a self-control task than did participants who were asked to suppress their emotions. They argue that attempts at changing or avoiding emotions are a form of control that uses up more resources and leads to the depletion of these resources, whilst acceptance does not rely upon control of emotions and therefore does not use up any self-regulatory resources. Therefore, given that mindfulness has been demonstrated as a successful tool for regulating and reducing identification with negative thoughts, and that acceptance-based coping does not use up any self-regulatory processes, it can be argued that mindfulness-based exercises are a useful tool for increasing self-regulation and enhancing participation in physical activity, by addressing potentially negative thoughts that may prevent people from carrying out their physical activity plans.

In summary, self-regulation can, in the long-term, become stronger through regular practice and exercise. Attempts to adhere to physical activity plans and not to follow any negative thoughts requires self-regulation; that is, engaging in regular (or repetitive) physical activity requires a level of control over task performance. Therefore, the regular effort required to engage in mindfulness practice may increase the capacity for self-regulation (i.e. self-regulation may become stronger through repetitive mindfulness exercise) which may in turn improve adherence to physical activity plans. Alberts, Schneider and Martijn (2012) suggest another mechanism for increasing self-regulatory resources. They argue that saving these resources and not using them up on emotional regulation can help to reduce the extent to which internal emotional states guide behaviour that is incongruent with the individuals' intentions. They suggest that this may therefore lead to an increase in self-control.

4.1.3.2 Attentional control

Bishop et al. (2004) proposed that mindfulness could be defined (in part) as the self-regulation of attention. This suggestion comes from the observation that mindfulness brings about an awareness of the current situation or experience by regulating the focus of attention, and that skills in sustained attention would be required to maintain this awareness of current experience. They also claim that the self-regulation of attention, as well as sustained attention, involves skills of attention switching and inhibition of elaborative processing, which again are the skills required to achieve mindfulness. Attention switching relates to how individuals are required to switch back to their thoughts when they notice themselves becoming distracted, and inhibition of elaborative processing is related to how individuals practicing mindfulness are required to simply notice the thought and not embark on any secondary elaborative processing of that thought.

Studies such as that of Wenk-Sormaz (2005), Valentine and Sweet (1999) and Semple (2010) provide evidence to suggest that mindfulness techniques improve attentional control. Wenk-Sormaz (2005) administered attention tasks (Stroop and a word production task) after a brief exposure to either mindful meditation, rest or a cognitive control condition. All participants were healthy adults who had no prior experience of meditation. Relative to controls, Wenk-Sormaz found that mindfulness meditation was associated with less Stroop interference and more flexible word production, suggesting that the exposure to the brief mindful meditation did in fact improve participants' attentional control. Valentine and Sweet (1999) found in their study that experienced mindfulness meditators were less vulnerable to unexpected events, again suggesting that mindfulness improves attentional control, and Semple (2010) found significant improvements in sustained attention following mindfulness meditation providing support for mindfulness enhancing attention. However, McMillan, Robertson, Brock and Chorlton (2002) conducted a mindfulness-based stress reduction course amongst patients with traumatic brain injury and found no positive effects of mindfulness on attentional control. In this particular study though, it is possible that this was due to the extent of the injuries suffered by these patients and their inability to use their attentional networks sufficiently. The course was also short in duration compared to previous studies and was also self-administered.

Following these research findings, Anderson et al. (2007) tested the hypothesis that mindfulness involves sustained attention, attention switching and inhibition of elaborative processing. They examined the level of mindfulness in healthy adults with no prior experience of mindfulness meditation after an 8-week mindfulness-based stress reduction course. Anderson et al. also contributed further to previous research through the inclusion of an independent measure of mindfulness in an attempt to relate mindfulness to attention, which previous studies had not included. In comparison to controls, Anderson et al. found no evidence for the effect of mindfulness on attentional control. They suggested that these findings could be due to factors such as self-report, short mindfulness course duration, short meditation session duration prior to administration of attention tasks or sample characteristics. The sample was non-clinical and Anderson et al. suggested that perhaps clinical populations with attentional deficits may demonstrate improvements in attentional control that may not necessarily be observed in healthy adults. However Wenk-Sormaz (2005) and Valentine and Sweet (1999) studied non-clinical samples and found positive effects on mindfulness on attentional control. Anderson et al. (2007) did find positive effects of mindfulness on present moment awareness; therefore it is possible that positive effects of mindfulness on attentional control would have been observed if the course was of longer duration.

How might improved attentional control promote adherence to exercise plans? Through improved skills in sustained attention that are brought about through mindfulness practice, an individual may be able to develop the appropriate skills to maintain an awareness of their current plans and provide them with the ability to switch attention back to the current moment if they notice themselves becoming distracted. They can then inhibit any secondary elaborative processing and simply notice the distracting thought. In terms of physical activity then, this ability to sustain attention and inhibit elaborative processing may enable individuals to stay focused on their current plans for physical activity, and if they start to experience distracting thoughts of, for example, feeling too tired and the rationalization of being more conscientious the next day, may be able to switch their attention back to the current moment and their current exercise plans and simply notice the distracting thoughts without acting on them.

4.1.4 Moderators of Mindfulness

Moderators can be qualitative (e.g. gender) or quantitative (e.g. personality score) in nature, and generally speaking are variables that affect the direction and/or strength of the relationship between an independent and dependent variable (Baron & Kenny, 1986). They describe *when* the relationship works and with particular reference to the current study, can tell us what factors may influence the efficacy of the intervention strategies. The openness and conscientiousness personality facets of the *NEO Five Factor Inventory (NEO-FFI)* (Costa & McCrae, 1992) could be suggested to be two moderating variables of mindfulness. Openness may moderate the extent to which participants are willing to engage in mindfulness strategies. People who score high on openness tend to be curious, imaginative, broad minded and unconventional (Barrick, Mount & Judge, 2001). Components or elements of openness are said to be consistent with the non-judgemental stance that is encouraged through mindfulness (e.g. receptivity to ideas, attentiveness to inner feelings and curiosity) (Baer, Smith & Allen, 2004; Giluk, 2009). This factor of the NEO-FFI is therefore argued to positively correlate with mindfulness measures (e.g. Baer, Smith & Allen, 2004). Given this, it is reasonable to assume that openness may moderate the effects of mindfulness.

Rhodes and Smith (2006) found that conscientiousness was a significant predictor of physical activity, and Why, Huang and Sandhu (2010) argue that research suggests that individuals who are highly conscientious are more likely to engage in physical activity (especially if they are highly motivated to do so). Conscientiousness may moderate mindfulness in terms of the extent to which participants actually do what they have been asked to do. People who are conscientious are said to be dependable, responsible, rule abiding and achievement orientated (Barrick, Mount & Judge, 2001) and according to Costa and McCrae (1992) a hallmark of conscientious individuals is self-discipline. In a similar way, mindfulness is said to bring about a greater ability to self-regulate (Masicampo & Baumeister, 2007), therefore it appears that mindfulness and conscientiousness share the characteristics of deliberate and effective responding and so it is argued that mindfulness and conscientiousness would positively correlate (Giluk, 2009). Given this, it is reasonable to assume that conscientiousness may moderate the effects of mindfulness.

It is also possible that task completion may influence the relationship between the independent and dependent variables. That is, if a relationship was observed between the mindfulness strategies and physical activity, only when participants reported sticking to the strategies provided, this would give us an indication that the intervention only worked if participants completed all the tasks given to them. According to Fogelholm and Kukkonen-Harjula (2000), poor adherence to any given exercise protocol may be one of the reasons why some randomised controlled trials may fail to find an association between physical activity and weight maintenance. It is reasonable to assume therefore, that sticking to the strategies provided may moderate any relationship observed between the intervention and physical activity, BMI and body fat percentage.

Given the effects that both the mediators and moderators described here may have on mindfulness, in that they may tell us why and when any potential effects may occur, it is important to include these variables in the current study. Therefore, the current study will include measures of self-regulation, attentional control, mindfulness, openness and conscientiousness and finally strategy adherence.

4.1.5 Implementation Intentions

If the current study was to employ a mindfulness strategy alone, then people may simply forget to exercise and it would therefore be difficult to determine whether the intervention was unsuccessful due to participants forgetting or because the strategy was not viable. If a combined mindfulness plus implementation intentions intervention produces effects over and above that of an implementation intentions only intervention, then it would be possible to conclude that the mindfulness strategy enhanced improvements in physical activity. Therefore, the current study will also include the use of implementation intentions.

There is increasing evidence for the effectiveness of implementation intentions on goal achievement (Webb & Sheeran, 2007). For example, Armitage (2004) asked participants in an experimental group to form implementation intentions to reduce their fat intake and found that participants showed significant reductions in their fat intake across all measurements. Adriaanse, Vinkers, de Ridder Hox and de Wit (2011) conducted a systematic review and meta-analysis of 23 empirical studies examining implementation intentions and their effects on healthy and unhealthy eating and concluded that implementation intentions were effective in promoting healthy eating behaviours. Research has also found that compared to controls, women are more likely to perform breast self-examination, individuals are more likely to take vitamin supplements, to eat healthily, attend cervical cancer screening appointments, and attend a health and safety training course after forming implementation intentions than controls (Orbell, Hodgkins & Sheeran, 1997; Sheeran & Orbell, 1999; Verplanken & Faes, 1999; Armitage, 2004; Sheeran & Orbell, 2000b; Sheeran and Silverman, 2003).

In terms of physical activity, Milne, Orbell and Sheeran (2002) recruited 248 male and female students aged 18 to 34 years with the aim of comparing a motivational intervention with a combined motivational and implementation intentions intervention to promote participation in physical activity. Participants were randomly assigned to one of three conditions to assess changes in exercise cognitions, intentions and behaviour; the groups were a control group, a protective motivation theory (PMT) intervention only group or a PMT plus implementation intentions group. Participants were followed-up over a two-week period, with measures of cognition and exercise taken at three different time points. At Time 1 participants were required to complete a background questionnaire and provided with a definition of physical activity (i.e. an exercise session must last at least 20 minutes), the motivational intervention was then administered and both intervention group participants were provided with a health education leaflet that gave details of coronary heart disease (CHD) and the benefits of exercise. At Time 2, the amount of physical activity engaged in over the previous week was measured, and to measure physical activity, participants were asked how many times they engaged in bouts of 20-minute sessions of exercise over the previous week. During this assessment participants in the implementation intentions group were also asked to form an implementation intention about where and when they would engage in physical activity over the next week. All measures of exercise cognitions, intentions and behaviour were assessed a week later at Time 3. Milne et al. found that those in the PMT only group significantly increased their intentions to engage in exercise; however this intervention did not bring about a significant increase in subsequent exercise behaviour. In contrast, the PMT plus implementation intentions group exercised significantly more than those in the PMT only and control groups, providing evidence for the effectiveness of implementation intentions.

This study by Milne, Orbell and Sheeran (2002) demonstrated the effectiveness of increasing physical activity using implementation intentions after just a short-term follow-up (i.e. two weeks). Similarly, Walsh, da Fonseca & Banta (2005) conducted a short-term follow-up, this time after only three days, and provided evidence for the effectiveness of implementation intentions. They examined eighty male and female white-collar office workers to determine whether forming an implementation intention to watch and take part in an exercise video would facilitate performance. Forty participants were randomly allocated to the implementation intentions group, and three days after forming their implementation intentions to watch and take part in the video they were asked to say whether they had indeed done so. Walsh et al. found that the formation of an implementation intention facilitated performance, and therefore concluded that this technique can be a powerful tool for the promotion of health behaviours.

A further short-term follow-up study conducted by Prestwich, Lawton and Conner (2003), demonstrated an increase in exercise frequency, the total amount of time spent exercising and increased fitness following the formation of implementation intentions. Eighty-six male and female undergraduates and university staff members aged between 16 and 41 and were randomly allocated to one of four groups, namely implementation intentions and decision balance sheet (a motivational strategy that involves making rational decisions about the positive and negative consequences of taking part in physical activity), implementation intentions only, decision balance sheet (DBS) only and a control group. Participants were assessed after a four-week period and Prestwich et al. found that the total time spent in physical activity increased for each of the three intervention groups, with the greatest increase observed in the combined implementation intention plus DBS group, although the difference between the groups was not significant. It was also found that participants in the implementation intentions only group increased their physical activity significantly more than those in the DBS only groups. Prestwich et al. describe the importance of a combined approach to increasing physical activity, arguing that their study provides further support for the results of Milne, Orbell and Sheeran (2002), who also employed a combined intervention approach. It is important to note here however, that these combined approaches were motivational approaches, and the current study examines two volitional approaches to behaviour change. Prestwich, Lawton and Conner do also note that Milne and colleagues demonstrated the combined intervention to be significantly better than a control or PMT only intervention, while Prestwich and colleagues only demonstrated marginal differences between the combined intervention and implementation intentions only or DBS only groups, the difference of which was not significant. They argue that this marginal difference, together with the significant difference between implementation intentions only and DBS only, provides support that implementation intentions are an effective strategy for increasing participation in physical activity.

The above studies demonstrate the effectiveness of implementation intentions after a short-term follow-up (e.g., a matter of days or weeks), but studies have also examined effects after a long-term follow-up (e.g., after several months). Luszczynska (2006) demonstrated participants' ability to increase physical activity after myocardial infarction (MI) after forming implementation intentions. A total of

114 male and female MI patients aged between 39 and 67 were assessed at three different time points of one week, two weeks and eight months. Participants were not allocated to their groups until after the first two appointments at one and two-weeks, therefore the first two assessments involved collecting data regarding MI and physical activity prior to MI, as well as participants' intentions to maintain regular physical activity. Participants were then randomly allocated to either the control or intervention group and were followed up after eight months to determine how often they engaged in physical activity and used a planning strategy. To measure physical activity participants were asked "Within the last two weeks, how often did you engage (for at least 30 min) in moderate physical activity (e.g. walking, cycling on level terrain, swimming; as intensively as recommended by your rehabilitation specialist)?" and to measure the use of the planning strategy they were asked four questions that enquired about how often participants made plans that included details of when, how often, where and with whom they were going to exercise. Luszczynska predicted that compared to controls, participants in the implementation intentions intervention group would perform more physical activity sessions and did in fact find that only participants in the implementation intentions intervention group adhered to their recommended number of physical activity sessions per week after eight months, thereby providing evidence for the role of implementation intentions in the promotion of a healthy lifestyle following MI. Similarly, Scholz, Knoll, Sniehotta and Schwarzer (2006) found that an implementation intention intervention enhanced physical activity in patients 12 months after being discharged from coronary heart disease rehabilitation. They examined 198 males and females and were randomly allocated to either an exercise implementation intentions intervention group or a standard-care group. Participants were followed-up at four months and 12 months and Scholz et al. found that compared to the standard-care treatment group, the intervention enhanced physical activity 12 months after discharge from cardiac rehabilitation, therefore concluding that this type of intervention should be included in rehabilitation programmes. These two studies by Luszczynska (2006) and Scholz, Knoll, Sniehotta & Schwarzer (2006), as well as demonstrating the effectiveness of implementation intentions over a long-term period, also demonstrate the effectiveness of implementation intentions within clinical populations. Given the wide range of application of implementation intentions, it could be argued that their use in behaviour change research is very effective; however it could also be argued

here that participants in clinical populations are more motivated to carry out their implementation intentions in order to increase a healthy lifestyle.

Stadler, Oettingen and Gollwitzer (2009) highlighted an additional benefit of implementation intentions in terms of cost and training requirements. They conducted a study examining the effect of an implementation intentions plus information intervention on exercise behaviour compared to an information-only intervention in women and found that participants in the implementation intentions plus information group were twice as physically active as participants in the information-only group and maintained this increase over 4 months. They argue that given the benefits of an implementation intention intervention in terms of cost and the low level of training required (individuals can apply the technique on their own), this form of intervention strategy should be incorporated into studies examining long-term physical activity behaviour change.

However, some disadvantages of implementation intentions have been raised. Budden and Sagarin (2007) conducted a study that examined the impact of implementation intentions on exercise amongst adults who reported varied levels of occupational stress. They hypothesised that employees who formed implementation intentions would be more likely to engage in exercise behaviour than those who did not form these plans. However, the results did not support this particular hypothesis. Budden and Sagarin found that not only were the participants who formed implementation intentions not more likely to exercise than those who did not, participants who did not form the intentions actually increased their levels of physical activity significantly more than those that did. One of the suggested explanations for this finding was in terms of the rigidity of implementation intentions. They proposed that implementation intentions may require some level of flexibility so that performance is not hindered if some plans cannot be adhered to. For example, if an individual forms an implementation intention to exercise at 5p.m. on a Monday, but is then unable to do so due to family or work commitments, they may experience difficulty adjusting their implementation intentions accordingly and adapting to a new time to account for the disruption in their plans. Therefore, Budden and Sagarin suggest that in order to be more effective, perhaps individuals need to form 'back-up plans' to account for any disruption or missed opportunities.

The example provided by Budden and Sagarin is “If I don’t exercise at 5p.m. on Monday I will exercise twice as long the next day” (Budden & Sagarin, 2007, p. 399). It is possible that back-up implementation intentions may increase performance.

De Vet, Oenema and Brug (2011) also highlight a disadvantage and have suggested that self-generated implementation intentions may limit the effectiveness of behaviour change. This suggestion came following the research findings of Armitage (2009) and Ziegelmann, Lippke and Schwarzer (2006), who demonstrated that self-generated implementation intentions were less effective than those that were formed when guided by an experimenter. Therefore, De Vet and colleagues conducted a study to examine the kind of implementation intention people make to increase physical activity in order to prevent weight gain. Specifically, they examined the specificity and number of implementation intentions individuals form for increasing physical activity and the relation between number and specificity of implementation intentions and physical activity change. Results showed that in terms of the specificity and number (quality and quantity) of implementation intentions formed, 30% of participants did not form specific implementation intentions for physical activity. Particularly, participants failed to specify ‘when’ they intended to carry out the activity in question. They argue that by not specifying when they intended to act, participants’ implementation intentions remained vague and may have prevented them from carrying out their goals. Further analysis demonstrated that individuals who were highly motivated to increase their physical activity formed better implementation intentions, but not more, and regardless of their motivation, participants who formed better implementation intentions reported greater levels of physical activity when assessed two weeks later. However, with regards to the relation between number and specificity of implementation intentions and physical activity change, results demonstrated that even though the quality (specificity) of the implementation intentions had a positive effect on physical activity, it was the *number* of *specific* implementation intentions formed that was important for physical activity change. Through examination of the interaction between number of implementation intentions and mean specificity per implementation intention, De Vet, Oenema and Brug found that the number of specific implementation intentions positively predicted physical activity change. They report that an increase in physical activity is more likely to occur when additional implementation intentions are formed with 'maximal specificity'. They also finally conclude that individuals were not able to form effective implementation intentions on their own, and that it may therefore be more effective to train individuals to form more specific implementation intentions, particularly in terms of 'when to act'.

Finally, Riet, Sijtsema, Dagevos and Bruijn (2011) highlight the difficulty in altering behaviour that is habitual. For example, eating is a habitual act and therefore something that we do not have to make much conscious effort to do. Changing this type of behaviour would be difficult. Given this, it could be suggested that interventions aimed at increasing a behaviour that is not habitual for some people (physical activity in the case of the current study), may be easier to promote. When interventions are aimed at promoting a behaviour that is new or infrequently engaged in, and is guided by intentions, it can become more habitual and may therefore increase that particular behaviour (Riet et al., 2011). Similarly, Adriaanse, de Ridder and de Wit (2011) argued that studies using implementation intentions aiming to promote healthy eating behaviours are effective, however studies attempting to diminish unhealthy eating behaviours (i.e. doing something versus not doing something) are less convincing (producing small effect sizes).

To summarise, implementation intentions are statements presented in an 'if-then' format that link together motivational and volitional phases of behaviour in order to narrow the intention-behaviour gap and help individuals to translate their intentions into action and achieve their personal goals. A large number of studies have been used to demonstrate the effects of implementation intentions on physical activity aside from those included here (such as Adriaanse et al., 2010; Prestwich, Perugini & Hurling, 2010; Andersson & Moss, 2011) and each of these studies differ in terms of the populations employed, recruiting samples of students, white-collar office workers, and a range of patients such as those with myocardial infarction and coronary heart disease, and the setting in which they are used (i.e. clinical and non-clinical). Given their use and success in both clinical and non-clinical health promotion studies and settings, the importance of the inclusion of implementation intentions in intervention studies not only in clinical rehabilitation programmes, but also in the area of health promotion and health behaviour change programmes is clear. Implementation intentions are an effective means of increasing physical activity, therefore their inclusion in the current study is justified.

4.1.6 Mediators of Implementation Intentions

Potential mediators of implementation intentions include accessibility of situational cues and the strength of the cue-response situation. Webb and Sheeran (2007) conducted one of the first experiments to investigate whether accessibility of situational cues (the identification of good opportunities to act) and the strength of the cue-response association (the automisation of behaviour) provided an explanation for how implementation intentions work. The accessibility of situational cues relates to the *'if'* component of implementation intentions (i.e. the anticipated situation), and when individuals engage in deliberation of the goal or act in question, the relevant situational cues become more accessible because mental representations of these cues become highly activated (Webb & Sheeran, 2007). This then makes situations in which these cues are encountered easier to notice and therefore attend to, and individuals therefore do not miss opportunities to act or waste time deliberating over what to do (Aarts, 1999; Webb & Sheeran, 2007).

The strength of the cue-response association relates to the *'then'* component of implementation intentions (i.e. the goal-directed response), and involves the forming of an association between the specified situational cue and the response that is necessary to achieve the particular goal in question. As Webb and Sheeran (2007) state, "...a mental link is formed between the *if*-component and the *then*-component of the plan" (Webb & Sheeran, 2007, p. 296). Compared to simply forming goal intentions, the formation of implementation intentions allows for control of behaviour that becomes more automatic and requires less of an individual's attention. By forging this link between a situation and response through the formation of implementation intentions, individuals do not need to consciously deliberate over a course of action, but are able to respond immediately and more efficiently, requiring limited cognitive resources and less conscious awareness/attention (Webb & Sheeran, 2007).

From their investigation of these potential mediating variables, Webb and Sheeran (2007) found that implementation intention effects were mediated by cue accessibility and the strength of the cue response and conclude that implementation intentions are effective because they involve "...specified situational cues that initiate action automatically" (Webb & Sheeran, 2007, pg. 295).

4.1.7 Moderators of Implementation Intentions

Potential moderators of implementation intentions include the ease of behaviour, activation and strength of goal intentions, the degree of implementation intention formation and the level of conscientiousness of an individual. With reference to ease of behaviour, according to Brandstatter, Lengfelder and Gollwitzer (2001) and Dewitte, Verguts and Lens (2003), implementation intentions are more likely to have stronger effects when the task in question is difficult or the individual has difficulty regulating the behaviour. Gollwitzer and Brandstatter (1997) found in an experiment on difficult versus easy goal intentions, that when individuals formed implementation intentions for both easy and difficult tasks they wished to complete, the effect was greater for the difficult tasks. The execution rate for difficult tasks increased from 22% to 62% for difficult tasks compared to an increase of 78% to only 84% in easy tasks; therefore it appears that when a task is more difficult implementation intentions can help to promote the behaviour. With respect to physical activity, Hall et al. (2012) carried out a study examining the effect of unsupportive environmental conditions on ease of implementation intentions and exercise. They expected to observe a stronger behaviour-intention relationship than the control condition when in non-supportive environmental conditions (i.e. winter), given that this would present the individual with a difficult task. The results, specifically in terms of physical activity, provided evidence for the beneficial effects of implementation intentions in difficult, non-supportive environmental conditions (Hall et al., 2012).

In terms of activation and strength of goal intentions, one of the difficulties with achieving successful task performance is actually getting started. Implementation intentions will only influence behaviour if the individual is motivated to actually perform the behaviour. Also, the stronger the goal intention is, the more likely the individual is to carry out that behaviour (Gollwitzer, 1999). According to Gollwitzer (1999), the strength of the commitment to the formed implementation intention as well as the commitment to the goal that the implementation intention was formed for, matters. Research such as that of Seehausen, Bayer and Gollwitzer (1994), Stellar (1992) and Orbell, Hodgkins and Sheeran (1997) (all cited in Gollwitzer, 1999) have shown that individuals benefit from having strong intentions and forming strong implementation intentions rather than weaker ones. Therefore, the degree of implementation intention formation is important; if an individual is committed to their plan it will be more effective (Gollwitzer, 1999).

Finally, as with mindfulness strategies, the conscientiousness personality facet of the *NEO Five Factor Inventory (NEO-FFI)* (Costa & McCrae, 1992) may also moderate the effects of implementation intentions, in that conscientiousness may be associated with the extent to which participants actually do what they have been asked to do. As Walsh, da Fonseca and Banta (2005) state, conscientiousness is the tendency to make plans and be well organized in carrying out those plans. Given this, it is reasonable to assume that more conscientious people would be more likely to carry out their implementation intentions to exercise.

4.1.8 Conclusions of Literature Review

4.1.8.1 Summary

Weight loss is difficult to achieve and even more difficult to maintain. Physical activity has been used in a wide range of studies in an attempt to promote weight loss amongst overweight and obese individuals; however there is evidence to suggest that physical activity is not always successful for weight loss but a more useful tool for weight loss maintenance. Given the evidence presented here for the success of physical activity as a weight maintenance tool, further research is needed to implement interventions aimed at helping people to adhere to strategies that promote physical activity and therefore assist people in maintaining weight loss. Also, given the evidence for the success of mindfulness strategies in promoting behaviour change and given the lack of studies employing mindfulness techniques for the promotion of physical activity, it can be further suggested that this is an important area of research that requires examination. Therefore, the current study was designed to examine whether mindfulness strategies may help to promote physical activity. Furthermore, given that implementation intentions have been shown to be an effective means of promoting physical activity, and the possibility that the mindfulness strategy may not work if participants do not make any plans (e.g., devise implementation intentions) to exercise, the inclusion of implementation intentions in this study is justified. Therefore the study will include a mindfulness plus implementation intentions group as well as an implementation intentions only group and a no-treatment control group in order to determine whether the combined mindfulness intervention is more effective than an implementation intentions strategy alone. By introducing an element of mindfulness to intervention strategy research, this may help to promote physical activity further.

4.1.8.2 Design and evaluation of complex interventions

Complex interventions are those that are made up of several different interconnecting components, of which randomised controlled trials are widely accepted as the most reliable method to determine the effectiveness (Campbell et al., 2000). Campbell et al. (2000) note the difficulties involved in defining, developing, documenting and reproducing complex health interventions that involve a wide range and number of components or variables. An example would be a group intervention study such as the current one, involving behavioural change strategies or interventions. Campbell et al. recommend a sequential process to developing and evaluating complex health interventions. The first step of such research is to identify the evidence and then define the components of the intervention through piloting for example. Following the identification of components through pilot analysis, exploratory trials are then recommended in order to establish measures, sample size and size of effect for a main trial. Campbell et al. suggest that the use of such a sequential process, although challenging, should lead to improved design, execution and generalisability of results.

In terms of the early piloting stages of Campbell's model, research that has demonstrated the positive effects of mindfulness in a large number of behaviour change studies (e.g., Dalen et al., 2010; Alfonso, Caracuel, Delgado-Pastor & Verdejo-Garcia, 2011; Libby, Brotto et al., 2012; Crane, Winder, Hargus, Amarasinghe & Barnhofer, 2012; Daubenmier et al., 2012; Libby, Worhunsky, Pilver & Brewer, 2012). Similarly, extensive work has been carried out on the effectiveness of implementation intentions on behaviour change, such as the experimental studies set out in Section 4.1.5, amongst others (e.g., Walsh, da Fonseca & Banta, 2005; Luszczynska, 2006; Scholz, Knoll, Sniehotta and Schwarzer, 2006). Therefore, as the success of implementation intentions in effecting behaviour change has also been demonstrated numerous times, particularly in the area of increasing physical activity, it is reasonable to suggest that there is sufficient evidence that allows us to proceed to an exploratory trial. Interestingly, implementation intentions have not yet been paired with mindfulness strategies and so it was deemed appropriate to conduct an exploratory trial assessing the effectiveness of a combined mindfulness plus implementation intentions intervention for increasing physical activity.

Campbell et al. also argue that even though in research the use of a no-treatment control group will seem unacceptable to those taking part in the study, a possible solution to this would be to include a no-treatment control group in which participants who fall into this group will ultimately receive the intervention strategies at the end of the study. Therefore the main study employed a no-strategy control group, in which all participants received all information about strategies after the final six-month follow-up. All participants in the main study were also randomised on the recommendations of Campbell and colleagues. This recommendation was suggested on the basis that it would allow for the assessment of effect size and for calculating sample sizes for a larger trial, should the results support the hypotheses (Campbell et al., 2000).

An additional important part of clinical or intervention trials is the ability to obtain an unbiased complete data set for all randomised participants in the research. This is achieved through an intention-to-treat analysis, which is analysis based on the initial treatment intent and not on the treatment eventually administered. It is carried out in order to avoid the effects of drop-out and is a strategy for the analysis of randomised controlled trials that compares all patients in the sample regardless of whether they subsequently withdrew from the research (Hollis & Campbell, 1999). It therefore provides information on the potential effects of treatment policy and not on any potential effects of the specific treatment carried out. There are a number of ways for dealing with missing data, the most commonly employed being the last observation carried forward (LOCF). This is where the last observation obtained from participants is used to replace any data values that are missing (Lachin, 2000). As with all methods, LOCF is not without its difficulties, and as Lachin (2000) argues, the best way to address the issue of missing data is to try and avoid as much missing data as possible. Attrition can introduce bias to a study if the characteristics of the participants that have dropped-out differ from those that remain in the study (Dumville, Torgerson & Hewitt, 2006). As reported by Dumville et al. (2006), Schulz and Grimes have argued that an attrition rate of 5% or less is generally acceptable, but that anything over 20% is a cause for concern (cited in Dumville et al., 2006).

A number of studies have attempted to reduce attrition rates and increase adherence to studies. These have included the effects of extended treatment contact, extended therapist contact, monetary incentives, provision of food, telephone contact, social support and the use of personal trainers to encourage physical activity (e.g., Perri, McAdoo, McAllister, Lauer & Yancey, 1986; Perri et al., 1988; Leermakers, Perri, Shigaki & Fuller, 1999; Jeffery et al., 1993; Wing & Jeffery, 1999). As Dumville, Torgerson and Hewitt (2006) state, loss to follow-ups can greatly affect the strength of a trial's findings, therefore it is important to try and avoid as much missing data as possible. In an attempt to address this particular issue in the current study, participants will be recruited on the basis that they were actively attempting to get fit through physical activity and were therefore assumed to be reasonably motivated to adhere to the study.

The most common means of assessing overweight and obesity is through body mass index (BMI), and as a means of comparison in terms of a weight loss measurement, this method seems appropriate. However, although commonly used, it is not without difficulties. For example, according to Hubert et al. (2009), BMI can sometimes provide false-positives. That is, without taking into account an individual's physique (e.g. muscle mass), some people can wrongly be considered overweight or obese. A way of overcoming this could be to measure body fat percentage (or body composition), which is the amount of an individual's body fat as a proportion of their body weight. Body fat is measured through bio-impedance analysis, which involves sending a safe low-level electrical signal through the feet of participants while they stand on the monitors footpads (Sung, 2001). It is easy for the signal to flow through fluids in the muscle and other body tissues, but meets resistance as it passes through body fat, as it contains little fluid. Based on medically researched formulas, percentage body fat is then calculated. The current study will examine both BMI and body fat percentage with the aim of reducing both of these in comparison to controls.

4.1.8.3 Addressing the gaps

To explore the issues addressed above, the present research was designed to implement an intervention using a 3-group randomised controlled design, with the primary aim of increasing individuals' current levels of physical activity and the secondary aims of reducing BMI and percentage of body fat relative to controls. Interventions that address increasing levels of physical activity have implications for not only improving general wellbeing and decreasing the risk of chronic health conditions, but also for helping to maintain weight loss after dieting. This study adds to the already well-established literature on the role of implementation intentions in health psychology by assessing their utility within the framework of mindfulness. It is, as far as we are aware, the first study to attempt to enhance the effects of implementation intentions to increase physical activity through the use of mindfulness. Based on the evidence presented in this review, the following predictions were made:

1) There will be a significantly greater increase in levels of physical activity in the mindfulness plus implementation intentions group compared to the implementation intentions only group, and a significantly greater increase in levels of physical activity in the implementation intentions only compared to the control group.
2) There will be a significantly greater decrease in BMI and body fat percentage in the mindfulness plus implementation intentions intervention group compared to the implementation intentions only group, and a significantly greater decrease in BMI and body fat percentage in the implementation intentions only compared to the control group.
3) Self-regulation, attentional control and mindfulness will mediate the effect of the mindfulness intervention on physical activity, BMI and body fat percentage. Mindfulness is thought to increase self-regulatory abilities and attentional control, therefore an increase in physical activity will be brought about by increases in self-regulatory ability and attentional control.

4) Strategy adherence, openness and conscientiousness will moderate the relationship between the mindfulness intervention and physical activity, BMI and body fat percentage. Specifically, higher levels of strategy adherence, openness and conscientiousness will be associated with greater increases in physical activity in the mindfulness group.
5) Strategy adherence and conscientiousness will moderate the relationship between the implementation intentions only intervention and physical activity, BMI and body fat percentage. Specifically, higher levels of strategy adherence and conscientiousness will be associated with greater increases in physical activity in the implementation intentions only group.

From the literature provided it is clear that there is good evidence to support the effectiveness of implementation intentions in increasing physical activity. It can also be reasonably suggested that mindfulness tasks could help promote physical activity. Therefore the current study was designed to examine whether the use of a mindfulness strategy could enhance the effects already observed with implementation intention interventions. In order to confidently conclude whether any improvements in physical activity are enhanced by a mindfulness strategy, a three-arm randomised controlled trial is necessary; this will allow us to determine whether a combined implementation intentions plus mindfulness intervention have effects over and above that of implementation intentions alone.

4.2 Pilot Study

The aim of the main study was to implement an intervention with the primary aim of increasing individuals' current levels of physical activity and the secondary aims of reducing BMI and percentage body fat relative to controls. However, prior to developing the main study materials it was considered necessary to assess the feasibility and acceptability of the intervention materials and questionnaires. A pilot study was therefore conducted, with the aim of exploring the effectiveness of the measures and length of time participants needed to become confident using a mindfulness intervention.

4.2.1 Method

4.2.1.1 Participants

A total of 9 pilot participants were recruited; 4 female and 5 male. These were all postgraduate students who were recruited via word of mouth at Swansea University Psychology Department. All participants volunteered to take part in the study without incentive. Inclusion criteria were English as a first language and aged 18 or over. The mean age of the sample was 32 years (SD=11.66, range 25-53). All participants were informed of the nature of the study and provided written consent. The study was approved by the ethics committee at Swansea University's Psychology Department.

4.2.1.2 Procedure

Participants were required to visit the Psychology Department in order to practice the mindfulness intervention. They were informed of the nature of the study, which involved practicing the exercise, and then answering a number of questions on how they found it, whilst also having the opportunity to ask questions and make comments. These responses were recorded verbatim. Participants were required to take part in a mindfulness intervention for 5 minutes every day for five days. The intervention consisted of an exercise encouraging participants to notice their thoughts for the 5 minutes each day. Participants were given an instruction sheet, which they were required to read until they felt confident enough to start, and were then timed for 2 minutes practicing the exercise. Participants were then asked how they found the exercise, asked to make comments, and then timed for a further 5 minutes. If participants had no further comments or questions, they were required to complete the Toronto Mindfulness Questionnaire (TMQ), which measures the extent to which people are mindful of their thoughts. Responses on this questionnaire were summed on two scales (Curiosity and Decentering). They were then asked to return each day for the following 4 days to practice this exercise for 5 minutes and to complete the TMQ. Participants were also given three additional sheets with different mindfulness exercises on them, to take home and practice. The results from this pilot allowed us to determine how long participants needed for the training programme in the main study.

4.2.1.3 Measures

The *NEO Five Factor Inventory (NEO-FFI)* (Costa & McCrae, 1992): the short version of the NEO Personality Inventory-Revised (NEO PI-R) questionnaire. It consists of 60 items comprised of 5 factors of adult personality. This pilot incorporated only two of the domains of this questionnaire, namely openness and conscientiousness, taking approximately 4-5 minutes to complete. Participants were required to complete 12 questions for each of these two domains, and to respond within the range of *'SA=strongly agree'* to *'SD=strongly disagree'*.

Toronto Mindfulness Scale (TMS) (Lau et al., 2006): the TMS is a 13-item, two-factor questionnaire called Curiosity and Decentering. The items relating to the curiosity factor reflect an individual's attitude of wanting to learn more about their experiences and the items reflecting the decentering factor reflects an awareness of an individual's experience with some distance rather than getting carried away with their thoughts and feelings. The items 3, 5, 6, 10, 12, 13 reflect the curiosity scale and are summed to get a score for this factor, whilst the items 1, 2, 4, 7, 8, 9, 11 reflect decentering and are summed to reveal the score for this factor.

'Making Plans' (See Appendix K): an intervention measure that provided information on what implementation intentions are and how they can be an effective way of helping people achieve their goals (in the case of this study, exercise goals).

'Leaves on a Stream' (See Appendix L): a mindfulness exercise, which provided an exercise for becoming more aware of thoughts.

'Practicing Noticing Your Thoughts' (See Appendix M): provided examples of the ways in which the Mindfulness task could be practiced.

'Sticking to your Plans' (See Appendix N): a cognitive defusion exercise for helping individuals stick to implementation intentions once they became more practiced at noticing their thoughts.

4.2.2 Results and Discussion

The NEO-FFI was used for timing purposes only and this particular measure (incorporating only the domains of openness and conscientiousness) took only 4-5 minutes. This was deemed acceptable for the main study as it was very quick and easy to administer and complete.

Participants were asked to provide comments on the intervention measures in order to determine whether they were suitable for the main study. Participants were asked to comment on ease of use and understanding. No comments were made on either the 'Making Plans' or 'Sticking to Your Plans' strategies, with participants verbally reporting that they had no difficulties with these measures at all. Only one comment was made for the 'Practicing Noticing Your Thoughts' strategy, which was "Difficult to time five minutes when in the bath for example". Five out of the nine pilot participants provided feedback for the 'Leaves on a Stream' exercise. Three of these participants commented on the difficulty of the exercise, particularly how it was difficult to keep visualizing the stream. This was addressed in the main study by ensuring participants were aware that this exercise was difficult, and that with continuous practice the exercise should become easier. Also, they were provided with additional examples of how they could practice noticing their thoughts rather than using the leaves on a stream exercise if they found it too difficult. The remaining two participants suggested ways in which to make the exercise easier to visualize, either through closing eyes or by reading the exercise to the participants. It was decided from this that for the main study, participants would be given time to read and practice the task whilst in the company of the researcher and they could do this either with their eyes open or closed, depending on which they found most useful.

Feasibility calculations were carried out to determine the viability of carrying out the number and length of assessments and intervention training on a sample of 50 participants per intervention group (i.e. 100 intervention participants), 40 per group or 30 per group. The total length of assessment time for each participant at each time point was calculated, followed by the total number of hours the assessments would take at each time point for each sample size (i.e. total number of hours for a group of 50 participants, 40 and 30). From this it was determined how many weeks it would take to carry out each of the assessments at each time point (i.e. including follow-ups) for each of the sample sizes. It was determined that to include 50 participants in each of the intervention groups it would take approximately 87 weeks, for 40 participants in each intervention group it would take approximately 70 weeks and for 30 participants in each intervention group it would take approximately 53 weeks. These calculations did not include control participants.

4.2.3 Main Observations/Summary

From the NEO-FFI and intervention measures results it was concluded that these measures were appropriate for use in the main study. The NEO-FFI was quick and easy to administer, and pilot participants had very few difficulties with the intervention measures. Those difficulties that were encountered and provided through feedback were addressed for the main study through clear explanations, training sessions and examples of how the exercises could be carried out.

Campbell et al. (2000) recommend a sequential process to developing and evaluating complex health interventions. Following the identification of components through for example, pilot analysis, exploratory trials are then recommended in order to establish measures, sample size and size of effect for a main trial. From the data obtained through the current pilot study, such as the difficulties encountered with the 'Leaves on a Stream' exercise, and the feasibility analysis, there will likely be some difficulty in bringing about sustained change using such brief intervention strategies. Given this, and the recommendations put forward by Campbell et al. (2000), it was decided to design the main study as an exploratory trial in order to determine the efficacy of mindfulness and implementation intentions on increasing physical activity and reducing BMI.

4.3 Study 3 Method

4.3.1 Sample Size

In terms of attrition rates, Baer (2003) conducted a review of empirical research on mindfulness-based interventions, and identified 13 studies that reported the number of participants that took part in a mindfulness training programme and the number of participants who completed it. They noted that the percentage of participants that completed the programmes ranged from 60 to 97%. In the study with the lowest completion rate of 60%, the sample of participants were outpatients drawn from an inner city health clinic, whilst the population of participants who took part in the study with the highest completion rate of 97% were medical students. Ten of the 13 papers identified employed a clinic sample of participants; however the three that used non-clinical samples were that of Astin (1997) who used college students and reported an attrition rate of 14%, Shapiro et al. (1998) who recruited medical students and reported a 3% attrition rate and finally Williams et al. (2001), who employed a sample of community volunteers and reported an attrition rate of 15%.

On the basis of sample size calculations, assuming a within-group standard deviation of 4.35, and an attrition rate of 15% (Williams et al., 2001), a sample size of 63 participants per group (189 in total) should be sufficient to detect a difference of approximately 2 sessions of moderate to vigorous levels of activity after 6 months (80% power, two-tailed, $p<0.05$) for a main randomised controlled trial (RCT). Initially, studies using the 7-Day Physical Activity Recall (7-Day PAR) questionnaire and implementation intentions were sought for these sample size calculations, however none were identified. Therefore, the level of change to be identified for a main RCT and the underlying variance were obtained from Tapper et al. (2009), who conducted an exploratory RCT of a mindfulness-based weight loss intervention. For a brief exploratory randomised controlled trial however, even after a 6-month follow-up, an effect of this magnitude is unlikely due to the difficulty of bringing about sustained change using very brief intervention strategies. It is important to note that this study was designed as a brief exploratory trial, the results of which will provide a more informed sample size calculation for any future second-phase randomised trial of this nature, and therefore a smaller number of participants were recruited for the current study.

4.3.2 Participants

A total of 60 participants took part in the current study (12 male; 48 female) and the ages of participants at baseline ranged from 18 to 65 (M=36.55; SD=12.36). The sample had a mean BMI of 26.70 (SD=5.29; range=17.16 to 40.44) and a mean percentage body fat[10] of 31.21% (SD=9.31%; range=10.5 to 47.5%) at baseline. The healthy range of body fat percentage differs for males and females, being between 8 and 25% for males aged between 18 and 99 years, and between 17 and 36% for females in the same age range. The mean body fat percentage for males in this study was 25.58 (SD=10.24; range=10.5 to 43.5), which was just slightly outside the healthy range for males, and the mean body fat percentage for females was 32.62 (SD=8.72; range=11 to 52), which was within the healthy range for females. Participants were recruited from staff and students at Swansea University via email and poster/flyer advertisements. As incentive to take part participants were entered into a prize draw to win £100 in High Street gift vouchers. An email was sent out to all staff and students of the university that contained details of the research and provided a link to the study advertisement and information sheet.

Inclusion criteria were English as a first language and over 18 years of age; participants were recruited on the basis that they were actively attempting to get fit through physical activity. At their first appointment participants were provided with an NHS Direct leaflet on exercise and directed to the section on risks involved in taking part in physical activity. They were told to contact their GP should they have any concerns about any of the points raised, or about their own physical health. Figure 4.1 shows the flow of participants through the study. Participants provided informed consent the study was approved by the ethics committee at Swansea University's Psychology Department.

[10] Body fat percentage is the amount of an individual's body fat as a proportion of their body weight. Monitoring body fat percentage is important as reducing excess levels has been shown to reduce the risk of certain conditions such as high blood pressure, heart disease, diabetes and cancer.

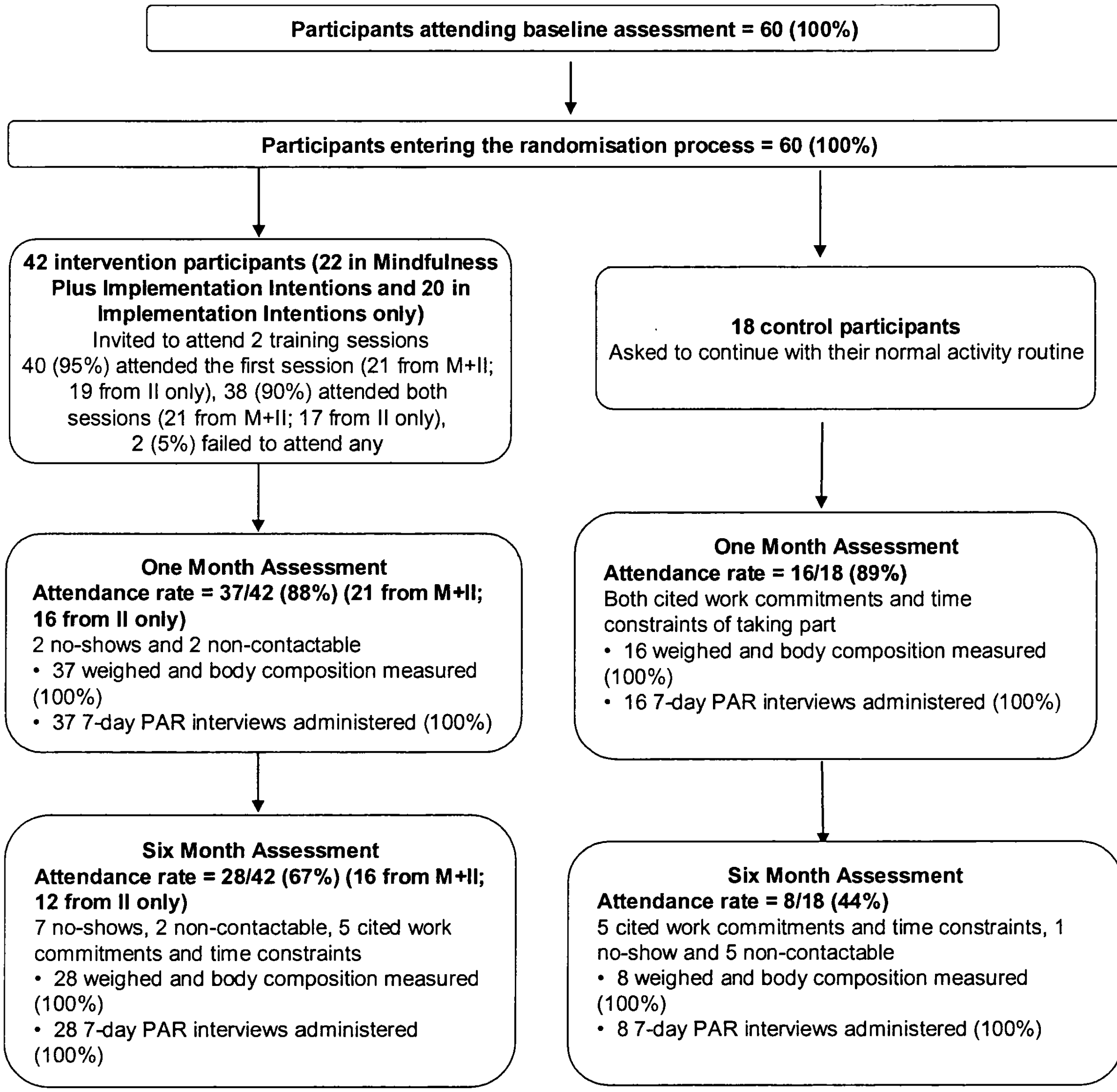

Figure 4.1 Flow of participants through the study.

4.3.3 Measures

Brief Physical Assessment Tool (or *3Q assessment)* (Smith, Marshall, & Huang, 2005) to assess physical activity. This measure has been shown to have moderate test–retest reliability (Smith et al., 2005). It consists of three items recording a) the number of 30 minute bouts of moderate intensity levels of activity within a week, b) the number of 30 minute bouts of walking within a week, and c) the number of 20 minute bouts of vigorous levels of activity within a week. The questionnaire is scored as the total number of activity sessions per week with 20 minute bouts of vigorous activity counting as two sessions. Of the total number of activity sessions per week, 0-2 sessions are regarded as 'minimal' physical activity per week, 3-4 sessions are classed as a 'low' level of physical activity per week, 5-7 sessions as 'adequate', and greater than 8 sessions as 'high' levels of physical activity. This measure was used at baseline as one of the randomisation variables.

7-day Physical Activity Recall (7-Day PAR) interview (Sallis et al., 1985) to measure continuous physical activity. This was the primary outcome measure in this study and was developed by Sallis, Haskell and Wood in 1985. It is a widely used measure of physical activity in epidemiological, clinical and behaviour change studies (Sallis et al., 1985) and is well validated (e.g. Blair et al., 1985; Rauh et al., 1992; Taylor et al., 1984). The interview administered version can be completed in approximately 20 minutes.

The 7-day PAR used in this study was the semi-structured interview version that estimates participants time spent in sleep, and moderate, hard and very hard physical activities (only for bouts of greater than 10 minutes) for the morning, afternoon and evening, 7 days immediately prior to interview. It covers all types of activity, including aerobic exercise, work-related activities, gardening, walking and leisure activities. The interviewer guides the participant through their daily activities by segmenting each day and asking questions and prompting participants in such a way that aids recall. The interviewer is then able to determine from this information, details regarding the duration, intensity, and volume (energy expenditure) of physical activity. Only activities of moderate intensity and greater are included in the calculations, and from the hours that the participant spends in these levels of activity, the total kilocalories per day can be estimated.

The PAR is scored by evaluating the average number of minutes of activity (the sum of moderate, hard, and very hard) that is performed each week. Because of the detail provided in the assessment it is also possible to estimate total daily energy expenditure. For this calculation, the time spent in each category (hours) is multiplied by body weight and a caloric value (based on intensity) to yield total energy expenditure. Any time that participants do not spend in sleep or any of these intensities of activity is assumed to be spent in 'light' activities. This measure was deemed appropriate as the primary outcome measure in this study as the intervention procedure used here targeted increasing physical activity among adults and it was expected that participants would engage in more physical activity after the intervention (Sallis et al., 1985).

Body Mass Index (BMI) and *percentage body fat*. These two variables were the secondary outcome measures. BMI (kg/m^{2}) is calculated through measurements of participants' height and weight. Height was measured using the SECA Portable Leicester Height Measure and was recorded to the last complete millimetre and weight was measured without shoes and socks using the Tanita InnerScan Body Composition Monitor (model number BC-571) in kg. This scale was also used to measure participants' body fat percentage and was measured through Bio-Impedance Analysis.

The *NEO Five Factor Inventory (NEO-FFI)* (Costa & McCrae, 1992). This is the first of the hypothesised moderator variables and is a short version of the NEO Personality Inventory-Revised (NEO PI-R) questionnaire. It consists of 5 factors of adult personality. It is a 60-item version that provides a brief, comprehensive measure of personality and consists of 12-item scales that measure the domains of neuroticism, extraversion, openness, agreeableness and conscientiousness. Each of these five domains also consists of six traits or facets. The full version takes approximately 10-15 minutes to complete, but as this study incorporated only two of these domains, namely openness and conscientiousness, this particular measure took only 4-5 minutes (employing a total of 24 items). Openness consists of the traits fantasy, aesthetics, feelings, actions, ideas and values, whilst conscientiousness consists of competence, order, dutifulness, achievement striving, self discipline and deliberation. Participants were presented with 12 questions for each of these two domains, to which they were asked to fill in only one response for each statement. They were required to respond to all of the statements, providing the answer that best represented their opinion. The responses that participants were required to give ranged from *'SA=strongly agree'* to *'SD=strongly disagree'* with an option of responding *'N=neutral'*. Participants were given a score for each of the 12 items on each domain, and that score represented their openness or conscientiousness score.

Participants were also given a background questionnaire (See Appendix O), which enquired about age, gender, occupation, and highest level of education. As well as these background variables, weight and height to determine BMI were also deemed to be potential moderator variables.

Task Completion Questionnaires. Quantitative measures of the extent to which participants stuck to the exercises provided were developed and given to the intervention participants at each of the follow-up sessions (at one- and six-months). All intervention participants were asked to *'Please indicate on the scale below the extent to which you have stuck to your exercise implementation intentions over the previous week'.* They rated their task completion on a 5-point scale, where *1=Not at all* and *5=All the time* (See Appendix P). Group A (Mindfulness plus Implementation Intentions) were also asked *'During the previous week, on approximately how many days did you spend 5 minutes practicing noticing you thoughts?'*, to which they indicated the number of days out of seven that they had practiced this exercise (See Appendix Q). Two further questions given to group A were *'Please indicate on the scale below the extent to which you have noticed your thoughts about exercise over the previous week'* (See Appendix R), and *'Over the previous week, when you have found yourself making excuses not to exercise, to what extent have you employed the strategies suggested on the 'Sticking To Your Plans' sheet? (e.g., 'Mind Bus', 'I'm having the thought...', 'But / And')'* (See Appendix S). Responses to these two questions were also on a 5-point scale, where *1=Not at all* and *5=All the time.*

The *Adult Temperament Short Version Questionnaire (ATQ Short)* (Rothbart, Ahadi & Evans, 2000; Evans & Rothbart, 2007). This is the first of the hypothesised mediator variable measures and was used as a measure of attentional control. The full version of the ATQ was adapted from Derryberry and Rothbarts' (1988) Physiological Reactions Questionnaire and based upon the results of studies by Rothbart, Ahadi & Evans (2000) and Evans & Rothbart (2007) the full version of the ATQ was developed. Both the full and short versions include the same sub-scales, namely attentional control and inhibitory control and are scored separately. Of the 12 questions on the short version of the questionnaire, 5 are from the attentional control (AC) scale, and 7 are from the inhibitory control (IC) scale. The AC items are 1 (*"It's often hard for me to alternate between two different tasks"*), 2 (*"When I'm trying to focus my attention, I am easily distracted"*), 6 (*"When interrupted or* *distracted, I can usually shift my attention back to whatever I was doing before"*), 7 (*"It is very hard for me to focus my attention when I am distressed"*), and 8 (*"When I am happy and excited about an upcoming event, I have a hard time focusing my attention on tasks that require concentration"*). The remaining questions are the IC items. Items 3, 4, 5, 6 & 12 are reverse coded and higher total scores represent poorer attentional control.

The *Mindful Awareness Attention Scale (MAAS)* (Brown & Ryan, 2003). This is the second of the hypothesised mediator variable measures and was used to measure mindfulness. Brown and Ryan (2003) found that individuals naturally differ in their tendencies towards their ability to be mindful. They reported that people who scored higher on the MAAS also reported higher states of mindfulness within their normal everyday lives. Brown and Ryan's MAAS is a 15-item scale that measures an individual's tendency to experience mindful states; that is, their tendency to be attentive to and aware of, moment-to-moment experience in daily life. It therefore examines the presence or absence of a person's awareness of what is happening to them in the present moment across cognitive, emotional, physical, interpersonal and general domains. Participants rate to what extent they experience periods of 'automatic pilot', being preoccupied and not paying attention to the present moment. Participants are asked to indicate how frequently they experience each of the items described in the questionnaire using a 6-point Likert scale where *1=almost always* and *6=almost never*. High scores are indicative of more mindfulness. The MAAS has been shown to have good internal consistency with alphas of 0.82 in student samples and 0.87 in adult samples and demonstrates convergent and discriminant validity with measures such as the NEO-PI, NEO-FFI, the Mindfulness/Mindlessness Scale (MMS), Beck's Depression Inventory (BDI), Rosenberg's Self-Esteem Scale, and the State-Trait Anxiety Inventory (STAI).

Freidburg Mindfulness Inventory (FMI) (Buchheld, Grossman, & Walach, 2001). The FMI is this is the third of the hypothesised mediator variable measures and is a consistent and reliable measure of mindfulness. It assesses the extent to which people judge their present-moment experiences from a non-judgmental stance and also their openness to negative experience. For this questionnaire participants are required to rate each of the items on the scale for a given time-period (decided by the researcher based on the requirements of the study). An example of an item on this scale is *"I am open to the experience of the present moment"*, and the responses range from *"Rarely"* to *"Almost always"*. The full version is a 30-item scale with an internal consistency alpha of 0.93 and is sensitive to changes in mindfulness over time and can be used for participants without any prior meditation experience although is more suitable for people who are already experienced in meditation practices. The short-form version was used in this study and is a 14-item scale reported by Walach et al. (2006) to be semantically robust and psychometrically stable with an alpha of 0.86. This short version also possesses medium to low construct validity (Walach et al., 2006).

The hand-grip task (Muraven et al., 1999). This was the final mediator variable measure used. The White Bear thought suppression task (Wegner et al., 1987) (which addresses deliberate attempts to avoid or get rid of unwanted thoughts; i.e., thought suppression), was presented to participants in between carrying out the first and second hand-grip task. Participants were required to spend 5 minutes in silence, attempting to not think about a white bear. According to Wenzlaff and Wegner (2000), these attempts have been found to increase the frequency of these unwanted thoughts. Every time participants did think of a white bear, they were asked to make a tally mark on the sheet provided (See Appendix T). For the hand-grip task, participants were required to squeeze the 2 handles of the hand grip together, compressing the spring and causing resistance. A piece of paper was placed between the 2 handles in order to determine when the participant loosened their grip, and the amount of time taken between starting the exercise and the piece of paper falling was recorded. The difference in the time taken to squeeze the hand grip before and after the thought suppression (White Bear) task was calculated (Muraven et al., 1999) by subtracting the second hand grip time from the first (i.e. time before thought suppression minus time after thought suppression). Therefore positive scores at each time point (i.e. baseline, one- and six-month follow-ups) indicate an improvement in self-regulatory ability and negative scores indicate poorer performance. In order to determine whether participants' self-regulatory ability improved after one-month and six-months, scores at baseline were subtracted from those at one- and six-months (i.e. one/six months minus baseline), and similarly a positive score represented an improvement and a negative score poorer self-regulatory ability.

4.3.4 Intervention

'Making Plans' (See Appendix K). This intervention strategy employed an implementation intentions sheet, which provided information on what implementation intentions are and how they can be an effective way of helping people achieve their goals (in the case of this study, exercise goals). This form was used to encourage participants to form implementation intentions relating to their exercise plans for both intervention groups (i.e. Mindfulness plus Implementation Intentions and Implementation Intentions only). The number of implementation intentions devised was not important, but the form read: "*We would like you to form a series of implementation intentions to help you get fit. These can relate to any type of exercise you like, wherever you like, as often as you like. You might want to make plans to do a bit of exercise every day (for example by walking to work), or you might prefer to plan for less frequent exercise (for example by going to the gym twice a week). The important thing is to make a plan you think you can stick to over the next 6 months*".

'Leaves on a Stream' (See Appendix L). This is a mindfulness exercise, which provided a brief explanation on how practicing noticing our thoughts can be a helpful exercise for becoming more aware of our thoughts and being better at preventing them getting in the way of plans (in this case exercise plans). This sheet was used to encourage participants to notice their thoughts. Participants were asked *"...we'd like you to set aside 5 minutes every day to practice seeing your thoughts as thoughts. This might be when you are in the shower, walking to work, eating breakfast or simply sitting quietly. During these 5 minutes you can either use the Leaves on a Stream exercise, or you can choose another method that you find more helpful. Some people prefer to imagine their thoughts on clouds or balloons or written on a wall. If you are doing this exercise with your eyes open you may find it easier to simply verbalise your thoughts without using any visual imagery. How you go about this task is up to you. The important thing is to try to notice your thoughts as they occur and, if you find your attention wandering, simply bring it back to your thoughts."* A *'Practicing Noticing Your Thoughts'* sheet (See Appendix M) was also given, which gave examples of the ways in which the mindfulness task could be practiced, or how variations of the exercise could be employed.

'Sticking to your Plans' (See Appendix N). This was a cognitive defusion sheet that provided participants examples of strategies to help them adhere to their implementation intentions once they became more practiced at noticing their thoughts. They were provided with the 'Mind Bus' example as an illustration of how it is possible to carry out intentions regardless of negative thoughts: *"Imagine you are the driver of a bus, driving to the gym to do some exercise. Your thoughts are a bit like passengers on the bus. They may say 'I'm too tired to exercise', 'I haven't got time', 'I'll go tomorrow instead'. Your job as the driver of the bus is to stick to your planned route and keep driving to the gym, regardless of what your thoughts are saying."*

'Leaves on a Stream', 'Practicing Noticing Your Thoughts' and 'Sticking to your Plans' were used for the Mindfulness plus Implementation Intentions group only and drew on exercises and metaphors previously employed in ACT intervention studies (Hayes & Smith, 2005). They were then adapted specifically for the purpose of this study, which was to increase physical activity levels.

4.3.5 Study Design and Randomisation

The study employed a randomised controlled trial design. All participants were randomly allocated to one of three comparison groups, namely Mindfulness plus Implementation Intentions (M&II), Implementation Intentions only (II) or Control (C) group. Two of these groups received information about strategies that may have been helpful for increasing levels of physical activity (M&II and II only groups), whilst the other group functioned as a 'no strategy' comparison group and did not receive any information about strategies. Participants were allocated to each of the 3 conditions using a stratified randomization protocol on the basis of gender, BMI (above 25 versus below 25) and current level of physical activity (as assessed by The Brief Physical Assessment Tool; Smith, B.J., Marshall, A.L. & Huang, N., 2005; less than 6 sessions per week versus 6 or more sessions per week), resulting in a total of eight strata. A block size of three was used for each strata. Following Pocock (1983), computer-generated random numbers were used to order intervention and control allocation within each block. The randomization list was prepared by the supervisor using data collected at baseline by the principal researcher. The principal researcher was blind to these randomisation procedures and the supervisor was blind to participant identities.

4.3.6 Procedure

Participants were required to attend an initial appointment at the Psychology Department to provide consent to participate, have weight, height and body fat percentage measured and to provide background information on age, gender, occupation, and highest level of education. They were also required to complete a number of baseline assessments and were provided with a NHS leaflet on exercise that included general information on the advantages of physical activity as well as the risks involved and informed participants to seek advice from their GP should they have any concerns or before starting any new exercise programme. This baseline assessment session took approximately 50 minutes to one hour in total (see Table 4.1 for list of measures, descriptions of which are provided later). Following the assessment, details of gender, BMI and reported levels of typical current physical activity (3Q assessment) were sent to the supervisor, who randomly assigned participants to one of the three groups. Once the randomisation process was complete the principal researcher contacted participants via email and informed them of the group they were allocated to, and an appointment was arranged to return to the Psychology Department.

At the time of the second meeting participants were provided with the appropriate information relevant to their allocated group (see Table 4.1) and if they fell into either intervention group, the appropriate training was given. If participants were allocated to the M&II group, they were given the 'Making Plans' (implementation intentions) sheet (See Appendix K). Participants were asked to read through this sheet and once it was clear that they understood the information and had no questions or queries they were asked to come up with their implementation intentions and write them down on the sheet provided.

The importance of bringing the sheet back with them to the follow-up appointments was stressed to participants, and they were assured that it was acceptable to make modifications to their implementation intentions if necessary. Participants were then given the 'Leaves on a Stream' (mindfulness) sheet (See Appendix L). Participants were asked to read through this exercise and were given time to read through thoroughly and visualise the exercise until they felt confident to carry out a practice whilst in the company of the researcher. When they were ready to start the practice, they were asked to summarise what they needed to do in order to check they were clear about the instructions, and were then timed for 5 minutes practicing the exercise. Once this was complete and participants were confident they knew what to do, they were finally given the 'Practicing Noticing Your Thoughts' sheet (See Appendix M). Participants were asked to read through this sheet and required to come up with their implementation intentions to practice noticing their thoughts. Again, it was stressed that it was important to bring the sheet back to follow-up appointments and were assured that it was acceptable to make modifications to their implementation intentions if necessary. They were also reminded that they could either use the 'Leaves on a Stream' exercise, or a variation of the examples written on the 'Practicing Noticing Your Thoughts' sheet for this task. Once it was clear that participants were confident about what was required, a follow-up appointment was made for the following week and photocopies taken of each of the 'Making Plans' and 'Practicing Noticing Your Thoughts' sheets.

If participants were allocated to the II group, they were only given the 'Making Plans' sheet, which followed the same procedure as above. If they were allocated to the 'no strategy' comparison group they were not required to attend the T2 and T3 follow-up sessions and therefore did not receive any information about strategies. They were provided with information about all the strategies at the end of the study however.

Following this second appointment (T2), participants in both intervention groups returned to the Psychology Department a week later (T3) in order to check on their progress. If they were part of the M&II group, they were required to rate the extent to which they stuck to their implementation intentions since training at T2 and also on how many days over the prior week they had practiced noticing their thoughts. This group were also provided with cognitive defusion strategies to help them stick to their implementation intentions (see Appendix N). Participants in the II group were only required to indicate to what extent they had stuck to their plans over the previous week.

Both the M&II and II only groups at T3 were first asked whether they had made any modifications over the last 7 days to the 'Making Plans' and 'Practicing Noticing Your Thoughts' sheets. If they had, new photocopies were made and participants were asked on what day/s the modifications were made. If participants had forgotten their sheets, they were asked to verbally state whether any modifications were made and if so, a note was made of these. Participants in both groups were then given a question that asked about the extent to which they stuck to the 'Making Plans' sheet for the 7 days immediately after the first training session (See Appendix P), the items for which were rated on a 5-point scale where *1=not at all* and *5=all the time*. Participants in the M&II group were also asked about the extent to which they practiced noticing their thoughts for the 7 days immediately after the first training session. They were simply required to circle the number of days out of seven to indicate on how many days they had practiced noticing their thoughts.

Following this, participants in the M&II group were given the 'Sticking to Your Plans' ('Mind Bus') sheet (See Appendix N), which provided examples of strategies to help them adhere to their implementation intentions. Participants were asked to notice their thoughts about exercise and if they found themselves making excuses not to exercise, to employ one of the strategies that were provided on the sheet with this illustration. Participants were asked read through this sheet and once it was clear that they understood the information and had no questions or queries, a follow-up appointment was made for the 1 month follow-up assessment. All intervention group participants were advised to use their sheets over the next 6 months.

All participants (including the control group) were contacted at 1 month and 6 months after baseline to repeat some of the assessments completed at the first appointment (which can be seen in Table 4.1). At the 1 month follow-up (T4), participants in both intervention groups were again asked to rate the extent to which they stuck to the 'Making Plans' sheet during the week following the last meeting (the previous week) and those in the M&II group were again also asked on how many days they had practiced noticing their thoughts. In addition, participants in the M&II group were required to answer an extra question (See Appendix S) about the 'Mind Bus' strategies provided at T3. They were asked: *"Over the previous week, when you have found yourself making excuses not to exercise, to what extent have* *you employed the strategies suggested on the 'Sticking to Your Plans' sheet? (e.g., 'Mind Bus', 'I'm having the thought...', 'But/And')"*. These items were rated on a 5-point scale where *1=not at* all and *5=all the time.* At the 6 month follow-up (T5) this procedure was repeated and all participants were fully debriefed and provided with a debrief form that included details of staff and student counselling services should any issues have arisen from taking part in this study.

As well as detailing at which points participants were due return to the Psychology Department, Table 4.1 highlights the measures participants were required to complete at each meeting/follow-up.

		Group		
Time	Measure/Procedure	Mindfulness Intervention plus Implementation Intentions	Implementation Intentions Only	Control Group
(T1) Baseline and Screening	Consent and general information sheet	✓	✓	✓
	Provide exercise information sheet and advise to read 'risks'	✓	✓	✓
	Self-regulation 1	✓	✓	✓
	Thought suppression	✓	✓	✓
	Self-regulation 2	✓	✓	✓
	Background	✓	✓	✓
	BMI	✓	✓	✓
	Brief physical activity questionnaire	✓	✓	✓
	Body composition	✓	✓	✓
	Level of physical activity interview	✓	✓	✓
	Attentional control questionnaire	✓	✓	✓
	Mindfulness questionnaires	✓	✓	✓
	Personality questionnaire	✓	✓	✓
(T2) Group Allocation and Training	Making Plans' (Implementation Intentions)	✓	✓	
	Practicing Noticing Your Thoughts' (Mindfulness)	✓		
	Leaves on a Stream' (Mindfulness) to visualise for 2 minutes	✓		
	Read mindfulness exercise for 2 minutes			
	Allow participant to practice 'Leaves on a Stream' for 5 mins	✓		
	Questions/Queries	✓	✓	
(T3) Week 1 follow-up	Questions/Queries	✓	✓	
	Photocopy 'Making Plans'	✓	✓	
	Sticking to your Plans' (Cognitive Defusion)	✓		
	Photocopy 'Practicing Noticing Your Thoughts'	✓		
	Advise to use sheets for next month	✓	✓	
	Questions/Queries	✓	✓	
(T4) 1 month follow-up	Self-regulation 1	✓	✓	✓
	Thought suppression	✓	✓	✓
	Self-regulation 2	✓	✓	✓
	BMI	✓	✓	✓
	Body composition	✓	✓	✓
	Level of physical activity interview	✓	✓	✓
	Attentional control questionnaire	✓	✓	✓
	Mindfulness questionnaires	✓	✓	✓
(T5) 6 month follow-up	Self-regulation 1	✓	✓	✓
	Thought suppression	✓	✓	✓
	Self-regulation 2	✓	✓	✓
	BMI	✓	✓	✓
	Body composition	✓	✓	✓
	Level of physical activity interview	✓	✓	✓
	Attentional control questionnaire	✓	✓	✓
	Mindfulness questionnaires	✓	✓	✓

Table 4.1 Measures and procedures used in study 3 displayed by time (T) and group.

4.4 Study 3 Results

4.4.1 Overview

All 60 baseline participants were included in the analysis of the study. Of these 60 participants, 53 returned to take part in the one-month follow-up (95% of the Mindfulness plus Implementation Intentions group; 80% of the Implementation Intentions only group; 89% of the Control group). At the six-month follow-up, 36 of the original 60 participants returned (73% of the M&II group; 60% of the II only group; 44% of the Control group). All participants were included in the analysis. The one-month follow-up sample had a mean BMI of 26.92 (SD=4.96; range=20.09 to 40.72) and a mean percentage body fat of 31.25% (SD=8.52%; range=11.50 to 47.10%). The six-month follow-up sample had a mean BMI of 26.90 (SD=4.37; range=20.22 to 38.55) and a mean percentage body fat of 32.40% (SD=9.19%; range=12.4 to 48.30%). Approximately 90% of the intervention participants attended both training sessions prior to the one-month follow-up, with only 5% failing to attend any.

4.4.2 Comparison of Baseline Characteristics across Intervention and Control Groups

Differences in baseline measures across intervention and control groups were examined to determine whether the groups were appropriately matched. Details of the way in which questionnaires were scored can be found in Section 4.3.3. Differences in age, BMI, percentage body fat, self-regulation, attentional control, mindfulness, the personality facets of openness and conscientiousness and finally energy expenditure and the total number of hours spent in moderate to very hard physical activity were examined, using multiple one-way ANOVAs. Table 4.2 displays the means, standard deviations and F ratios of the baseline measures for the intervention and control groups.

Baseline Measure[a]	**M plus II**[b] **(n=22)**	**II only**[c] **(n=20)**	**Control (n=18)**	***F* value**
Age	35.73 (12.54)	36.80 (12.50)	37.28 (12.63)	0.08 (ns)[d]
BMI	26.12 (4.13)	26.77 (5.90)	27.33 (6.02)	0.26 (ns)[d]
Percentage Body Fat	28.90 (9.36)	33.37 (9.10)	31.63 (9.61)	1.23 (ns)[d]
Self-regulation	14.18 (32.15)	9.15 (31.85)	26.26 (42.91)	1.15 (ns)[d]
BPAT	8.11 (4.78)	5.65 (3.84)	6.25 (4.08)	1.90 (ns)[d]
ATQ Short	51.95 (7.98)	52.60 (5.38)	50.11 (7.73)	0.62 (ns)[d]
MAAS	54.19 (10.83)	55.11 (11.50)	59.78 (10.57)	1.40 (ns)[d]
FMI	36.45 (5.56)	37.95 (5.12)	39.28 (6.12)	1.27 (ns)[d]
NEO Openness	36.23 (3.48)	36.20 (3.49)	36.06 (4.08)	0.01 (ns)[d]
NEO Conscientiousness	39.45 (4.15)	40.95 (2.95)	41.17 (3.88)	1.31 (ns)[d]
Physical Activity[e]	59.11 (50.87)	32.88 (23.01)	36.64 (36.69)	2.76 (ns)[d]
Physical Activity[f]	11.73 (10.70)	6.83 (4.52)	7.75 (7.85)	2.12 (ns)[d]

[a] Values are means and SDs unless otherwise stated

[b] Mindfulness plus Implementation Intentions intervention group

[c] Implementation Intentions only intervention group

[d] One-way ANOVA

[e] Total kilocalories per kg of energy expenditure

[f] Total number of hours of moderate to very hard physical activity

Table 4.2 Comparison of baseline characteristics across intervention and control groups.

As shown in Table 4.2, no significant group differences were observed in age, BMI, percentage body fat or in the questionnaire measures between intervention and control groups at baseline. This suggests that all groups were well matched across all measures. Control participants had, on average a higher BMI than both intervention groups, and the II only group had a higher average body fat percentage than the M&II intervention and Control groups. At baseline on average, participants in the M&II group reported engaging in a greater number of hours of physical activity and expending a larger amount of energy than those in the II only and Control groups in the week prior to the assessment. However, no significant differences were observed between any of the groups in terms of energy expenditure or total number of hours spent in moderate to very hard physical activity, suggesting again that the groups were well matched in terms of level of activity at baseline.

4.4.3 Comparison of Baseline Measures across Returnees and Non-Returnees

At T4 (one-month follow-up) an overall attrition rate of 12% was observed. Of the total number of participants assigned to each group, 5% of the Mindfulness plus Implementation Intentions group, 20% of the Implementation Intentions only group and 11% of the Control group failed to return at T4. From T4 to T5 (six-month follow-up) an overall attrition rate of 32% was observed. Of the total number of participants in each group at T4, 24% of the M&II group, 25% of the II only group and 50% of the Control group failed to return at T5. Overall, from baseline to T5, an attrition rate of 40% was observed, with 56% of these being control participants.

Differences in baseline measures across intervention and control groups for those who returned to take part in each of the follow-ups and those who did not, were examined to determine whether participants who dropped out of the study were different in any way to those returned to participate in the follow-ups. This was carried out for the one month follow-up participants and then the six-month follow-up participants. Differences in age, BMI, percentage body fat, brief physical activity (for randomisation purposes), self-regulation, attentional control, mindfulness, the personality facets of openness and conscientiousness and finally energy expenditure and the total number of hours spent in moderate to very hard physical activity were examined using independent t-tests.

4.4.3.1 One-month follow-up participants

Table 4.3 displays the means, standard deviations and p values for baseline measures for participants that returned to take part in the one-month follow-up and those that did not.

Follow-up Measure [a]	Returned (n=53)	Not Returned (n=7)	*p* value
Age	36.83 (12.23)	34.43 (14.14)	0.63 (ns)[b]
BMI	26.74 (5.08)	26.41 (7.18)	0.88 (ns)[b]
Percentage Body Fat	30.94 (9.20)	33.21 (11.28)	0.55 (ns)[b]
Self-regulation	17.65 (37.08)	4.56 (20.99)	0.37 (ns)[b]
BPAT	6.83 (4.20)	6.00 (5.65)	0.64 (ns)[b]
ATQ Short	51.58 (7.19)	51.86 (6.77)	0.93 (ns)[b]
MAAS	56.12 (10.46)	57.00 (15.73)	0.89 (ns)[b]
FMI	38.00 (5.56)	36.29 (6.32)	0.45 (ns)[b]
NEO Openness	36.23 (3.35)	35.71 (5.53)	0.73 (ns)[b]
NEO Conscientiousness	40.34 (3.69)	41.43 (4.12)	0.47 (ns)[b]
Physical Activity [c]	8.88 (8.58)	9.04 (7.10)	0.96 (ns)[b]
Physical Activity [d]	43.30 (40.90)	46.07 (38.18)	0.87 (ns)[b]

[a] Values are means and SDs unless otherwise stated

[b] *t*-test

[c] Total kilocalories per kg of energy expenditure

[d] Total number of hours

Table 4.3 Comparison of baseline measures for participants that did and did not attend the one-month follow-up.

No significant differences were observed between participants that returned and those that did not return at the one-month follow-up. On average, participants that returned appeared to possess better self-regulatory abilities than those who did not return (17.65 seconds compared to 4.56 seconds respectively), but this difference was not significant.

4.4.3.2 Six-month follow-up participants

Table 4.4 displays the means, standard deviations and *p* values for baseline measures for participants that returned to take part in the six-month follow-up and those that did not.

Follow-up Measure [a]	Returned (n=36)	Not Returned (n=24)	*p* value
Age	39.36 (11.80)	32.33 (12.21)	0.03*[b]
BMI	26.78 (4.18)	26.57 (6.72)	0.89 (ns)[b]
Percentage Body Fat	31.34 (9.35)	31.00 (9.65)	0.89 (ns)[b]
Self-regulation	16.46 (41.41)	15.62 (25.68)	0.93 (ns)[b]
BPAT	7.36 (4.21)	5.77 (4.45)	0.16 (ns)[b]
ATQ Short	51.19 (6.79)	52.25 (7.63)	0.58 (ns)[b]
MAAS	54.89 (10.17)	58.41 (12.29)	0.24 (ns)[b]
FMI	38.33 (5.45)	37.00 (5.91)	0.37 (ns)[b]
NEO Openness	36.67 (2.53)	35.42 (4.76)	0.25 (ns)[b]
NEO Conscientiousness	40.44 (2.78)	40.50 (4.88)	0.96 (ns)[b]
Physical Activity [c]	9.13 (7.56)	8.55 (9.61)	0.80 (ns)[b]
Physical Activity [d]	45.51 (38.94)	40.79 (42.92)	0.66 (ns)[b]

[a] Values are means and SDs unless otherwise stated

[b] *t*-test

[c] Total kilocalories per kg of energy expenditure

[d] Total number of hours

* Significant $p<0.05$

Table 4.4 Comparison of baseline measures for participants that did and did not attend the six-month follow-up.

The only significant difference observed between participants that returned to take part in the six-month follow-up and those that did not was in terms of age. Participants who returned at six months were, on average, significantly older than participants that failed to return (39.36 years compared to 32.33 years respectively). On average, participants that returned reported engaging in a greater number of hours of moderate to very hard physical activity at baseline (45.51 hours compared to 40.79 hours respectively), but this difference was not significant.

4.4.4 Intention to Treat Analysis

The data were first analysed on an intention to treat basis, to determine the effect of the intended intervention strategies on each of the primary and secondary measures, for the one-month and six month follow-up data. The primary outcome measure in this study was level of physical activity and the secondary outcome measures were BMI and percentage body fat. Missing data at each follow-up were replaced by calculating the mean change score from the previous observation in the control group (e.g. if the missing data point was at one-month, the mean change score from baseline to one month in the control group was calculated) and adding this to the previous observation relating to the missing data point (e.g. again if the missing data point was at one month, the new mean change score would be added to the baseline score for that participant and inserted to represent their one-month score).

Data were replaced for seven participants that did not return to the one-month follow-up and for 24 participants that did not return to the six-month follow-up. One of the one-month non-returnees was from the M&II group, four from the II only and two from the Control group. Six of the six-month follow-up participants were from the M&II group, eight from the II only and 10 from the Control group A 3 (group) x 3 (time: baseline, one-month and six-months) mixed model ANOVA was employed to examine the effect of the intended intervention on physical activity, BMI and percentage body fat at each of the follow-ups. Table 4.5 shows the means and standard deviations for both intervention groups and control group at baseline and the one- and six-month follow-ups. It also includes the baseline means and standard deviations for comparison.

Outcome Measure	**M + II (n=22)**	**II only (n=20)**	**Control (n=18)**
Baseline			
Physical Activity (mean, SD)[a]	59.11 (50.87)	32.88 (23.01)	36.64 (36.69)
Physical Activity (mean, SD)[b]	11.73 (10.70)	6.83 (4.52)	7.75 (7.85)
BMI (mean, SD)	26.12 (4.13)	26.77 (5.90)	27.33 (6.02)
Percentage Body Fat (mean, SD)	28.90 (9.36)	33.37 (9.10)	31.63 (9.61)
One-month follow-up			
Physical Activity (mean, SD)[a]	43.92 (30.95)	32.84 (21.83)	53.17 (52.29)
Physical Activity (mean, SD)[b]	8.80 (6.30)	7.61 (5.22)	10.92 (9.77)
BMI (mean, SD)	26.22 (4.01)	27.08 (5.63)	27.49 (6.11)
Percentage Body Fat (mean, SD)	29.85 (8.45)	32.81 (9.19)	31.95 (8.80)
Six-month follow-up			
Physical Activity (mean, SD)[a]	50.71 (46.32)	43.00 (30.83)	30.58 (31.90)
Physical Activity (mean, SD)[b]	11.68 (10.71)	6.93 (4.99)	5.23 (7.90)
BMI (mean, SD)	26.09 (3.80)	27.14 (6.23)	27.35 (6.12)
Percentage Body Fat (mean, SD)	30.13 (8.86)	33.65 (9.29)	33.49 (9.32)

[a] Total kilocalories per kg of energy expenditure

[b] Total number of hours

[c] Mixed ANOVA

Table 4.5 Means and standard deviations for the intention to treat analysis of primary and secondary outcome measures for each group at the one- and six-month follow-ups.

In comparison to the means and standard deviations at baseline, the total kilocalories per kg of energy expenditure for each group did not change in the predicted direction at one month, nor did the total number of hours spent in physical activity for the M&II and Control groups. Both energy expenditure and the total number of hours spent in moderate to very hard physical activity decreased from baseline to one month in the M&II group (59.11 kilocalories per kg compared to 43.92 kcal/kg and 11.73 hours compared to 8.80 hours at baseline and one month respectively), but remained constant in the II only group (32.88 kcal/kg compared to 32.84 kcal/kg and 6.83 hours compared to 7.61 hours at baseline and one month respectively). Energy expenditure and total number of hours of physical activity also increased in the

Control group (36.64 kcal/kg compared to 53.71 kcal/kg and 7.75 hours compared to 10.92 hours at baseline and one month respectively), again a change that was not in line with predictions. BMI and percentage body fat remained constant for both intervention groups and control group from baseline to one month (M&II BMI = 26.12 to 26.22; II only BMI = 26.77 to 27.08; Control BMI = 27.33 to 27.49; M&II percentage body fat = 28.90 to 29.85; II only percentage body fat = 33.37 to 32.81; Control percentage body fat = 31.63 to 31.95).

In comparison to the means and standard deviations at baseline, on average, the total kilocalories per kg of energy expenditure decreased for the M&II group at the six-month follow-up (59.11 kcal/kg compared to 50.71 kcal/kg), but increased for the II only group (32.88 kcal/kg compared to 43.00 kcal/kg). The total number of hours spent in moderate to very hard physical activity on the other hand, remained constant for both the intervention groups (M&II = 11.73 to 11.68; II only = 6.83 to 6.93). As expected, on average, the level of energy expenditure and total number of hours spent in activity decreased for the Control group (36.64 kcal/kg compared to 30.58 kcal/kg and 7.75 hours compared to 5.23 hours). BMI remained constant for both intervention groups and control group from baseline to one month (M&II = 26.12 to 26.09; II only = 26.77 to 27.14; Control = 27.33 to 27.35), whilst body fat percentage increased for the M&II and Control groups and remained constant for the II only group (M&II = 28.90 to 30.13; II only = 33.37 to 33.65; Control = 31.63 to 33.49).

A significant interaction between group and time was observed for the total number of hours spent in physical activity, $F(2, 114) = 5.27, p = 0.001$, however, no significant interactions were observed between group and time for energy expenditure, $F(2, 66) = 2.11, p = 0.09$, BMI, $F(2, 114) = 0.53, p = 0.71$ or percentage body fat, $F(2, 114) = 1.68, p = 0.18$. Post-hoc tests were conducted for the variables that demonstrated a significant interaction, in order to determine what brought about the significant effect. Dependent t-tests were employed to compare baseline and one-month follow-up means for each group, as well as baseline and six-month follow-up means for each group, for the total number of hours spent in moderate to very hard physical activity. No significant differences were observed between baseline and one-month total number of hours of activity for either the II only group, $t(19) = 0.70$, $p = 0.49$, or the Control group, $t(17) = 1.63, p = 0.12$. However, a significant difference was observed between baseline and one-month total number of hours of activity for the M&II group, $t(21) = 2.05$, $p = 0.05$, suggesting that the significant interaction observed between group and time for number of hours was brought about by the mindfulness intervention strategy. Given the direction of the means however, these results suggest that the M&II group showed a significant decrease in the total number of hours of activity from baseline to one month, which was not in line with predictions. No significant differences were observed between baseline and six-month total number of hours of activity for the M&II group, $t(21) = 0.05$, $p = 0.96$, the II only group, $t(19) = -0.10$, $p = 0.92$, or the Control group, $t(17) = 1.86$, $p = 0.08$.

A significant main effect of time was observed for percentage body fat, $F(2, 114) = 6.62$, $p = 0.005$, and Bonferroni corrected post-hoc analysis suggested that percentage body fat did not significantly differ between baseline and the one-month follow-up ($p = 1.00$), or between the one- and six-month follow-ups ($p = 0.08$), but did significantly differ between baseline and 6-months ($p < 0.05$). Observation of the mean values further demonstrate that percentage body fat remained relatively constant from baseline (M = 31.21) to the one-month follow-up (M = 31.47), but increased from baseline to the six-month follow-up (M = 32.31). No other significant main effects of group or time were observed.

4.4.5 Effect of the Intervention on Primary and Secondary Outcome Measures (Intervention Efficacy)

The effect of the intervention on primary and secondary outcome measures was assessed without replacing missing data.

4.4.5.1 Primary outcome measure: Physical activity

A 3 (group) x2 (time) mixed ANOVA was employed to examine the effect of the intervention on the primary outcome measure of physical activity. This was conducted first of all, using the total energy expenditure for moderate to very hard levels of activity and then using the total number of hours in moderate to very hard levels of activity at the one-month and then the six-month follow-up. A significant interaction was expected between group and time for physical activity at the one- and six-month follow-ups. Table 4.7 shows the means, standard deviations and F ratios (for interaction effects) for both intervention groups and control group at the one-month follow-up. Table 4.8 shows the same at the six-month follow-up, and both tables include the baseline means and standard deviations for comparison.

Outcome Measure	M + II (n=21)	II only (n=16)	Control (n=16)	*F* value (grp x time)
Baseline				
PA (mean, SD)[a]	59.11 (50.87)	32.88 (23.01)	36.64 (36.69)	
PA (mean, SD)[b]	11.73 (10.70)	6.83 (4.52)	7.75 (7.85)	
One-month follow-up				
PA (mean, SD)[a]	41.38 (29.26)	33.28 (22.38)	52.41 (54.47)	3.24[c]*
PA (mean, SD)[b]	8.58 (6.37)	7.70 (5.26)	10.56 (9.96)	3.39[c]*

PA = Physical Activity

grp = group

[a] Total kilocalories per kg of energy expenditure

[b] Total number of hours

[c] Mixed ANOVA

* Significant $p<0.05$

Table 4.6 Means, standard deviations and *F* ratios (for interactions) for physical activity for each group at the one-month follow-up.

In comparison to the means and standard deviations at baseline, on average, the total kilocalories per kg of energy expenditure and total number of hours spent in moderate to very hard physical activity decreased for the M&II group at the one-month follow-up (59.11 kcal/kg compared to 41.38 kcal/kg and 11.73 hours compared to 8.58 hours respectively), but stayed reasonably constant for the II only group (32.88 kcal/kg compared to 33.28 kcal/kg and 6.83 hours compared to 7.70 hours respectively). Both measures of physical activity increased in the Control group from baseline to one month (36.64 kcal/kg compared to 52.41 kcal/kg and 7.75 hours compared to 10.56 hours respectively). Significant interactions between group and time were observed for both energy expenditure, $F(1, 50) = 3.24$, $p = 0.05$, and total number of hours of activity, $F(1, 50) = 3.39$, $p = 0.04$. No significant main effects of group or time were found.

Post-hoc tests were conducted for the variables that demonstrated a significant interaction, in order to determine what brought about the significant effect. Dependent t-tests were employed to compare baseline and one-month follow-up means for each group, firstly for energy expenditure and secondly for the total number of hours spent in moderate to very hard physical activity (six dependent t-tests in total). No significant differences were observed between baseline and one-month energy expenditure or number of hours of activity for the II only group, $t(15) = 0.004$, $p = 0.99$ and $t(15) = 0.55$, $p = 0.59$ respectively, or the Control group, $t(15) = 1.37$, $p = 0.19$ and $t(15) = 1.44$, $p = 0.17$ respectively. Also, no significant differences were observed between baseline and one-month follow-up number of hours of activity for the M&II group, $t(20) = 1.95$, $p = 0.07$, however, a significant difference was observed between baseline and one-month energy expenditure for this group, $t(20) = 2.10$, $p = 0.05$, suggesting that the significant interaction observed between group and time for energy expenditure was brought about by the mindfulness intervention strategy. However, given the direction of the means, these results suggest that the M&II group showed a significant decrease in energy expenditure from baseline to one month, which was not in line with predictions.

Outcome Measure	**M + II (n=16)**	**II only (n=12)**	**Control (n=8)**	***F* value (grp x time)**
Baseline				
PA (mean, SD)[a]	59.11 (50.87)	32.88 (23.01)	36.64 (36.69)	
PA (mean, SD)[b]	11.73 (10.70)	6.83 (4.52)	7.75 (7.85)	
Six-month follow-up				
PA (mean, SD)[a]	45.50 (34.50)	40.71 (34.70)	45.06 (39.73)	1.19 (ns)[c]
PA (mean, SD)[b]	9.69 (7.23)	7.40 (5.20)	10.93 (9.39)	0.30 (ns)[c]

PA = Physical Activity

grp = group

[a] Total kilocalories per kg of energy expenditure

[b] Total number of hours

[c] Mixed ANOVA

Table 4.7 Means, standard deviations and *F* ratios (for interaction effects) for physical activity for each group at the six-month follow-up.

In comparison to the means and standard deviations at baseline, on average, the total kilocalories per kg of energy expenditure and total number of hours spent in moderate to very hard physical activity decreased for the M&II group at the six-month follow-up (59.11 kcal/kg compared to 45.50 kcal/kg and 11.73 hours compared to 9.69 hours respectively), but increased for the II only group (32.88 kcal/kg compared to 40.71 kcal/kg and 6.83 hours to 7.40 hours respectively). Again, as at the one-month follow-up, the Control group increased in physical activity (36.64 kcal/kg compared to 45.06 kcal/kg and 7.75 hours compared to 10.93 hours respectively). However, unlike at the one-month follow-up, no significant interactions between group and time were observed for either energy expenditure, $F(1, 33) = 1.19, p = 0.32$, or the total number of hours of activity, $F(1, 33) = 0.30, p = 0.74$, thereby failing to provide any evidence for intervention efficacy after 6 months. No significant main effects of group or time were found.

4.4.5.2 Secondary outcome measures: BMI and percentage body fat

A series of 3 (group) x2 (time) mixed ANOVAs were again employed to assess the effect of the intervention on the secondary outcome measures of BMI and percentage body fat. A significant interaction was expected between group and time for BMI. Table 4.9 shows the means, standard deviations and *F* ratios (for interaction effects) for BMI and percentage body fat for both intervention groups and control group at the one-month follow-up. Table 4.10 shows those at the six-month follow-up, and both tables include the baseline means and standard deviations for comparison.

Outcome Measure	M + II (n=21)	II only (n=16)	Control (n=16)	*F* value (grp x time)
Baseline				
BMI (mean, SD)	26.12 (4.13)	26.77 (5.90)	27.33 (6.02)	
% Body Fat (mean, SD)	28.90 (9.36)	33.37 (9.10)	31.63 (9.61)	
One-month follow-up				
BMI (mean, SD)	25.51 (3.87)	26.63 (5.48)	27.76 (5.84)	0.26 (ns)[a]
% Body Fat (mean, SD)	30.17 (8.52)	31.86 (8.89)	32.06 (8.54)	1.20 (ns)[a]

grp = group

% Percentage

[a] Mixed ANOVA

Table 4.8 Means, standard deviations and *F* ratios (for interaction effects) for BMI and percentage body fat for each group at the one-month follow-up.

In comparison to the means and standard deviations at baseline, on average, BMI remained constant from baseline to one month in all groups (M&II = 26.12 compared to 25.51 respectively; II only = 26.77 compared to 26.63 respectively; Control = 27.33 compared to 27.76 respectively). Percentage body fat increased in the M&II group (28.90% compared to 30.17%) and decreased in the II only group (33.37% compared to 31.86%). Percentage body fat remained fairly constant in the Control group (31.63% compared to 32.06%). The mixed ANOVA results showed no significant interactions between group and time for either BMI, $F(1, 33) = 0.26$, $p = 0.77$, or percentage body fat, $F(1, 33) = 1.29$, $p = 0.29$, thereby failing to provide any evidence for intervention efficacy after one month. No significant main effects of group or time were observed for either BMI or percentage body fat at one month.

Outcome Measure	**M + II (n=16)**	**II only (n=12)**	**Control (n=8)**	***F* value (grp x time)**
Baseline				
BMI (mean, SD)	26.12 (4.13)	26.77 (5.90)	27.33 (6.02)	
% Body Fat (mean, SD)	28.90 (9.36)	33.37 (9.10)	31.63 (9.61)	
Six-month follow-up				
BMI (mean, SD)	26.01 (2.90)	28.58 (6.01)	26.15 (3.68	0.35 (ns)[a]
% Body Fat (mean, SD)	30.34 (9.67)	35.15 (8.80)	32.41 (8.82)	1.25 (ns)[a]

grp = group

% Percentage

[a] Mixed ANOVA

Table 4.9 Means, standard deviations and *F* ratios (for interaction effects) for BMI and percentage body fat for each group at the six-month follow-up.

For the 6 month follow-up, in comparison to the means and standard deviations at baseline, on average, BMI remained constant from baseline to 6 months in the M&II group (26.12 compared to 26.01 respectively), as well as fairly constant in the Control group (27.33 compared to 26.15 respectively), but increased slightly in the II only group (26.77 compared to 28.58 respectively). Percentage body fat increased in both intervention groups (M&II = 28.90% compared to 30.34% respectively; II only = 33.37% compared to 35.15% respectively), but again remained fairly constant in the Control group (31.63% compared to 32.41% respectively). The mixed ANOVA results showed no significant interactions between group and time for either BMI, $F(1, 33) = 0.35, p = 0.71$, or percentage body fat, $F(1, 33) = 1.25, p = 0.30$, thereby failing to provide any evidence for intervention efficacy after 6 months. A significant main effect of time was observed for percentage body fat at six months, $F(1, 33) = 8.22, p = 0.007$, with the means indicating that, overall, body fat percentage increased over the 6 month period. No other significant main effects were observed.

4.4.6 Effect of the Intervention on Mediator Variables

The impact of the intervention on hypothesised mediator variables was examined using a series of 3(group) x 2(time) mixed ANOVAs. An increase in self-regulation and attentional control was expected for the M&II group as mindfulness is thought to increase self-regulatory abilities and attentional control (Anderson et al., 2007;

Bishop et al., 2004; Masicampo & Baumeister, 2007; Valentine & Sweet, 1991). Similarly, an increase in mindfulness was expected in this group. Due to the exploratory nature of the study and to determine whether the mediators would affect the outcome, prior to the main analysis of mediator variables, correlations between the baseline levels of primary and secondary outcomes and baseline levels of mediator variables were examined. No significant associations were observed between baseline levels of total number of hours of physical activity and baseline mediator variables, as well as baseline levels of energy expenditure and mediators. Similarly, no significant associations were found between baseline levels of BMI and mediators, as well as percentage body fat and mediators.

Table 4.11 shows the means, standard deviations and *F* ratios for interaction effects) for mediator variables for both intervention groups and control group at the one-month follow-up. Table 4.12 shows those at the six-month follow-up, and both tables include the baseline means and standard deviations for comparison.

Mediator	**Mindfulness plus II (n=21)**	**II Only (n=16)**	**Control (n=16)**	***F* value (grp x time)**
Baseline				
Self-reg. (mean, SD)	14.18 (32.15)	9.15 (31.85)	26.26 (42.91)	
MAAS (mean, SD)	54.19 (10.83)	55.11 (11.50)	59.78 (10.57)	
FMI (mean, SD)	36.45 (5.56)	37.95 (5.12)	39.28 (6.12)	
ATQ (mean, SD)	51.95 (7.98)	52.60 (5.38)	50.11 (7.73)	
One-month follow-up				
Self-reg. (mean, SD)	8.09 (28.47)	28.86 (55.89)	11.65 (38.69)	1.81 (ns)[a]
MAAS (mean, SD)	58.05 (7.64)	54.07 (6.97)	60.94 (10.67)	1.37 (ns)[a]
FMI (mean, SD)	37.71 (5.32)	37.31 (6.13)	40.94 (8.09)	1.77 (ns)[a]
ATQ (mean, SD)	52.62 (8.15)	52.06 (5.40)	51.25 (7.30)	0.33 (ns)[a]

Self-reg. = self-regulation

grp = group

[a] Mixed ANOVA

Table 4.10 Means, standard deviations and *F* ratios (for interaction effects) for mediators for each group at the one-month follow-up.

In comparison to the means and standard deviations at baseline, on average, self-regulation decreased in the M&II and Control groups (M&II = 14.18 seconds compared to 8.09 seconds respectively; Control = 26.26 seconds compared to 11.65 seconds respectively) and increased in the II only group (9.15 seconds compared to 28.86 seconds respectively). An important point to note here is in terms of the large standard deviations. These values indicate a large range of values and therefore a lot of variability in scores within the sample.

Despite the self-regulatory abilities appearing to improve on average in the II only group, no significant interaction between group and time was observed for this mediator following mixed ANOVA analysis, $F(1, 50) = 1.81, p = 0.18$. Attentional control appeared to remain fairly constant on average, for all groups (M&II = 51.95 compared to 52.62 respectively; II only = 52.60 compared to 52.06 respectively; Control = 50.11 compared to 51.25 respectively), and again the mixed ANOVA results showed no significant interactions between group and time, $F(1, 50) = 0.33, p = 0.72$. The MAAS increased on average in the M&II group (54.19 compared to 58.05 respectively) but remained constant in the II only and Control groups (II only = 55.11 compared to 54.07 respectively; Control = 59.78 compared to 60.94 respectively). The FMI remained fairly constant on average for all groups (M&II = 36.45 compared to 37.71 respectively; II only = 37.95 compared to 37.31 respectively; Control = 39.28 compared to 40.94 respectively). Mixed ANOVA results showed no significant interactions for MAAS, $F(1, 48) = 1.37, p = 0.26$ or FMI, $F(1, 50) = 1.77, p = 0.18$ after one month. The results suggest that there were no effects of intervention on any of the mediator variables after one month. No significant main effects were observed.

Mediator	Mindfulness plus II (n=16)	II Only (n=12)	Control (n=8)	*F* value (grp x time)
Baseline				
Self-reg. (mean, SD)	14.18 (32.15)	9.15 (31.85)	26.26 (42.91)	
MAAS (mean, SD)	54.19 (10.83)	55.11 (11.50)	59.78 (10.57)	
FMI (mean, SD)	36.45 (5.56)	37.95 (5.12)	39.28 (6.12)	
ATQ (mean, SD)	51.95 (7.98)	52.60 (5.38)	50.11 (7.73)	
Six-month follow-up				
Self-reg. (mean, SD)	18.33 (32.36)	-0.19 (24.42)	27.46 (22.05)	0.65 (ns)[a]
MAAS (mean, SD)	58.44 (7.59)	54.67 (8.06)	57.63 (11.54)	2.86 (ns)[a]
FMI (mean, SD)	39.25 (5.27)	40.67 (4.72)	40.88 (6.88)	0.18 (ns)[a]
ATQ (mean, SD)	49.81 (7.10)	50.17 (5.13)	53.13 (9.09)	0.65 (ns)[a]

Self-reg. = self-regulation

grp = group

[a] Mixed ANOVA

Table 4.11 Means, standard deviations and *F* ratios (for interaction effects) for mediators for each group at the six-month follow-up.

For the 6 month follow-up data, in comparison to the means and standard deviations at baseline, on average, self-regulation increased in the M&II group (14.18 seconds compared to 18.33 seconds respectively), decreased in the II only group (9.15 seconds compared to 0.19 seconds respectively) and remained constant in the Control group (26.26 seconds compared to 27.46 seconds respectively). Attentional control demonstrated an average decrease for both intervention groups (M&II = 51.95 compared to 49.81 respectively; II only = 52.60 compared to 50.17 respectively), but an increase in the Control group (50.11 compared to 53.13 respectively). MAAS and FMI increased in the M&II group (54.19 compared to 58.44 respectively and 36.45 compared to 39.25 respectively) and MAAS remained constant for the II only group (55.11 compared to 54.67 respectively) and decreased for the Control group (59.78 compared to 57.63 respectively). FMI increased for II only (37.95 compared to 40.67 respectively) but remained constant for controls (39.28 compared to 40.88 respectively). The mixed ANOVA results showed no significant interactions between group and time for self-regulation, $F(1, 32) = 0.65$, $p = 0.53$, MAAS, $F(1, 33) = 2.86$, $p = 0.07$, FMI, $F(1, 33) = 0.18$, $p = 0.83$, or ATQ,

$F(1, 33) = 0.65, p = 0.53$, thereby failing to provide any evidence for the impact of intervention on mediators. A main effect of time for FMI after six months was observed, $F(1, 33) = 4.76, p = 0.04$, with the means indicating that, overall, FMI increased over the 6 month period. No other significant main effects were found.

Given the interaction for the MAAS was approaching significance, together with the exploratory nature of the trial, follow-up tests were conducted for MAAS scores. Three dependent *t*-tests were used to determine whether there were any differences between baseline and six-month MAAS scores for the intervention groups and control group. No significant differences were observed in the II only or Control groups, $t(11) = 0.22, p = 0.83$ and $t(7) = 0.75, p = 0.48$ respectively, however, the M&II group showed a significant increase in mindfulness from baseline to six months, $t(15) = 2.16, p = 0.05$, which could suggest that after six months participants were becoming more mindful.

4.4.7 Effect of Moderator Variables on Intervention Efficacy

Not all participants reported using the strategies consistently over the 6 months. Table 4.13 displays the proportion of participants that reported using the intervention strategies half/most of the time at the one- and six-month follow-ups. At the one-month follow-up, approximately 19% of the M&II group reported using the implementation intentions ('Making Plans') strategy a little/not at all, compared to 13% of the II only group. In the M&II group approximately 33% of participants reported using the mindfulness strategy ('Sticking to your Plans') a little/not at all. Approximately 31% of the M&II group reported using the implementation intentions strategy a little/not at all at the six month follow-up, compared to 50% of the II only group. In the M&II group approximately 38% of participants reported using the mindfulness strategy a little/not at all.

Strategy	One Month (T4)		Six Months (T5)	
	M plus II (n=21)	**II only (n=16)**	**M plus II (n=16)**	**II only (n=12)**
Making Plans	76%	75%	69%	33%
Sticking to Plans	62%	n/a	56%	n/a

Table 4.12 Proportion of participants that reported using the intervention strategies half/most of the time at T4 and T5.

Of the 21 participants that were assigned to the mindfulness intervention group and returned to the one-month follow-up, 76% reported adhering to the implementation intentions strategy and 62% to the mindfulness strategy. At six months the proportion of participants (out of 16) in this group that adhered to the strategies was comparable to the one month results. Of the 16 participants that were assigned to the II only intervention group and returned to the one-month follow-up, 75% reported adhering to their implementation intentions strategies compared to only 33% of the 12 that returned to the six-month follow-up reported sticking to the strategies.

Prior to the main analysis of the effect of strategy adherence on intervention efficacy, given the exploratory nature of the trial, the task completion data were first analysed using Pearson's correlation coefficients to determine whether there were any associations between task completion and primary or secondary change scores. These were examined in order to inform later analysis of task completion. Only two significant associations were observed and one variable showing a trend towards significance. There was a significant relationship between change in total kilocalories per kg of energy expenditure and the extent to which participants used the implementation intentions strategy after 6 months in the implementation intentions only group, $r = 0.90$, $p = 0.02$, and a significant relationship between change in BMI and the extent to which participants used the 'mindbus' cognitive defusion strategy after one month in the mindfulness plus implementation intentions group, $r = -0.74$, $p = 0.004$. The variable approaching significance was the change in body fat percentage and the extent to which participants used the 'mindbus' cognitive defusion strategy after one month in the mindfulness plus implementation intentions group, $r = 0.53$, $p = 0.07$. Given these findings, the effect of strategy adherence on intervention efficacy was examined to determine whether results could have been affected by the inclusion of participants who did not adhere to strategies.

4.4.7.1 Effect of strategy adherence on intervention efficacy: physical activity

In order to determine whether the direction of results were affected by the inclusion of participants who did not use the strategies consistently or at all, participants who reported at T4 and T5 that they had only used the strategies *'a little'* or *'not at all'* were removed, and means and standard deviations calculated to examine the direction of the energy expenditure and total number of hours of physical activity results. Therefore participants included in these calculations were those who said they used the strategies *'about half the time'*, *'most of the* time' and *'all of the* time'. Table 4.14 shows the means and standard deviations of the intervention groups for these participants at the one-month follow-up, Table 4.15 shows those at the six-month follow-up, and both tables include the one- and six-month means and standard deviations of all participants for comparison. The mean values for control participants at one- and six-months were also included in the tables for comparison, however statistical analyses on this data was not justified given the very small participant numbers.

Outcome Measure	M + II (n=13)[a]	II only (n=14)	Control (n=16)
***All* participants (one month)**			
Physical Activity (mean, SD)[b]	41.38 (29.26)	33.28 (22.38)	52.41 (54.47)
Physical Activity (mean, SD)[c]	8.58 (6.37)	7.70 (5.26)	10.56 (9.96)
Task completion participants (one month)			
Physical Activity (mean, SD)[b]	48.31 (34.12)	36.46 (21.98)	
Physical Activity (mean, SD)[c]	10.02 (7.51)	8.41 (5.20)	

[a] Number (n) of participants that used the strategies

[b] Total kilocalories per kg of energy expenditure

[c] Total number of hours

Table 4.13 Means and standard deviations for physical activity for intervention group participants who used the strategies at least half of the time at the one-month follow-up.

In comparison to the one-month means of *all* participants, the means for those who followed the strategies at least half of the time were not in the same direction from baseline to one-month for either intervention group. On average, the total kilocalories per kg of energy expenditure and total number of hours spent in moderate to very hard physical activity increased for the M&II group (41.38 kcal/kg compared to 48.31 kcal/kg and 8.58 hours compared to 10.02 hours). The total kilocalories per kg of energy expenditure also increased for the II only group (33.28 kcal/kg compared to 36.46 kcal/kg), whilst the total number of hours spent in moderate to very hard physical activity for the II only group stayed reasonably constant (7.70 hours compared to 8.41 hours). In comparison to controls, the intervention groups expended less energy and took part in less hours of physical activity on average.

A 3 (group) x2 (time) mixed ANOVA was employed to examine the effect of the intervention on energy expenditure and total number of hours of physical activity for the participants who used the strategies at least half the time in order to determine whether task completion had any effect on the intervention efficacy at one month. A significant interaction was expected between group and time. No significant interactions were observed between group and time for energy expenditure $F(1, 40) = 1.98, p = 0.15$ or the total number of hours spent in physical activity, $F(1, 40) = 1.87, p = 0.17$, suggesting that neither intervention were effective at promoting change after a period of one month. No significant main effects were found.

Outcome Measure	**M + II (n=9)[a]**	**II only (n=6)**	**Control (n=8)**
All participants (six months)			
Physical Activity (mean, SD)[b]	45.50 (34.50)	40.71 (34.70)	45.06 (39.73)
Physical Activity (mean, SD)[c]	9.69 (7.23)	7.40 (5.20)	10.93 (9.39)
Task completion participants (six months)			
Physical Activity (mean, SD)[b]	47.67 (42.39)	60.92 (39.03)	
Physical Activity (mean, SD)[c]	9.72 (8.54)	9.46 (6.04)	

[a] Number (n) of participants that used the strategies

[b] Total kilocalories per kg of energy expenditure

[c] Total number of hours

Table 4.14 Means and standard deviations for physical activity for intervention group participants who used the strategies at least half of the time at the six-month follow-up.

In comparison to the six-month means of *all* participants, the means for those who followed the strategies at least half of the time were not in the same direction from baseline to six-months for the M&II group. On average, the total kilocalories per kg of energy expenditure increased for the M&II group (45.50 kcal/kg compared to 47.67 kcal/kg) and as at the six-month follow-up for all participants, increased for the II only group (40.71 50 kcal/kg compared to 60.92 kcal/kg). The total number of hours spent in physical activity remained constant for the M&II group (9.69 hours compared to 9.72) but as at the six-month follow-up for all participants, increased for the II only group (7.40 hours compared to 9.46 hours). In comparison to controls at baseline, the intervention groups expended more energy but took part in less hours of physical activity on average. No further analysis was carried out on this data due to the small participant numbers.

4.4.7.2 Effect of strategy adherence on intervention efficacy: BMI and percentage body fat

In order to determine whether the direction of results were affected by the inclusion of participants who did not use the strategies consistently or at all, participants who reported at T4 and T5 that they had only used the strategies *'a little'* or *'not at all'* were removed, and means and standard deviations calculated to examine the direction of BMI and percentage body fat results. Therefore participants included in these calculations include those who said they used the strategies *'about half the time'*, *'most of the time'* and *'all of the time'*. Table 4.16 shows the means and standard deviations for the intervention groups for these participants at the one-month follow-up. Table 4.17 shows those at the six-month follow-up, and both tables include the one- and six-month means and standard deviations for comparison. The mean values for control participants at one- and six-months were also included in the tables for comparison, however statistical analyses on this data was not justified given the very small participant numbers.

Outcome Measure	**M + II (n=13)** [a]	**II only (n=14)**	**Control (n=16)**
All participants (one month)			
BMI (mean, SD)	25.51 (3.87)	26.63 (5.48)	27.76 (5.84)
Percentage Body Fat (mean, SD)	30.17 (8.52)	31.86 (8.89)	32.06 (8.54)
Task completion participants (one month)			
BMI (mean, SD)	25.00 (3.60)	27.22 (5.62)	
Percentage Body Fat (mean, SD)	27.55 (9.60)	32.04 (9.54)	

[a] Number (n) of participants that used the strategies

Table 4.15 Means and standard deviations for BMI and percentage body fat for intervention group participants who used the strategies at least half of the time at the one-month follow-up.

In comparison to the one-month means of *all* participants, the means for those who followed the strategies at least half of the time from baseline to one-month were in the same direction for both intervention groups for BMI, but not for body fat percentage. On average, BMI remained constant in all groups (M&II = 25.51

compared to 25.00 and II only = 26.63 compared to 27.22), however percentage body fat decreased in the M&II group (30.17 % compared to 27.55%) and remained fairly constant in the II only group (31.86% compared to 32.04%). In comparison to controls, the participant who used the strategies at least half the time in the M&II group demonstrated lower BMI's and body fat percentages, whilst the II only group were similar to the control participants in both BMI and percentage body fat.
A 3 (group) x2 (time) mixed ANOVA was employed to examine the effect of the intervention on BMI and percentage body fat for the participants who used the strategies at least half the time, in order to determine whether task completion had any effect on the intervention efficacy at one month. A significant interaction was expected between group and time. No significant interaction was observed between group and time for BMI, $F(1, 40) = 0.24$, $p = 0.79$, or percentage body fat, $F(1, 40) = 2.41$, $p = 0.10$, and no significant main effects were found.

Outcome Measure	**M + II (n=9)** [a]	**II only (n=9)**	**Control (n=8)**
All participants (six months)			
BMI (mean, SD)	26.01 (2.90)	28.58 (6.01)	26.15 (3.68
Percentage Body Fat (mean, SD)	30.34 (9.67)	35.15 (8.80)	32.41 (8.82)
Task completion participants (six months)			
BMI (mean, SD)	27.31 (2.57)	25.83 (5.01)	
Percentage Body Fat (mean, SD)	32.78 (9.18)	32.30 (5.61)	

[a] Number (n) of participants that used the strategies

Table 4.16 Means and standard deviations for BMI and percentage body fat for intervention groups participants who used the strategies at least half of the time at the six-month follow-up.

In comparison to the six-month means of *all* participants, the means for those who followed the strategies at least half of the time from baseline to six months were in the same direction for the M&II intervention group, but not for the II only group. On average, BMI remained constant in the M&II group (26.01 compared to 27.31), but decreased in the II only group (28.58 compared to 25.83). Percentage body fat increased in the M&II group (30.34% compared to 32.78%) but decreased in the II only group (35.15% compared to 32.30%). In comparison to controls, the participant who used the strategies at least half the time in both intervention groups demonstrated similar BMI's and body fat percentages. Again, due to small participant numbers no further analysis was carried out on this data.

4.4.7.3 Effect of openness and conscientiousness on intervention efficacy

In order to determine the effect of the openness and conscientiousness factors of the NEO personality questionnaire on intervention efficacy and following the recommendations of Field (2009) and Aiken and West (1991) for examining interactions between categorical and continuous variables, multiple regression analysis was employed. The groups were first recoded into dummy variables, whereby each of these categories except one (in this case the control group) was represented by a dummy (or indicator) variable. Each dummy variable was given a value of one for the category being represented (for example M&II group) and a value of zero for all other categories. This was carried out for both intervention groups. The Control group (for which there was no dummy variable) was given a value of zero for all the dummy variables and was the reference category. These new dummy variables were then multiplied (separately) by the moderators of openness and conscientiousness of the NEO-FFI in order to obtain new interaction variables. The new interaction terms computed were M&II group x Openness, M&II group x Conscientiousness, II only group x Openness and II only group x Conscientiousness. Each of these new variables were then placed into multiple regression analyses. For each step of the analysis, the recoded dummy variables and the score for openness or conscientiousness (separately) were entered into block one of the regression. For example, to assess the effect of openness on the mindfulness intervention efficacy, the recoded mindfulness variable and openness were entered into block one. For block two, these variables were re-entered plus with the new interaction term, in this example M&II group x Openness. This was repeated using each of the new interaction variables to assess the effect of both openness and conscientiousness on intervention efficacy, for change scores at the one-month follow-up. Given the risks for type 1 error as well as the high attrition rate at the six-month follow-up, the analysis was conducted for the main dependent variable (physical activity) at the one-month follow-up only. For each of the analyses conducted we would expect the mindfulness intervention and the implementation intentions intervention to be more effective amongst people who are more conscientious (e.g., Giluk, 2009). Tables 4.18 and 4.19 show the multiple regression results for each of the new interaction variables on energy expenditure and total number of hours spent in moderate to very hard physical activity change scores at the one-month follow-up.

Interaction Variable	R^2	ß	*t* value	*p* value
Mindfulness Group (n=37)				
M&II group and openness	0.30	2.88	1.97	0.06 (ns)
M&II group and conscientiousness	0.14	0.69	0.41	0.69 (ns)
Implementation Intentions Only Group (n=32)				
II only group and openness	0.26	4.04	2.01	0.05*
II only group and conscientiousness	0.08	2.23	0.95	0.35 (ns)

* Significant $p<0.05$

Table 4.17 Means, standard deviations and multiple regression results for the interaction effects between group and moderator on energy expenditure at the one-month follow-up.

Openness significantly moderated the effects of the implementation intentions intervention on change in energy expenditure after one month. No other significant effects were observed for energy expenditure after one month. Figure 4.2 displays the interaction between the implementation intentions group and openness on change in energy expenditure at the one-month follow-up. This figure was generated using a macro called Modprobe, for SPSS (Hayes & Matthes, 2009). According to Hayes and Matthes, it is employed for probing single-degree-of-freedom interactions in linear and logistic regression models and "…makes the pick-a-point approach easy to implement" "[It] produces the usual regression output, as well as estimates the effect of the focal predictor variable at values of the moderator variable" (Hayes and Matthes, 2009, p.927). It also employs the Johnson-Neyman technique for calculating regions of significance, and by default produces *simple slopes*, useful for generating visual plots of the interactions observed.

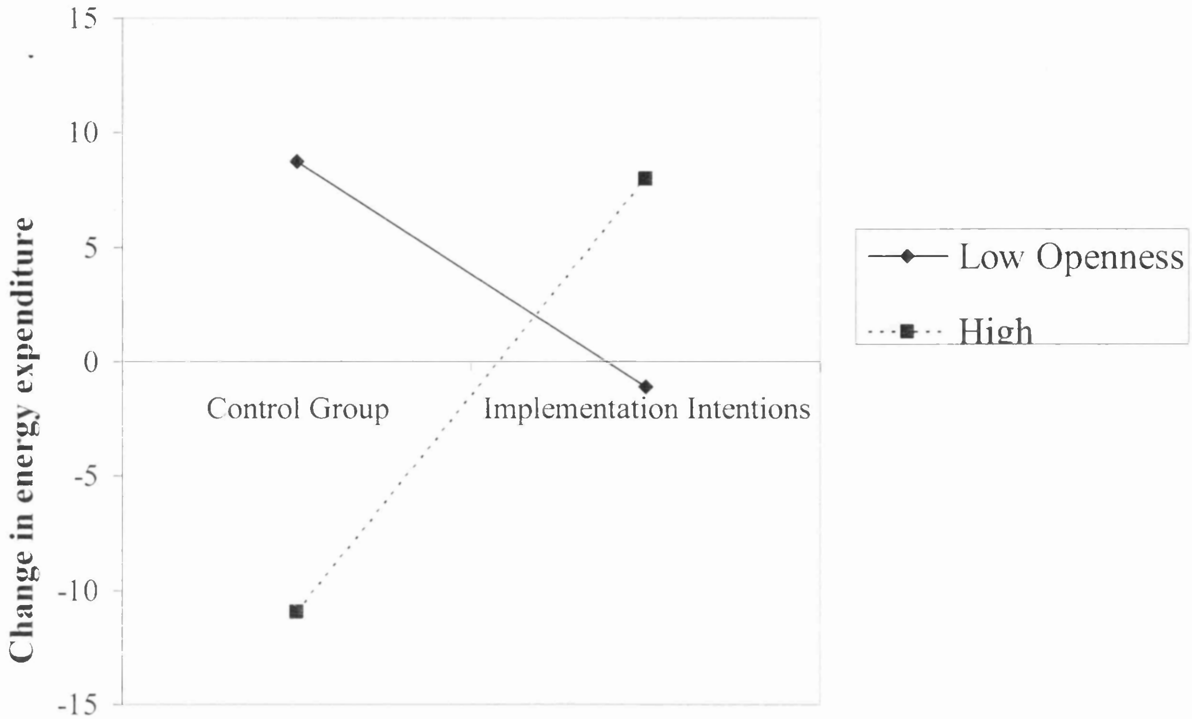

Figure 4.2 Interaction between the implementation intentions group and openness on change in energy expenditure at the one-month follow-up.

The results in figure 4.2 appear to demonstrate that there was a greater increase in energy expenditure among participants in the control group who scored low on openness compared to participants in the implementation intentions group who scored low on openness. Conversely, there appeared to be a greater increase in energy expenditure among participants in the implementation intentions group who scored high on openness relative to those in the control group who scored high on openness. These results are in line with predictions in that the implementation intentions condition seemed to be more effective amongst those who were higher in openness. However, further inspection using Johnson-Neyman analysis demonstrates that the difference between the Implementation Intentions and control group is not significant for either low, $t(3, 49) = 0.86$, $p = 0.39$, or high levels of openness, $t(3, 49) = 0.79$, $p = 0.34$.

Interaction Variable	R^2	ß	*t* value	*p* value
Mindfulness Group (n=37)				
M&II group and openness	0.27	3.77	2.64	0.01*
M&II group and conscientiousness	0.15	0.90	0.53	0.60 (ns)
Implementation Intentions Only Group (n=32)				
II only group and openness	0.29	3.69	1.88	0.07 (ns)
II only group and conscientiousness	0.06	2.21	0.93	0.36 (ns)

* Significant $p<0.05$

Table 4.18 Means, standard deviations and multiple regression results for the interaction effects between group and moderator on total number of physical activity hours at the one-month follow-up.

Openness significantly moderated the effects of the mindfulness intervention on change in the total number of hours of physical activity after one month. No other significant effects were observed for the total number of hours of PA after one month. Figure 4.3 displays the interaction between the mindfulness group and openness on change in total number of hours of physical activity at the one-month follow-up

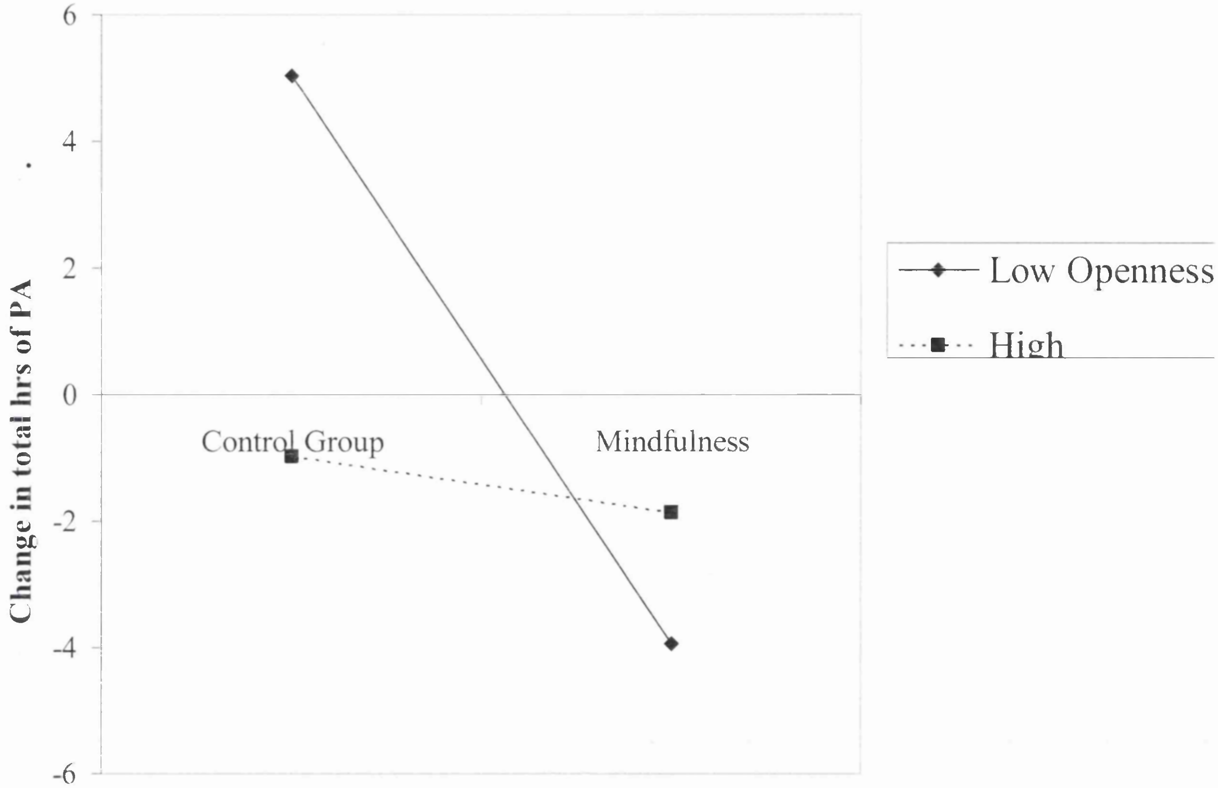

Figure 4.3 Interaction between the mindfulness group and openness on change in total number of hours of physical activity at the one-month follow-up.

The results in figure 4.3 appear to demonstrate that there was a greater increase in the total number of hours of physical activity among participants in the control group who scored low on openness compared to participants in the mindfulness group who scored low on openness. For those who were high in openness, there appeared to be little difference between the mindfulness and control group. Upon further inspection using the Johnson-Neyman technique, results demonstrated that the difference between the Mindfulness and control group was not significant for high levels of openness, $t(3, 49) = 0.32$, $p = 0.75$, but was significant for low levels of openness, $t(3, 49) = 3.28$, $p = 0.002$. This therefore appears to suggest that the Mindfulness intervention reduces physical activity at low levels of openness. Also, given that the interaction coefficient is positive, this implies that the effect of the Mindfulness intervention increases as openness increases.

4.4.8 Formation of Implementation Intentions

In terms of the proportion of participants that completed their implementation intentions fully, observations showed that 57% of the M&II group did not complete the 'when' items for each of their implementation intentions, 81% did not complete all of the 'where' items, but all participants completed each of the 'how' items. For the II only group, 47% did not complete the 'when' items for each of their implementation intentions, 63% did not complete all of the 'where' items and 11% did not complete each of the 'how' items of their implementation intentions. Chi square analysis demonstrated that there were no differences between the two intervention groups for the 'when' item, however there was a difference in the 'how' and 'where' items.

4.4.9 Summary of Findings

The study aimed to examine whether a mindfulness plus implementation intentions intervention strategy would increase levels of physical activity after one- and six-month follow-ups, more so than an implementation intentions only intervention. It also aimed to examine whether the mindfulness plus implementation intentions intervention would produce greater reductions in the secondary outcome measures of BMI and body fat percentage.

On average, after one month, physical activity significantly decreased in the mindfulness plus implementation intentions group, stayed relatively constant in the implementation intentions only group, but increased in the control group (non-significantly). Significant interactions were observed between group and time for both the total number of hours of activity and energy expenditure. Follow-up tests showed that a change in energy expenditure was brought about by the mindfulness plus implementation intentions intervention strategy, however the means were not in the predicted direction and as mentioned, this intervention group actually brought about a significant decrease in physical activity after one month.

On average, after six months, physical activity again decreased (non-significantly so) in comparison to baseline in the mindfulness plus implementation intentions group but increased in the implementation intentions only and control groups. There were no significant interactions observed for physical activity; therefore there was no evidence of intervention efficacy on physical activity after six months.

In terms of secondary outcome measures, on average, BMI remained fairly constant in all groups after one month. Body fat percentage increased on average in the mindfulness plus implementation intentions group, decreased in the implementation intentions only group and remained constant in the control group. No significant interactions were observed, therefore there was no evidence of intervention efficacy on BMI or body fat percentage after one month. After six months, on average, BMI remained fairly constant in the mindfulness plus implementation intentions and control groups, but increased in the implementation intentions group. Body fat percentage however, increased in both intervention group but remained constant in the control group. No significant interactions were observed here; therefore again there was no evidence of intervention efficacy on BMI or body fat percentage after six months. A significant main effect of time was observed for body fat percentage; however this indicates that overall body fat increased over the six month period.

Finally, examination of the effect of the openness and conscientiousness factors of the NEO personality questionnaire on intervention efficacy demonstrated that the Mindfulness intervention reduced physical activity at low levels of openness. This may suggest that people with low levels of openness struggle to use the Mindfulness techniques, or perhaps even dislike the techniques, which may have impacted negatively on their levels of physical activity.

4.5 Discussion

The current study was designed to implement an intervention with the primary aim of increasing individuals' current levels of physical activity and the secondary aims of reducing BMI and percentage body fat relative to controls. Specifically the study was conducted to examine whether the inclusion of a mindfulness strategy would enhance the promotion of physical activity. Previous research has found that physical activity may not always have beneficial effects for weight loss per se. However, there is evidence to suggest that even though physical activity may not necessarily contribute significantly to weight loss, it is a powerful tool for weight loss maintenance. Therefore interventions that are aimed at increasing levels of physical activity can be beneficial for long-term weight loss maintenance.

A large body of evidence has demonstrated the beneficial effects of implementation intentions as a strategy for increasing physical activity (e.g. Milne, Orbell & Sheeran, 2002; Prestwich, Lawton & Conner, 2003; Walsh, da Fonseca & Banta, 2005; Luszczynska, 2006; Scholz, Knoll, Sniehotta & Schwarzer, 2006; Stadler, Oettingen & Gollwitzer, 2009), therefore the current exploratory randomised controlled trial was designed to combine implementation intentions and mindfulness in order to determine whether their combined effects would enhance the promotion of physical activity over and above the use of implementation intentions alone. The current study was also designed as a brief mindfulness intervention in order to determine whether it could influence behaviour change and allow us to confidently conclude that cognitive defusion can promote physical activity. Studies such as that of Masuda et al. (2004) have demonstrated the role of very brief defusion techniques in reducing the believability of negative thoughts.

It was predicted that there would be a significantly greater increase in levels of physical activity in the mindfulness plus implementation intentions (M&II) groups as compared to the implementation intentions (II) only group, as well as a significantly greater decrease in BMI and body fat percentage in the M&II group as compared to the II group. However, the results showed that the combined M&II strategy failed to promote physical activity after one and six months. In comparison to both the implementation intention (II) only and control groups, physical activity actually decreased in the M&II group (significantly so after one month, non-significantly after six months), which was not in line with predictions. There were also no significant effects of the II only strategy after one- or six-months. These results suggest that potential difficulties in the M&II intervention may have lay with the mindfulness strategies. Results demonstrated a significant increase in body fat percentage after six months, which was again not in line with predictions and overall there were no significant effects of either intervention on BMI or body fat percentage after one or six months. Interestingly, observations of the effect of openness on intervention efficacy demonstrated that the Mindfulness intervention reduced physical activity at low levels of openness. This has important implications for interventions as it appears to suggest that people with low levels of openness struggle to use the Mindfulness techniques.

In order to determine whether the direction of results were affected by the inclusion of participants who did not use the strategies consistently or at all, the data were re-analysed taking out participants who reported not using the strategies consistently over the six months. At the one-month follow-up, in comparison to controls at baseline, the mindfulness intervention participants expended less energy and took part in less hours of physical activity on average. There was no evidence to suggest that the intervention was effective at promoting change in physical activity, BMI or body fat percentage after one month. At the six-month follow-up, in comparison to controls at baseline, participants in the mindfulness intervention expended more energy but took part in less hours of physical activity. No further analysis was carried out on the six-month follow-up data due to small participant numbers, but the overall analysis suggests that strategy adherence had no effect on intervention efficacy. Similarly, there was no evidence to suggest that the II only intervention was effective at promoting change after removing participants who did not complete the strategies at least half of the time at the one- or six-month follow-up.

There are a number of possibilities for the direction of the results observed. The task completion results suggest that whether or not participants completed the tasks given to them had no bearing on whether the intervention would work. That is, if significant results had been observed only when participants reported using the strategies and not for those participants who did not adhere to the strategies, then we would be able to conclude that had all participants completed all tasks, any significant results obtained between the independent and dependent variables would have been due to task completion. This was not the case; therefore task completion did not influence the efficacy of the intervention. Also, implementation intentions have been demonstrated numerous times to be an effective means of increasing physical activity (e.g., Milne, Orbell & Sheeran, 2002; Prestwich, Lawton and Conner, 2003; Walsh, da Fonseca & Banta, 2005; Luszczynska, 2006; Scholz, Knoll, Sniehotta & Schwarzer, 2006; Stadler, Oettingen & Gollwitzer, 2009), although unfortunately the current study failed to provide further evidence to support these results. This again points towards the suggestion that there may have been other factors affecting the outcome of the results, perhaps for example, task difficulty, insufficient training or too many tasks.

In terms of task difficulty, it is possible that the decrease in physical activity observed in participants in the mindfulness group at both the one- and six-month follow-ups were a result of difficulties in adhering to the plans they made. Budden and Sagarin (2007) have suggested that implementation intentions can be too rigid. They found, in a study of the effect of implementation intentions on exercise that participants who did *not* form implementation intentions actually increased their levels of physical activity significantly more than those that did. Exercise behaviour was assessed in 274 participants one week after the first phase of the study, which involved completing measures of occupational stress, theory of planned behaviour, obligation to comply and participants were also randomly assigned to either receive instructions to form an implementation intention or receive no instructions. Budden and Sagarin suggested that implementation intentions require some form of flexibility in order to promote successful performance. That is, if some plans cannot be adhered to for reasons that are unavoidable and therefore hinder goal attainment this can affect the volitional phase of behaviour, and it would perhaps be more effective to have a 'back-up plan' that can account for any disruptions or missed opportunities. If it was the case in the current study that participants in the M&II group made plans that were unattainable, perhaps devising 'back-up' plans would have proved beneficial.

It could be argued however, that the same could be expected in the II only group. Participants in this group may also have had equal difficulty in adhering to their plans. A high percentage of participants in both intervention groups did not form their implementation intentions properly. Observations show that 57% of the M&II group did not complete the 'when' item for each of their implementation intentions compared to 47% in the II only group. Eighty-one percent of the M&II group did not complete all of the 'where' items, compared to 63% in the II only group and finally all participants in the M&II group completed all of the 'how' items of their implementation intentions in comparison to 11% of the II only group who did not. It therefore appears that participants in the II only group completed more items of their implementation intentions than the mindfulness group; however the proportions of participants that did not complete their implementation intentions properly are comparably high. Chi square analysis demonstrated that there were no differences between the two intervention groups for the 'when' item, however there was a difference in the 'how' and 'where' items. It is possible that given participants in the II only group completed more items of their implementation intentions than the mindfulness group, and the differences observed from the chi square analysis, that participants in the mindfulness group had more difficulty adhering to their plans because they did not form their implementation intentions properly.

It has been suggested that self-generated implementation intentions may limit the effectiveness of behaviour change. De Vet, Oenema and Brug (2011) suggested this after Armitage (2009) and Ziegelmann, Lippke and Schwarzer (2006) found that self-generated implementation intentions were less effective than those that were formed when guided by the researcher. Also, De Vet, Oenema, Sheeran and Brug (2009) examined the impact of implementation intentions on increasing physical activity in a large group of Dutch adults and failed to find any effects of implementation intention formation on exercise. They suggested that given participants in their study formed their implementation intentions themselves without any guidance or assistance from the researchers, that they may have been ambiguous or aimed at a situation that may not necessarily be encountered frequently (e.g., 'if the weather is nice'). They therefore argue that this may result in the effects of the intervention on outcome being diminished. De Vet, Oenema and Brug (2011) examined whether self-generated implementation intentions were less effective than those that were formed when guided by the researcher and concluded from their study that individuals were not able to form effective implementation intentions on their own and that it may be more effective to train individuals to form more specific implementation intentions.

As Sheeran et al. (2005) report, in order to form an effective implementation intention, individuals must first identify a response that will lead to goal achievement and then anticipate a suitable occasion in which to initiate that response. In terms of identifying the critical situation, in order for that situation to become highly accessible the individual must specify a good opportunity to act. This refers to the if-component of the implementation intention, which relates to the 'when' and aspects of goal formation. Given that only 43% of the M&II group and 53% of the II only group specified when they would carry out their plans in each of the implementation intentions that they set out, it could be suggested that participants did not form effective if-components. In terms of anticipating a suitable occasion, this refers to the then-component of the implementation intention. Only 19% of the M&II group and 37% of the II only group specified where they would implement their plans in each of the implementation intentions, therefore it could again be suggested here that participants' implementation intentions would not prove to be effective. Hekler et al. (2012) argued that little attention has been paid to daily variations in perceived supportive and unsupportive environments. They examined whether (amongst other variables) implementation intentions were associated with walking, and whether perceived access to supportive and unsupportive environments (e.g., nice walking paths and bad weather) were associated with walking. They found that daily variations in implementation intentions were positively associated with walking as were perceived access to supportive environments, therefore leading them to conclude that intervention research needs to address context-specific information about perceived access to supportive environments. Perhaps if participants in the current study felt that they did not have access to supportive environments in which to implement their implementation intentions, this prevented them from forming their intentions fully and subsequently affected their behaviour. However, if participants were required to form new implementation intentions each day in the Hekler et al. study, it is possible that the frequency as well as the variability of the implementation intentions accounted for the differences observed in these results compared to lack of effect observed in the current study of this thesis.

Alternatively, it could be suggested that the direction of the results for both intervention groups were more to do with motivation. It may have been that participants in the current study were not sufficiently motivated to carry out the exercises provided. Both of the strategies in the study were examples of volitional strategies and were not targeting motivation. Numerous studies attempting to increase physical activity have examined the effects of motivational strategies though, and demonstrated positive results. For example, Edmunds, Ntoumanis and Duda (2008) carried out a study on the effects of self-determination theory (SDT)-based teaching style on a number of variables including exercise behaviour, class commitment and behavioural intention to continue participating and found that attendance rates were significantly higher in the exercise class that provided the motivational (SDT) teaching style. Many studies of implementation intentions have employed motivational strategies. Milne, Orbell and Sheeran (2002) compared a motivational intervention with a combined motivational and implementation intentions intervention to promote participation in physical activity. They found the combined protection motivation theory (PMT) (motivational strategy) plus implementation intentions group exercised significantly more than those in the PMT only and control groups, providing evidence for the effectiveness of implementation intentions using motivational strategies. The current study did not include motivational strategies as it was assumed that participants were already sufficiently motivated given that they were recruited on the basis of wanting to increase their levels of physical activity. Some studies in which participants are already assumed to be highly motivated have demonstrated positive outcomes. For example, Luszczynska (2006) demonstrated participants' ability to increase physical activity after myocardial infarction (MI) after forming implementation intentions and found that compared to controls, participants in the implementation intentions intervention group performed more physical activity sessions and adhered to their recommended number of physical activity sessions per week after eight months. Similarly, Scholz, Knoll, Sniehotta and Schwarzer (2006) found that an implementation intention intervention enhanced physical activity in patients 12 months after being discharged from coronary heart disease rehabilitation. Neither of these studies included a motivational component; however it can be argued that these participants would have already been highly motivated given their medical history. It can therefore be reasonably assumed that these participants would be better equipped to sustain their motivation over the period of the study than participants in the current study.

However, according to Schwarzer, Lippke and Luszczynska (2011), one of the main challenges of health behaviour change is increasing the participants' motivation to adhere to those changes, with many programmes failing to provide evidence of such adherence (e.g., Cutrona et al., 2010; Dean, Walters & Hall, 2010; McLean, Burton, Bradley and Littlewood, 2010; cited in Schwarzer, Lippke & Luszczynska, 2011). It is therefore possible that motivation fluctuates over time, rather than remains constant. An example of this can be seen in the results of the study by Milne et al. (2002), in which a motivational intervention had a significant effect on intention to engage in physical activity, but did not have a significant effect on subsequent exercise behaviour. Milne et al. reported that the changes in intention to engage in physical activity that were brought about by the motivation intervention were not strong enough to influence the targeted behaviour when faced with competing goals. In the case of this study these competing goals were in the form of examinations, and therefore participants' motivation to engage in physical activity diminished. This may therefore be an important area for future research, to examine the ways in which motivation varies over time. Even though it was assumed that participants in the current study would have already been motivated, perhaps this was not sufficient to sustain their motivation or behaviour over the study period. Measures of motivation were not included in the current study, so it is possible that participants' motivation was not actually very high. As such, it could be suggested that the current study may have been improved by including strategies that targeted the motivational phase of behaviour change as well as measures of motivation in order to examine the actual levels of motivation in each of the intervention groups. Further support for the inclusion of motivational strategies in behaviour change studies comes from De Vet et al. (2009) and Zhang and Cooke (2012). De Vet et al. found that forming implementation intentions had some effect on physical activity at a two-week follow-up, but only for those who had positive intentions to increase physical activity. They suggest that implementation intentions may need to be supported by motivational interventions, and that future research should seek to combine these two interventions. Zhang and Cooke (2012) demonstrated that a motivational intervention successfully changed cognitions, but also that a combined motivational and volitional intervention significantly decreased fat intake and increased physical activity. They therefore concluded from these results that in order to change behaviour, interventions that are based on both motivation and volition are required. It could be suggested that an individuals' level of motivation could possibly be enhanced by devising 'collaborative implementation intentions'. According to Prestwich et al. (2012), collaborative implementation intentions involve two people planning when and where they will perform a particular behaviour together. They argue that by including another person in their plans, the motivation to perform the action may be increased and the likelihood of forgetting decreased. Prestwich et al. examined the efficacy of a collaborative implementation intention intervention to promote physical activity over a six-month period. They found that as well as losing the most weight, participants in the collaborative implementation intentions condition took part in more physical activity than any of the other three conditions at each of the 1-, 3- and 6-month follow-ups. They therefore concluded that collaborative implementation intentions are a potentially useful intervention tool for promoting health behaviours. Given this evidence, it is possible that participants in the current study would have benefitted from including another person in the physical activity plans. Perhaps if they had done this, their motivation to not only increase their physical activity, but also to adhere to the intervention over the full 6-month period would have been enhanced.

However, it is also possible (and perhaps more likely) that it was not necessarily the levels of motivation, implementation intentions or adherence to plans that participants in the M&II group struggled with, but more to do with the amount of exercises and mindfulness strategies that they were provided with. It is possible that participants in the mindfulness group were given too many strategies and that the general thoughts technique of 'Leaves on a Stream' was diluting the effects of the strategy. Tapper et al. (2009) note the difficulty participants experienced in their study with regards to understanding and utilising the willingness/acceptance part of their mindfulness strategy, often confusing the aim of the exercise with relaxation. It is possible that participants in the current study experienced similar difficulties and it is therefore possible that future studies may benefit from simplifying the techniques. Perhaps looking only at the effects of the situation-specific technique (i.e. 'mindbus' exercise) in order to determine whether using one strategy may be more effective than providing participants with a number of exercises would be beneficial. Jenkins and Tapper (2012, abstract submitted to the British Feeding and Drinking Group conference, Brighton) obtained significant findings on chocolate consumption using the 'mindbus' exercise after 5 days, therefore perhaps doing something similar to this study but with exercise, would allow us to determine whether just a situation-specific strategy would be more effective.

Further support for the idea that difficulties may have been encountered with the mindfulness techniques comes from the positive results of studies employing implementation intentions alone or implementation intentions combined with motivational strategies after a short-term follow up (e.g. Milne, Orbell & Sheeran, 2002; Luszczynska, 2005; Walsh, da Fonseca & Banta, 2005). Studies such as these that have demonstrated positive changes in physical activity after three days, five days and two weeks show that short-term behaviour change is possible; therefore with specific regard to the current study, it is possible that removing some of the exercises and conducting a shorter follow-up may be beneficial.

It is also possible that insufficient training in mindfulness techniques affected the direction of the results. Self-regulation, attentional control and mindfulness were expected to mediate the effect of the mindfulness intervention on physical activity (Anderson et al., 2007; Bishop et al., 2004; Masicampo & Baumeister, 2007; Valentine & Sweet, 1991). However, the results failed to provide any evidence for the effect of the mindfulness intervention on the mediators of self-regulation, attentional control or mindfulness after one or six months. Previous research has demonstrated that mindfulness interventions may be a useful tool for improving self-regulation and attentional control (e.g., Anderson et al., 2007; Bishop et al., 2004; Masicampo & Baumeister, 2007; Valentine & Sweet, 1991). Therefore, given that the results of this study failed to demonstrate any significant improvement in these variables, it could be suggested that participants experienced some difficulties with the mindfulness exercises, were given too many tasks or indeed did not actually use the strategies properly. Perhaps if participants were given one task to concentrate on we may have observed an increase in each of these mediators. On the other hand, the MAAS interaction was found to be approaching significance after six months, and further tests demonstrated a significant increase in mindfulness from baseline to six months, so it is possible that participants may have benefitted from further mindfulness training. Perhaps an increase in the number and duration of training sessions would have brought about greater improvements in self-regulation, attentional control and mindfulness. Some support for this comes from Anderson et al. (2007), who examined the effects of mindfulness on attentional control. They found no evidence for this effect and suggested that perhaps these kinds of effects would be observed on more clinical samples. However, Valentine and Sweet (1999) and Wenk-Sormaz (2005) also assessed non-clinical samples and observed positive effects of mindfulness on attentional control. Anderson et al. also suggested therefore, that perhaps positive effects would have been observed in their study had it been of longer duration.

4.5.1 Limitations of the Study

The main limitation and consideration in the current study was in terms of attrition rates and adherence to the study. Baer (2003) conducted a review of empirical research on mindfulness-based interventions and identified three studies that used non-clinical samples. These were Astin (1997) who used college students and reported an attrition rate of 14%, Shapiro et al. (1998) who recruited medical students and reported a 3% attrition rate and finally Williams et al. (2001), who employed a sample of community volunteers and reported an attrition rate of 15%. One of the difficulties with the current study was the high drop-out rate. At the six month follow-up it was noted that 40% of participants failed to return, and as Dumville et al. (2006) report, Schulz and Grimes have argued that an attrition rate of 5% or less is generally acceptable, but anything over 20% is a cause for concern. Attrition can introduce bias to a study if the characteristics of the participants who dropped-out differ from those that remain in the study (cited in Dumville et al., 2006). Fortunately, there were no differences observed in baseline characteristics between participants who returned and those that did not return to the one month follow-up. On average, participants that returned appeared to possess better self-regulatory abilities than those who did not return, but this difference was not significant. The only significant difference at the six-month follow-up was in terms of age. Participants who returned at six months were, on average, significantly older than participants that failed to return. On average, participants that returned reported engaging in a greater number of hours of moderate to very hard physical activity at baseline, but this difference was not significant. In terms of the impact that these attrition rates may have had on the current study, it can be said that the sample size following attrition would have affected the power of the sample. According to Lurati Buse, Botto and Devereaux (2012), sufficient power is crucial to the quality of a randomised controlled trial.

Of the 40% of participants that failed to return at the six-month follow-up, 56% of these were from the control group. This high attrition in the control group could be a result of participants feeling they were not gaining anything from participation in the study. This could be addressed through keeping participants blind to group allocation in future studies and ensuring participant return to all follow-up assessments. This could be achieved for example, by providing participants in the control group with a general information strategy on the benefits of exercise in order to keep them unaware that they are not receiving the strategies of interest or perhaps encouraging them to increase their exercise but not providing them with any intervention. However, in the case of providing control participants with encouragement this may be sufficient to increase this groups' levels of physical activity (De Vet, Oenema, Sheeran & Brug, 2009).

Adherence to studies is a difficult issue, with a number of studies attempting to reduce attrition rates through adherence strategies. Such studies have examined the effects of extended treatment contact, monetary incentives, telephone contact and social support amongst others, and have all proved to be unsuccessful at promoting or maintaining weight loss in the long-term (e.g., Perri et al., 1987; Perri, Nezu, Patti & McCann, 1989; Leermakers, Perri, Shigaki & Fuller, 1999). It is possible that the participants who took part in the current study were looking to increase their levels of exercise as a means of losing weight and as research has demonstrated that physical activity may not always have the desired weight loss effects (e.g. Epstein & Wing, 1980; Kempen, Saris & Westerterp, 1995; Westerterp-Plantenga et al., 1997; King, 1998; Meijer, Saris & Verstappen, 1999; Fogelholm & Kukkonen-Harjula, 2000; Blundell et al., 2003; Finlayson et al., 2011; Evero et al., 2012), it is possible that the attrition rates observed in the current study could be explained by this. If physical activity did not have the desired weight loss effects for participants this may be why we saw a high drop-out rate. On a related note, but in terms of adherence to strategies as opposed to adherence to the study, this was examined using a 'task completion' questionnaire. Participants were only required to complete this at each follow-up for the week prior to the session. Perhaps asking participants to complete this questionnaire more often may have been an incentive to adhere to the strategies.

This study was designed as an exploratory trial, in order to provide more informed sample size calculations and effectiveness of measures for any future second-phase randomised trial of this nature. However, given the nature of the results in the current study, it is possible that further exploratory trials are needed in order to explore the effectiveness of the intervention strategies and length of time participants need with regards to training and experimenter contact (i.e. follow-ups). Campbell et al. (2000) have recommended a sequential process to complex health intervention trials, suggesting the identification of evidence and defining of components through piloting. Given the extensive work on implementation intentions and evidence to show the effectiveness of this strategy for increasing physical activity, piloting in this area was not considered necessary. Similarly, extensive work has been carried out on the effectiveness of mindfulness in behaviour change studies (Dalen et al., 2010; Alfonso, Caracuel, Delgado-Pastor & Verdejo-Garcia, 2011; Libby, Brotto et al., 2012; Crane, Winder, Hargus, Amarasinghe & Barnhofer, 2012; Daubenmier et al., 2012; Libby, Worhunsky, Pilver & Brewer, 2012). However, prior to the current study, implementation intentions had not been paired with mindfulness strategies therefore it was deemed appropriate to conduct and exploratory trial assessing the effectiveness of this combined intervention for increasing physical activity. From the point of view of mindfulness, research in this area has tended to employ multiple components to effect behaviour change; therefore it can be very difficult to determine which of the components are promoting the behaviour and which are not. From this point of view then it may be more reasonable to suggest that we need to take a step back and conduct more piloting stages of mindfulness strategies in order to determine which components are successful at promoting behaviour change. It can also be suggested that given the limited number of studies examining mindfulness to promote physical activity, that experimental studies employing single components of mindfulness are needed. The results of such studies would be helpful in terms of the use of mindfulness to promote physical activity.

With regard to the control group, mean values were not in the predicted direction in terms of physical activity at both the one- and six-month follow-ups. That is, participants in this group were expected to show lower levels of physical activity as compared to the intervention groups, but this was not the case. The control participants, on average, increased their levels of physical activity compared to both intervention groups. It could be that this increase was a consequence of being allocated to this group. That is, it is possible that control participants increased their levels of physical activity because it was their initial intention to do so. It is difficult to say whether this was in fact a real effect, and the only way in which this could be achieved is through the recruitment of a much larger sample. Also, participants were recruited on the basis that they were actively attempting to get fit through physical activity; therefore it may have been the case that because it was always participants' intentions to engage in physical activity, the control group chose to continue with this behaviour regardless of the group they were allocated to. Again, it may be more prudent to keep participants blind to group allocation in future studies as discussed above.

On a positive note, one of the advantages of the current study was in terms of the measure used for assessing physical activity. The majority of studies attempting to promote change in physical activity have employed the use of very brief measures of physical activity (e.g., Luszczynska, 2005; Chatzisarantis and Hagger, 2007; Goodwin, Forman, Herbert, Butryn & Ledley, 2012), simply asking participants for example, "Within the last two weeks, how often did you engage (for at least 30 min) in moderate physical activity (e.g. walking, cycling on level terrain, swimming; as intensively as recommended by your rehabilitation specialist)?" (Luszczynska, 2005) or only providing brief physical activity questionnaires (Goodwin et al., 2012). The current study employed the 7-day Physical Activity Recall, which is a semi-structured interview and well validated measure of continuous physical activity through the assessment of time spent in sleep, and moderate, hard and very hard physical activities throughout the day for the week immediately prior to interview. It covers all types of activity, including aerobic exercise, work-related activities, gardening, walking and leisure activities and therefore make it very versatile and detailed in the information it provides. The detail gained from the assessment also allow for estimates of total daily energy expenditure, therefore the benefits that this measure has over other very brief measures is the detailed information it provides and the type of information that can be drawn out of it.

As Wareham (2007) argues, physical activity is not simple to assess due to its complex, multi-dimensional nature. Physical activity can occur in a number of domains such as occupation or recreation, as well as differ in its intensity, frequency, duration and type. Many measures of physical activity are self-report and therefore do not cover each of these factors, and although self-report measures are valuable, they can sometimes reduce physical activity to a more simplistic behaviour. By addressing for example, each domain in which an activity takes place during a persons' day, this can allow for a more accurate picture of the overall level of activity engaged in. For example, if examining how much walking an individual engaged in, by asking them how much time was spent walking during working hours, how much was spent during taking their children to school, and how much was spent for pleasure (i.e. placing the walking into domains or context), it is possible to gain a more accurate assessment of the total amount of time spent walking during that day than if the participant was simply asked to estimate how much walking they had done in total during the day. The 7-day PAR attempts to do this through breaking each day up into morning, afternoon and evening, and taking the participant through each part of their day in detail.

4.5.2 Future research

The findings of this study fail to provide evidence for the effectiveness of a mindfulness intervention in increasing physical activity relative to an implementation intentions only intervention and reducing BMI and body fat percentage relative to controls. There are a number of possible reasons for this and future research would benefit from addressing these issues. Given that a significant decrease in physical activity was observed in the mindfulness group after one month and no evidence for intervention efficacy after six months, as mentioned previously, it is possible that participants struggled with the mindfulness tasks given. Perhaps reducing the number of exercises and repeating the study but using the mindbus technique only would be beneficial for future studies (Jenkins & Tapper, 2012, abstract submitted to the British Feeding and Drinking Group conference, Brighton). It is also possible that participants experienced difficulties with the 'Leaves on a

Stream' exercise, perhaps confusing this with a form of relaxation rather than awareness (Tapper et al., 2009). Therefore future studies may also benefit from addressing this through either simplifying the task (for example, using a simpler exercise such as balloons floating into the sky with thoughts written on them), or providing a greater number of training sessions.

It is also possible that participants set themselves goals that were unachievable; therefore one way to address this in future studies may be to ask participants to form 'back-up' plans. By asking participants to form a 'plan B', this introduces some flexibility, so that should participants fail to achieve their goals due to circumstances beyond their control, they have another plan in place (Budden & Sagarin, 2007). As Masicampo and Baumeister (2012) argue, while making plans does generally make people more likely to act on a goal, this can sometimes lead to failure rather than success if participants have limited time and do not make alternative plans. They claim that recognising and seizing an alternative opportunity for goal achievement is essential, and demonstrated as such in an experimental study in which participants were given limited (insufficient) or unlimited (sufficient) time to achieve a goal. They found that in the insufficient time condition performance was impaired and they argued this was due to the fact that participants did not capitalise on an alternative opportunity for gaining it. This therefore highlights the potential benefits of 'back-up' plans. De Vet, Oenema, Sheeran and Brug (2009) suggested, following their results of no effects of implementation intentions for increasing physical activity, that perhaps participants generate plans to take part in 'extra' physical activity that they are unable to maintain due to various kinds of barriers. They discuss the point that participants in their study were recruited in order to assist them in increasing physical activity (as participants were in the current study), but that perhaps they started with 'extra' plans that they were then unable to maintain. They suggest that one way in which to overcome this would be to generate additional implementation intentions to help them overcome any barriers. The example they provide is "...participants could have specified precisely how they would react to particular temptations or distractions (e.g., "And if I feel tired when I come home, then I will ignore it and go for my walk")" (De Vet et al., 2009. p.18). They also argue that the act of forming implementation intentions and mentally representing them may be different from the act of self-regulation of daily behaviours, and that individuals therefore need to make and adapt plans that enable them to overcome any potential self-regulatory problems (De Vet et al., 2009).

A way in which to increase the effectiveness of implementation intentions could be through episodic future thinking (EFT) (Atance & O'Neill, 2001). By asking participants to imagine themselves engaging in the behaviour they wish to increase at a certain time and place may help when forming implementation intentions. This may be a useful way of ensuring participants make plans that are more achievable and therefore increase the effectiveness of the intervention. According to Atance and O'Neill (2001), EFT "...refers to an ability to project the self forward in time to pre-experience an event" (Atance & O'Neill, 2001, pg. 537). The authors suggest given that implementation intentions involve consideration of future goal attainment, and that individuals are required to imagine themselves engaging in a certain behaviour at a certain time and place in the future, that this process is in fact mediated by some form of EFT (Atance & O'Neill, 2001). It is possible then, that training individuals in EFT will help participants to form more effective implementation intentions. Similarly, mental contrasting involves thinking about personal goals for behaviour change and imagining a positive future situation that involves the success of achieving that goal compared with a negative current reality of achieving that goal (Adriaanse et al., 2010). For example, in terms of wishing to increase current levels of physical activity, a person may imagine the positive future event of losing a target stone after engaging in increasing levels of exercise, compared with the negative reality of always feeling too tired to go to the gym after work. In this way then, mental contrasting has been argued to be a powerful tool for forming a strong mental association between a desired outcome and the obstacle preventing an individual from achieving their goals. By using mental contrasting to identify obstacles that hinder goal achievement, it can provide a person with a critical knowledge that could help them to realize their goals. Finally, mental contrasting has also been shown to be successful at reducing unhealthy snacking behaviour (Adriaanse et al., 2010). Adriaanse et al. note however, that the intervention used in their study had beneficial effects for those who strongly intended to reduce their snacking behaviour; therefore it is possible that this form of intervention may only work when people are strongly motivated and intend to change their behaviour.

According to Andersson and Moss (2011), imagining performing a particular task correctly may increase confidence in ability for that particular behaviour. For example, Martin and Hall (1995) used guided imagery on performance in a golf-putting task and found that participants in the imagery group spent more time practicing and setting more realistic goals. Andersson and Moss (2011) demonstrated a greater increase in physical activity in a guided imagery group (although the increase was not significantly greater that the implementation intentions group), therefore it is possible that some form of guided imagery or future thinking would benefit individuals when forming implementation intentions. However, it is difficult to say to what extent it would be beneficial given that in the current study the increase in activity was not significantly greater than in the implementation intentions group (as with the Andersson & Moss study).

A final method that may improve intervention efficacy is through the use of reminders. Prestwich, Perugini and Hurling (2010) conducted a study examining the efficacy of implementation intentions and a text message (SMS) reminder for increasing physical activity. Participants were allocated to one of three groups, namely implementation intentions plus SMS plan reminder, implementation intentions plus SMS goal reminder or a control group. Both intervention groups increased their activity levels relative to the control group, concluding that the use of text messaging could enhance the efficacy of implementation intention interventions. Similarly, Soureti et al. (2011) also found that text message reminders altered dietary behaviour, thereby supporting their assumptions that these tools can enhance the effects of planning on behaviour. In terms of the current study, if it was the case that participants simply forgot to carry out their implementation intentions, then receiving reminders such as these may help to enhance their intended behaviours.

In terms of the results obtained for the effect of openness on intervention efficacy, these results are potentially important as they suggest that mindfulness techniques may only be effective for certain personality types. It could be suggested that the mindfulness intervention reduced physical activity in people with low levels of openness because these individuals struggle to use these techniques, or perhaps even dislike them, which may have resulted in failure to increase their levels of physical activity. Given the potential importance of personality types when employing mindfulness techniques to promote behaviour change, the inclusion of a screening measure may be helpful when recruiting for mindfulness-based interventions and studies.

Monitoring adherence and ensuring lower attrition rates is also an important point for future studies. Ensuring adherence can be very difficult; however attempts to reduce attrition rates in order to avoid introducing bias to studies are important (Dumville et al., 2006). From an experimental point of view this can be achieved through payment (for example a sliding payment incentive where monetary value increases at each testing session), however from an applied point of view this can be more difficult. Evers, Klusmann, Schwarzer and Heuser (2012) argued that adherence to behavioural intervention programmes is necessary for beneficial outcomes to be achieved and conducted a study to examine adherence to physical and mental activity interventions. They found that coping plans (i.e., the *'then'* component of implementation intentions or self-regulation strategies) predicted adherence at 10- and 20-week follow-ups, and that coping plans mediated the relationship between intention and behaviour for physical activity. However, this study was conducted in a sample of older females (age range 70-93) and according to Reuter et al. (2010) the strength of the association between planning and physical activity increases with age. They demonstrated that the use of planning as a means to engage in physical activity is more beneficial for older adults (age range 34-64 years) than younger adults (age range 19-33 years). Also, the effect in the Evers et al. (2012) study was larger for participants who had lower levels of prior adherence, which Evers et al. argue may have prevented them from dropping out of the study. Despite this however, it does appear possible that generating coping plans may facilitate adherence to physical activity interventions and it is possible that had participants in the current study devised these coping plans (i.e., the anticipation of barriers and how to overcome them), they may have adhered to the study.

In terms of attempting to reduce attrition of control participants, this is a much more difficult task. Keeping participants blind to group allocation may help adherence (particularly with the control group) but this may raise ethical concerns regarding the size of commitment required for participation and it may therefore be more advisable to be open with participants from the outset that they may not receive strategies initially but will receive them at the end of the study. However, receiving the strategies after six months may not have been acceptable to people allocated to the control group and this may be why such a high drop-out rate was observed in the control group. It could be suggested that participants may not have wanted to return because they felt they were not gaining anything from participation.

As Hill and Wyatt (2005) conclude *"Although substantial data suggest that increasing physical activity is an important strategy for preventing weight gain and preventing weight regain, we still have a big challenge in producing such increases."* (Hill & Wyatt, 2005, p.769). They argue that the environment we live in is not one that encourages physical activity, in that many technological advances have likely contributed to declines in physical activity (for example, increased computer game playing and television watching) (Hill & Wyatt, 2005), therefore it could be argued that more and more people are living quite sedentary lifestyles. It could also be suggested however, that trying to promote non-habitual behaviour in people (i.e. something they do not already do) is easier than trying to stop a behaviour that is habitual. Van't Riet, Sijtsema, Dagevos and Bruijn (2011) highlight the difficulty in altering behaviour that is habitual. For example, eating is a habitual act and therefore something that we do not have to make much conscious effort to do and changing this type of behaviour would be difficult. Given this, it could be suggested that interventions aimed at increasing a behaviour that is not habitual for some people (physical activity in the case of the current study), may be easier to promote. When interventions are aimed at promoting a behaviour that is new or infrequently engaged in, and is guided by intentions, it can become more habitual and may therefore increase that particular behaviour (van't Riet et al., 2011). An example of such a study is that of Chatzisarantis and Hagger (2007), who showed that non-habitual exercisers were more likely to translate their intentions into actions than habitual exercisers. The current study does not provide further support for this notion however, so why might this be? It is possible that the majority of participants were habitual exercisers already and this could be why we do not observe an increase in physical activity. However physical activity actually decreased in the mindfulness group, therefore again this points towards the potential difficulties of the mindfulness exercises.

It is possible that future research could apply the current intervention to eating behaviour. The strategies used in the current study might be helpful given that mindfulness-based weight loss programmes targeting foods and eating have been effective at reducing BMI, and similarly implementation intentions have been effective at reducing dietary fat intake. Therefore a combination of mindfulness and implementation intentions strategies, aimed at addressing thoughts in an attempt to stick to a healthy eating programme might be beneficial as a weight loss maintenance strategy.

Finally, King et al. (2012) highlight the importance of individual variability when devising weight loss and weight loss maintenance strategies. They argue that one of the key issues with research examining the efficacy of physical activity as a method of weight loss and weight loss maintenance is the fact that mean data are always presented and this means that individual variability in response to exercise is often overlooked. King et al. have recognised that the variability of individuals demonstrated in results of responders versus non-responders (i.e. those that lose the expected amount of weight versus those that do not), has attracted the wrong type of attention and can sometimes deter people from actually taking part in physical activity. They therefore argue that it is essential for researchers to examine and understand what accounts for this variability and how to use this information for the development of strategies to promote weight loss rather than it be used as a means of deterring those who experience poor weight loss from engaging in physical activity. As King et al. state, we need a better understanding of how underlying processes collectively contribute to a lower-than-expected weight loss and therefore determine why exercise is not always the most effective weight loss method for some individuals. Future interventions would benefit from examining these underlying processes in order to create more efficient weight loss and weight loss maintenance strategies that are tailored more to the individual.

4.5.3 Conclusion

The current study was designed as a three-arm exploratory randomised controlled trial in order to examine the efficacy of a mindfulness plus implementation intentions intervention for promoting physical activity over an implementation intentions strategy alone. Implementation intentions have been widely demonstrated to be successful for increasing physical activity, however the evidence for mindfulness as a strategy for increasing exercise is somewhat more limited. The evidence that does exist though, demonstrates that individuals who are more mindful are more likely to carry out their physical activity intentions than those who are not (e.g. Chatzisarantis & Hagger, 2007). However, it is also possible that mindfulness strategies alone may not work if individuals do not make the plans (i.e. implementation intentions) to exercise, and close the intention-behaviour gap. The current study therefore sought to combine these two strategies and aimed to enhance levels of physical activity.

The results demonstrated that the combined mindfulness plus implementation intentions strategy failed to promote physical activity after one- and six-months, suggesting that the intervention was not effective at promoting change during this period. It is possible that potential difficulties in this group lay with the mindfulness strategies employed, and future research may benefit from more piloting stages to determine which components of mindfulness are successful at promoting behaviour change.

Chapter Five

General Discussion

5.1 Research Aims

The aim of the current thesis was to examine the psychological factors that contribute to overweight and obesity and to identify successful psychological interventions that promote healthy behaviour. The causes of overweight and obesity involve a range of psychological, environmental, social, genetic and economic factors that can interact in varying degrees to the development of obesity (Wright & Aronne, 2012), and in order to tackle the obesity crisis we need to intervene at all of these different levels (King & Thomas, 2007). The current thesis addressed the psychological factors, which can have significant implications for the development of interventions and can inform public policies and health services. According to Johnston, Weinman and Chater (2011), "In offering consultancy, health psychologists bring their theory and methods to address identified problems, and this has been clearest in consultancy to government". For example, Abraham and Michie (2008) and Michie et al. (2009) conducted research on behaviour change to reduce behavioural risk factors for disease such as smoking, low levels of physical activity and unhealthy diet, and completed major reviews that contributed to reports such as the Wanless Report (2004) and the public health White Paper, Choosing Health (2004) (Johnston, Weinman & Chater, 2011, p.892). Health psychologists are often asked to respond to National Institute for Health and Clinical Excellence (NICE) and government consultations, as well as serve on health and research committees such as the Medical Research Council (MRC) and NICE (Johnston, Weinman & Chater, 2011).

The current thesis is divided into three studies; Study One aimed to examine overweight and obese participants' perceived reasons for eating, with a particular focus on the consumption of unhealthy snacks and the additional aim of investigating sex differences. Study Two aimed to determine what factors (specifically in terms of reasons for eating) predict weight change after one year, amongst a group of overweight and obese males and females, and Study Three sought to examine the efficacy of a new approach designed to increase levels of physical activity. A full discussion of these studies can be found in earlier chapters; however the purpose of this final chapter is to focus on the implications of the findings and how they relate to the wider issue of predicting overweight and obesity, and ensuring the population maintains a healthy weight. The results of such studies are important on a number of levels. As well as reducing the burden to the NHS and the broader economy (King, 2011), tackling overweight and obesity and identifying successful psychological interventions will improve general well being and decrease the individual's risk of developing a number of chronic conditions (Kopelman & Grace, 2004; Kopelman, 2007; Wright & Aronne, 2012).

5.2 What Reasons do Overweight and Obese Males and Females Give for Eating, and What are the Implications of this Evidence for Interventions?

Literature on the reasons for initiating eating and sex differences in reasons for eating are sparse, however the evidence that does exist suggests that there are a range of different reasons people may have for deciding to eat, and that males and females may choose to eat for different reasons (Tuomisto et al., 1998). Study One extended the current literature by exploring whether males and females gave different reasons for eating and employed a 5-day diary. It also addressed foods that may be important contributors to weight gain (i.e. unhealthy snacks), as reducing consumption of these foods may be a useful weight management strategy.

The results of this study provided evidence for the existence of reasons other than hunger for eating, as well as the existence of sex differences. Out of the 358 snacks reported, 79% (283) of these were unhealthy (i.e. high in fat or sugar), which has important implications for addressing this type of eating in relation to weight loss programmes. The results demonstrated a high proportion of eating episodes for which external eating (grouped reason of 'Planned Eating' that relates to external type reasons for eating identified in Study One = 60%; grouped reason of 'Temptation' that also relates to external type reasons for eating identified in Study One = 58%) was reported as a reason for eating unhealthy snacks. This high proportion of eating for external reasons has implications for interventions that might target cravings or enhance self-control. Cravings can be triggered by environmental cues (external cues such as the sight and smell of food for example) and bring about associated thoughts and images of a craved item. Cravings can be distressing and distracting; therefore interventions that help to reduce cravings would be beneficial (Andrade, Pears, May & Kavanagh, 2012). Furthermore, interventions that help to promote self-control will have implications for cravings. Through practicing self-control individuals can improve self control performance (Muraven, 2010), and by helping individuals to exert self-control over their cravings, they may be able to inhibit responses when faced with environmental cues that illicit associated thoughts and images of craved items. 'Planned Eating' included reasons of hunger and to avoid hunger, therefore given the high proportion in which this type of eating was reported as a reason, implications for intervention also point towards weight loss programmes that help to limit hunger. Evidence suggests that increased hunger and craving are predictors of weight regain after weight loss (see Jakubowicz, Froy, Wainstein & Boaz, 2012), therefore studies that are designed to limit this increase in hunger would have implications for not only weight loss but also weight regain following weight loss.

The results of Study One also demonstrated high levels of emotional eating ('Psychological Control' = 36%) for unhealthy snacks, therefore interventions may benefit from addressing negative moods that may increase the desire to eat. Finally, a significant proportion of episodes were initiated for social reasons (e.g., out of obligation) ('Obligation' = 24%), which again has implications for intervention. These results highlight that eating is often a social act and therefore weight management interventions that provide individuals with strategies to employ in a social context may be beneficial.

The identification of key motivators for eating unhealthily, as well as any sex differences may provide crucial information for developing interventions that are tailored towards individuals. The results of Study One did not demonstrate that males and females differed in the frequencies with which they reported reasons for the consumption of unhealthy snacks; however social reasons (i.e., 'Obligation') did appear to be approaching significance, with females reporting this reason more than males. This may therefore be particularly interesting to investigate in future research from an intervention point of view, as many interventions tend not to address this issue. Weight loss/maintenance programmes may benefit from addressing this potential difference between males and females' eating behaviour in addition to other reasons for eating, in order to inform interventions that are more tailored towards the individual. Strategies such as mindfulness techniques for females, that make them more aware of their reasons for eating in a social context (e.g., eating because they feel obliged to eat something that has been prepared for them at a dinner party) may be beneficial.

5.3 Do Reasons for Eating Predict Weight Change After One Year?

Psychological predictors of long-term weight change started to receive increasing interest approximately ten years ago (Wadden, Brownell & Foster, 2002). Evidence for psychological predictors however, is both limited and inconclusive, and as these types of predictors have implications for the development of interventions, research in this area is warranted. Study Two extended the current literature by exploring whether psychological reasons for eating could predict weight change after one year and expanded the types of reasons for eating that could be attributable to weight change not already addressed by previous research. It also employed more objective measures of weight change (i.e., height and weight measurements rather than self-reported weight at follow-up) than previous studies, as well as diaries in order to prevent recall bias.

The results of this study however, did not conclusively demonstrate reasons for eating as a predictor of weight change, as no significant associations were observed between the grouped reasons for eating and weight change. The lack of associations may have been to do with issues of power; however, some correlations were not in the predicted directions, therefore it is still unclear whether psychological reasons for eating are predictive of weight change. As with Study One, the results of this type of research have implications for the development of interventions that are tailored towards individuals. For example, if social reasons for eating were predictive of weight change after one year in females, then we could suggest that weight loss/maintenance programmes include factors that address eating within a social context for females. Future research is therefore needed to obtain further information regarding the psychological reasons for eating and whether they are indeed predictive of weight change.

5.4 Can Mindfulness Enhance the Effects of Implementation Intentions for Increasing Physical Activity?

Successful healthy weight maintenance has implications for better health outcomes. Weight loss is almost always regained over time (Byrne, 2002), therefore knowing how to successfully maintain weight loss is important. This is not without difficulty though, and the current literature suggests that people struggle to maintain weight loss because they fail to stick to healthy eating and exercise habits (McGuire et al., 1999; Byrne 2002). Study Three therefore, examined the efficacy of a new approach designed to increase levels of physical activity and therefore help individuals maintain a healthy weight.

Fox and Hillsdon (2007) discuss why physical activity should be promoted. For example, fewer jobs now require physical work due to the UK becoming a more service-based economy; more use of technology in the home that has resulted in increased work and shopping from home; and changes in outdoor shopping patterns due to the development of more 'out-of-town' shopping centres resulting in increased use of motorised transport such as cars or buses, amongst other reasons. As well as this however, overweight and obesity are the fourth most important risk factor for ill health and premature death (Anderson, 2008), therefore research such as Study Three in the current thesis, that addresses the promotion of healthy behaviours and the long-term maintenance of healthy weight will not only reduce economical costs but also improve future health outcomes.

There is a large body of current literature demonstrating the positive effects of implementation intentions on increasing physical activity, but no research combining this strategy with mindfulness exercises in order to further enhance these levels. Study Three specifically looked to examine whether mindfulness could enhance the effects of implementation intentions for increasing physical activity and extended the current literature by combining these two volitional strategies in an exploratory randomised controlled trial. The combined intervention failed to promote physical activity and pointed towards potential difficulties with the mindfulness exercises. In comparison to both the implementation intention (II) only and control groups, physical activity significantly decreased in the mindfulness group after one month (also at six months but non-significantly), and there were no significant effects of the

II only strategy after one- or six-months. In terms of the II only group, it is possible that these results were observed due to participants forming ineffective implementation intentions, being faced with unsupportive environments (e.g., bad weather), or having insufficient motivation for the period of the study. It is possible that participants in the mindfulness group were given too many strategies and that some strategies were diluting the effects of others. Future research would therefore benefit from more piloting stages of mindfulness strategies to determine which components of mindfulness are successful at promoting behaviour change. As well as promoting weight maintenance, the results of this type of research that tackle lifestyle change have implications for reducing the burden to the NHS and the broader economy, improving health and wellbeing and decreasing the risk of developing a number of chronic conditions.

5.5 Limitations

One of the most noteworthy difficulties involved in applied research is that of recruitment and the subsequent difficulties involved in preventing high attrition rates. This limitation is particularly true for Study One, given that for some grouped reasons for eating there were differences in the means in the predicted directions (but non significant); therefore it could be suggested that where non-significant findings were observed, there was possibly an issue of power and the study may have benefited from further recruitment. The same cannot be said for studies two and three, as the non-significant results were not in the predicted directions, however, it can still be argued that both Study Two and Three were underpowered given the high attrition rates (50% and 40% consecutively).

Given the large amount of commitment that can be involved in applied research, this can be an unfavourable factor for many people, discouraging not only initial participation but also returning to follow-ups. One of the most noteworthy difficulties of studies two and three was the lack of control over participants returning to follow-ups. Difficulties always lie in obtaining sufficient numbers for applied research; however, attempts at preventing attrition and obtaining sufficient numbers of participants that took part at baseline to return, is even more challenging. Many trials can lose participants to follow-up (Dumville et al., 2006) and there are a number of potential reasons why participants may not wish to return. These include a form of social desirability, whereby participants may feel that they cannot return to take part in the follow-up if they believe they have not fulfilled the requirements of the study. Also time may have been a concern; applied research can require a large amount of commitment and time, which participants may not have felt able to devote. It is possible that the study demands were too high for participants, or that there was a lack of immediate or perceived benefit to returning to the follow-up sessions.

High attrition rates can introduce bias to a study, although it is not clear at what level of attrition bias actually becomes problematic. As Dumville et al. (2006) report, Schulz and Grimes have argued that an attrition rate of 5% or less is generally acceptable, but anything over 20% is a cause for concern. Given the potential for the introduction of bias, as well as issues of power and the need of adequate numbers for statistical significance, every effort is needed to avoid attrition in applied research studies. Jancey et al. (2007) conducted a study investigating attrition in a 6-month physical activity intervention. The characteristics of participants who were lost to attrition were compared with those who returned to take part in the 6-month follow-up, and found that participants that were lost to attrition were of lower socioeconomic status, were overweight and less physically active. They suggest that in order to identify individuals at risk of attrition, to improve retention and to avoid potential bias, an early assessment of these characteristics should be undertaken to identify those most at risk of drop-out. The research described in this thesis did not conduct a review or early examination of characteristics that may have attributed to drop-out. Therefore in future it may be appropriate for a thorough background search of the literature to be conducted in order to identify potential characteristics of individuals likely to drop-out of applied research.

5.6 Future Research

Future research would benefit from addressing the issues of recruitment and attrition. Obtaining adequate numbers of participants to ensure power, as well as addressing potential characteristics that lead individuals to drop out of applied research is necessary. Furthermore, socioeconomic status (SES) is strongly associated with overweight and obesity, with a higher proportion of overweight and obese people among those from lower SES groupings (Swinburn and Egger, 2004; Law, Power, Graham & Merrick, 2007). Most of the participants in the current research were likely to have been from mid to high SES groups, therefore future research may benefit from carrying out investigations in areas of lower SES.

Knowledge about the relative frequencies with which particular reasons are reported for eating unhealthily can help to inform future studies targeting interventions. Future research could utilise the information gained in Study One of the current thesis to examine potential strategies aimed at reducing overweight and obesity. For example, given that sex differences were observed in social reasons for eating, future research could examine the potential utility of mindfulness in females when eating in a social context. Providing females with a strategy that makes them aware of why and when they are eating unhealthily may have implications for reducing unhealthy snacking and promoting weight loss. Previous literature does however suggest that it is easier to promote behaviour that is non-habitual than behaviour that is (Adriaanse, de Ridder & de Wit, 2011); therefore given that the mindfulness plus implementation intentions strategy employed in Study Three of the current thesis failed to promote non-habitual exercise behaviour as would have been expected, perhaps future research would benefit from applying this intervention strategy to promote healthy eating rather than attempting to reduce or stop unhealthy eating. Implementation intentions have been demonstrated to be effective at promoting healthy eating (Adriaanse, 2011), therefore it would be interesting to examine whether these effects could be further enhanced through the inclusion of a mindfulness technique. It would be prudent to bear in mind however, that the results of Study Three suggested that difficulties may have been encountered with some of the mindfulness techniques; therefore it would be sensible to suggest that piloting of these techniques was carried out prior to any main analysis.

In order to inform our understanding of the environmental causes of overweight and obesity as well as the policies and interventions that can help to prevent it, future research needs to assess the interaction of social, behavioural and biological determinants of overweight and obesity through life course research and ecological studies. The cause of overweight and obesity is much more complex than an energy imbalance between the calories consumed and the calories expended, and involve a range of psychological, environmental, social, genetic and economic factors that can interact in varying degrees (Wright & Aronne, 2012). We therefore need to address each of these factors in order to inform government policy and ensure healthy outcomes for the population.

The results of Study One demonstrated high levels of emotional eating for unhealthy snacks, hence interventions may benefit from addressing negative moods that may increase the desire to eat. Therefore future studies that may be focused on addressing methods of intervention could include examination of negative moods, and could employ strategies such as mindfulness to help people become more aware that they are eating in these situations. By helping individuals to be more mindful of their negative thoughts and emotions in certain contexts, they can then employ strategies such as cognitive defusion in order to see their thoughts as just thoughts and not 'buy into' their emotions and seek comfort in the form of food.

Furthermore, a significant proportion of episodes in Study One were initiated for social reasons, which again has implications for intervention. These results highlight that eating is often a social act and therefore weight management interventions that provide individuals with strategies to employ in a social context may be beneficial. Future studies could employ a similar strategy to be used in a social context as the example provide above for negative thoughts and emotions. Making people aware of why they are eating in these contexts is the key here, and this can be achieved through mindfulness training.

As with Study One, the results Study Two have implications for the development of interventions that are tailored towards individuals. For example, if social reasons for eating were predictive of weight change after one year in females, then we could suggest that weight loss/maintenance programmes include factors that address eating within a social context for females. Future research is therefore needed to obtain further information regarding the psychological reasons for eating and whether they are indeed predictive of weight change. Future studies could examine some of the reasons for eating and manipulate them using a more experimental design (rather than a correlational one). For example, the grouped reason 'Planned Eating' includes reasons of hunger, therefore the types of foods eaten over a 5-day period could be manipulated in order to eliminate feelings of hunger and try to reduce the level at which this type of reason should be reported. For 'Temptation', a more controlled environment could be introduced in order to reduce the number of external cues, thereby reducing the amount at which this reason should be reported. Finally, in terms of social reasons for eating, it may be possible to manipulate the social contexts in which people eat. For example, individuals could be required to eat at a social function with other people for two consecutive days and then eat alone for the following two days, thereby attempting to eliminate the level at which social reasons are reported as a reason for eating over these final two days. In each of these examples, before and after measures would need to be obtained, and it is possible that some of these designs would be more problematic than others. For example, manipulating social contexts may be more difficult than producing a controlled environment and eliminating external cues. Given that an experimental design can be potentially more problematic for some reasons for eating than others, it can be argued that a diary methodology is more appropriate for this type of research, in that it is possible to examine *all* reasons for eating rather than just some. Therefore, a combination of both experimental and diary methodology may be beneficial.

In terms of the results obtained in Study Three, with particular reference to the Implementation Intention (II) only group, it is possible that the results observed were due to participants forming ineffective implementation intentions, being faced with unsupportive environments (e.g., bad weather), or having insufficient motivation for the period of the study. It is possible that the participants in the mindfulness group were given too many strategies and that some strategies were diluting the effects of others. Future studies could consider reducing the number and/or difficulty of the tasks, or adjusting the number and/or length of the follow-ups. It is possible that the mindfulness strategies employed in this study were not well formulated, therefore future research may benefit from more piloting stages of mindfulness strategies to determine which components of mindfulness are successful at promoting behaviour change. For example, a two-arm randomised controlled trial could be designed employing an experimental group and a control group, in order to examine the effectiveness of the mindbus technique only. A short physical activity exercise could be employed, such as the Six Minute Walk Test (6MWT) (Butland et al., 1982), to examine whether the mindbus strategy was successful at increasing people's participation in this type of exercise. In terms of developing the mindfulness plus implementation intentions study further, future research may be improved by employing a four-arm randomised controlled trial that includes less mindfulness tasks, allows participants to devise 'back-up' implementation intentions, employs some form of future thinking or guided imagery, and incorporates a motivational component. It may also be possible that employing a sample of participants that have already achieved significant weight loss would be beneficial. It is possible that individuals who have already achieved their desired weight loss would be highly motivated to maintain it, and that a Mindfulness plus Implementation Intentions intervention would work better amongst these individuals.

The result of Studies One and Two not only highlight the importance of examining the different reasons for eating between males and females, but also in individuals who are overweight or are obese. This may have considerable implications for informing and developing appropriate interventions, however it is also possible that differences may have been observed between overweight/obese and normal weight individuals. Reasons for eating may differ between normal and overweight/obese participants and this prospect cannot be tested by the current design. It is difficult to make comparisons to other studies that have used normal weight individuals due to methodological differences; therefore it may be beneficial for future studies to consider comparing these two groups of individuals. It could also be suggested that given a larger sample size, significant findings would have been observed in Studies One and Two, therefore future research should consider a larger scale study.

Finally, given the difficulties generated by attrition and adherence to applied research studies, findings ways of tackling these issues is important. Future studies could consider keeping participants blind to group allocation, which may promote adherence (particularly if participants are part of a control group and may be at greater risk of dropping out of a study if they feel they are not gaining anything). Perhaps conducting a greater number of follow-ups, or generating coping plans (that is, anticipating any potential barriers and forming a plan to cope with them) may aid adherence. Future studies should also consider screening individuals in order to address the factors that lead people to drop out of applied research. Examining the psychosocial determinants of adherence and understanding the key factors and contributors that influence volitional behaviour may help to inform further studies that promote healthy behaviour/behaviour change. The inclusion of these factors in future exploratory research may then inform their inclusion in for example, weight management programmes.

5.7 Implications of Findings for the Treatment of Obesity

In terms of the implications of the thesis findings for the treatment of obesity, there are a number of factors which need to be considered. From a broader perspective, the findings of Study One have implications for people's ability to accurately report the reasons why they chose to initiate eating. A number of studies have noted the difficulties that people may face when taking part in self-report studies (e.g., Barrett, 1997; Ready, Weinberger & Jones, 2007), with some arguing that a number of cues that may precede meals and mealtimes and come to be associated with hunger and therefore misinterpreted (Tuomisto et al., 1998), that people over-interpret and therefore incorrectly report emotional experiences and the desire to eat in emotional situations (Adriaanse, de Ridder and Evers, 2011), and that people can also *under*estimate the impact of emotions on behaviour when they are not in any kind of emotional state (Evers, de Ridder & Adriaanse, 2009; Nordgren, van der Pligt and van Harreveld, 2007).

In Study One, the frequency with which Automaticity was recorded as a reason for the consumption of unhealthy snacks (7% of eating occasions) was interesting, as it could be considered a relatively high frequency of unawareness in comparison to that reported for healthy snacks and main meals. It might be that this high level of unawareness with unhealthy snacks (i.e. in comparison to the frequencies with healthy snacks and main meals) is a reflection of how people are unaware of why they have decided to eat a chocolate bar for example, and therefore cannot accurately report their reasons for choosing to eat this type of food. This could have important weight implications, as an unawareness of eating unhealthy snacks could lead to overweight or obesity. This subsequently has implications for the development of interventions aimed at reducing overweight and obesity, and should therefore be included as a focus in future research. Intervention studies may benefit from employing strategies such as mindfulness to help people become more aware of the reasons why they choose to eat unhealthy snacks. Training people to become more aware of what they are eating and why, could have considerable advantages if included in weight loss strategies.

Additionally, the results of Study One demonstrated that on average, females tended to report higher levels for all reasons for eating in comparison to males; therefore it could be argued that there was a reporting bias here. It is possible that there was a tendency for females to over-report their reasons for eating, and perhaps future studies of increasing awareness of the consumption of unhealthy snacks should focus on females. On the other hand, it is possible that males may be under-reporting, and therefore studies aimed at increasing awareness may be better targeted at these individuals.

Given the frequency of unawareness reported and the tendency for females to report higher levels for all reasons in comparison to males, it is possible that the reasons that people report for eating may not actually reflect reality, and this should be considered in future research. Furthermore, in terms of the results of Study Two, it is possible that the lack of association between weight change and reasons for eating could also reflect participants' inability to accurately report their reasons for eating. It may be beneficial to experimentally manipulate the reasons for eating at baseline (as suggested in section 5.3) in addition to carrying out diary methodologies to determine the reasons why people eat and to inform interventions. This may help to determine whether what people report does actually reflect reality, as this will have implications for intervention.

In addition to experimentally manipulating the reasons for eating and employing diary methodology, future research could address the issue of self-report and whether participants' responses actually reflect reality through public and user involvement. Patient and public involvement (PPI) in research is that which is carried out *with* members of the public (Involve, 2012), and this public involvement in research can illuminate the user experience and can help us to shape studies and services that are truly responsive to the individual's needs. Barber et al. (2012) carried out a systematic evaluation of the impact of user involvement and endorsed its value and the importance of evaluating its impact. There are very few studies examining the reasons for eating, and as eating can be a source of conflict for individuals who are obese or overweight the processes involved in meal initiation are very important. Given the lack of evidence and literature on reasons for eating, and that PPI is now an established part of many applied studies in the UK (DoH, 2005), it may be that in order to determine whether people's perceptions actually reflect reality, future studies would benefit from involving the public in the design of experimental and diary studies.

5.8 Conclusions

According to Swinburn et al. (2011), the management of overweight and obesity requires policy interventions to improve environments that promote poor dietary intake and physical activity, rather than interventions that are focused on the individual. However, it can be argued that obesity really needs to be tackled at multiple levels, for example, at the societal (e.g., government policy) as well as individual level, and requires collaboration across a range of different disciplines (such as sociologists, geographers, and medics). As Swinburn et al. (2011) state, obesity is the normal response of normal people to an abnormal situation. There are a range of factors and environmental influences for unhealthy eating and behaviours that people face everyday, therefore supporting and encouraging people to respond more healthily to these situations is essential. This can be achieved through multi-level research. For example, medical research can provide us with information on genetic influences and dietary behaviour, societal research with information on health inequalities and environmental influences, and psychological research on predictors of unhealthy behaviour and behaviour change. Overweight and obesity, and attempts to reduce them, can then be constructed from these elements and therefore inform government policy.

From a broader perspective, given that overweight and obesity are the fourth most important risk factor for ill health and premature death (Anderson, 2008), it is essential that we examine the psychological factors that contribute to overweight and obesity as well as promote healthy behaviours that tackle the impact and future course of overweight and obesity. We must do all we can to help ensure the population maintain a healthy weight and improve health outcomes for people in the long-term. This needs to be addressed at multiple as well as individual levels, through user involvement and collaboration across a range of different disciplines in order to inform government policy. The current thesis fits in to this overall aim by addressing the psychological aspects of overweight and obesity. It examined the psychological factors that contribute to overweight and obesity and attempted to identify psychological interventions to promote healthy behaviour.

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Appendices

The following documents are included in the appendices.

Document	Title/Description of Document
A	Study One pilot pre-study questionnaire.
B	Study One pilot diary.
C	Study One pilot post-study questionnaire.
D	Study One background/demographics questionnaire.
E	Study One diary list of instructions.
F	List of reasons for eating included in Study One diary.
G	List of reasons for drinking alcohol included in Study One diary.
H	List of foods and their sources, for categorisation not obtained from Food Standards Agency (2002), McCance and Widdowson's The Composition of Foods).
I	Detailed schedule of coding procedure for inter-observer reliability analysis.
J	Study Two dieting questionnaire.
K	'Making Plans' implementation intention strategy.
L	'Leaves on a Stream' mindfulness strategy.
M	'Practicing Noticing your Thoughts' cognitive defusion strategy.
N	'Sticking to your Plans' cognitive defusion strategy.
O	Study Three background questionnaire.
P	'Making Plans' task completion questionnaire.
Q	'Practicing Noticing your Thoughts' task completion questionnaire.
R	Extent to which thoughts were noticed questionnaire.
S	'Sticking to your Plans' task completion questionnaire.
T	White Bear exercise instructions and tally sheet.
U	Department of Psychology, Ethics Committee Memo - Reasons for eating: a one-day diary study.
V	Department of Psychology, Ethics Committee Memo - Reasons for Eating: A Diary Study.
W	Department of Psychology, Ethics Committee Memo - Mindfulness and implementation intentions in people actively attempting to lose weight.
X	Department of Psychology, Ethics Committee Memo - Strategies for promoting existing levels of physical activity.

Appendix A

Participant Number:

Reasons for Eating: A One-Day Diary Study

Pre-Study Questions (Background Information)

Age: ……………………..

Gender: ……………………..

Occupation: ……………………..

Height: ……………………..

Weight: ……………………..

Are you currently trying to lose weight?

☐ YES ☐ NO

How are you trying to lose weight?

………………………………………………………………………………………………

………………………………………………………………………………………………

………………………………………………………………………………………………

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………………………………………………………………………………………………

Appendix B

Participant Number.....................

Food Diary

Food Diary

Thank you for agreeing to take part in the following study. Below are a number of questions that will help you to complete this food diary. Please take time to read them before you proceed. If you require any additional information you can contact me (Ms Louise Cleobury) on 01792 602282.

When should I fill in this diary?

You are required to complete one Eating Episode section of this diary each time you eat something, throughout the entire day, for one day only. The End of Day section should be completed just prior to going to bed in the evening (when you will not be eating or drinking anything else that day). Please ensure that you complete one Eating Episode section of the diary every time you eat something.

The diary should be completed on ....

What about snacks and drinks?

You should complete an Eating Episode section for all main meals (breakfast, lunch, dinner, tea, supper, and any other main meals you may have) as well as any in-between meal snacks. You need not include drinks in the Eating Episode sections as there is space for you to record these in the End of Day section.

What if I can't fill it in at the time of eating?

If for any reason you cannot complete the diary at the time of eating then it is important that you complete the relevant section as soon as possible to ensure you do not forget any details. Enter the time that you ate the meal or snack as well as the time at which you are completing that particular section.

What if I miss a meal?

Only fill the diary in for foods you have *actually* eaten throughout the day, not meals you would think you would *usually* eat.

What will you do with the information?

All the information about your participation in this study will be kept strictly confidential and you are free to withdraw from the study at any time. The information will be used as part of the write up for a PhD thesis and may also be published in academic journals and related media.

Eating Episode 1

Please complete the following details for each eating episode:

1. Time now ....
2. Time you started eating ....
3. Time you finished eating ....
4. Where you were when you were eating
   ....
5. Please list all the foods you ate ....

   ....

   ....

   ....

   ....

   ....

   ....

   ....

   ....

   ....

   ....

   ....
   .

6. How would you describe the eating episode? (e.g., breakfast, lunch, snack)

   ....

   ....

7. What prompted you to eat? *There may be more than one reason. Please list all that apply*

   ....

   ....

8. Why didn't you stop eating *sooner* than you did? *There may be more than one reason. Please list all that apply*

End of Day

Please take a moment to look back over your day to make sure you have completed the diary for each eating episode (that is, every meal, snack, etc). If you have missed one, please complete the appropriate sections and return to the questions below.

1. Please try to recall and list all the drinks you have consumed over the course of the day

Type......................... Amount ....glasses / cups / pints *(delete as appropriate)*

Type......................... Amount ....glasses / cups / pints *(delete as appropriate)*

Type......................... Amount ....glasses / cups / pints *(delete as appropriate)*

Type......................... Amount ....glasses / cups / pints *(delete as appropriate)*

Type......................... Amount ....glasses / cups / pints *(delete as appropriate)*

Type......................... Amount ....glasses / cups / pints *(delete as appropriate)*

Type......................... Amount ....glasses / cups / pints *(delete as appropriate)*

Type......................... Amount ....glasses / cups / pints *(delete as appropriate)*

Type......................... Amount ....glasses / cups / pints *(delete as appropriate)*

Type......................... Amount ....glasses / cups / pints *(delete as appropriate)*

2. During a typical 7-day period (a week), how many times on average do you do the following kinds of exercise for more than 15 minutes during your free time (write on each line the appropriate number).

    a) Strenuous exercise (heart beats rapidly). For example, running, jogging, hockey, football, soccer, squash, basketball, cross country skiing, judo, roller skating, vigorous swimming, vigorous long distance cycling, etc

    TIMES PER WEEK ....

b) Moderate exercise (not exhausting). For example, fast walking, baseball, tennis, easy cycling, volleyball, badminton, easy swimming, alpine skiing, popular and folk dancing, etc

TIMES PER WEEK
....

c) Mild exercise (minimal effort). For example, yoga, archery, fishing from riverbank, bowling, horseshoes, golf, snow mobiling, easy walking, etc

TIMES PER WEEK
....

3. During a typical 7-day period (a week), in your leisure time, how often do you engage in any regular activity long enough to work up a sweat (heart beats rapidly)?

☐ Often ☐ Sometimes ☐ Never/Rarely

Appendix C

Participant Number:

Reasons for Eating: A One-Day Diary Study

Post-Study Questions

What difficulties did you encounter whilst completing this diary?

....

....

....

....

....

....

....

....

....

....

How did you find the questions and instructions?

....

....

....

....

....

....

....

....

....

How did you find the layout of the diary? (i.e. booklet format, the way the questions were structured, etc).

How did you find carrying the booklet around throughout the day?

How easy was it to fit the completion of this diary into your schedule?

....

....

....

....

....

....

....

....

How many consecutive days do you think other people would be willing to conscientiously complete the diary for?

....

....

....

Do you have any suggestions for improvement?

....

....

....

....

....

....

....

....

....

....

Additional questions/comments

Appendix D

Date of Completion: **Participant Number:**

Demographics

1. Diary Completion

   ………………………………………………………………………

2. Date of Birth……………

3. Gender

   ☐ Male ☐ Female

4. Occupation………………………………………………………………………

5. Level of Education…………………………………………………………………………

6. Current Height…………………

7. Current Weight…………………

8. BMI……………………………

9. Do you have any physical conditions that affect what you eat?

   ☐ No ☐ Yes *(if yes you are unfortunately not able to take part)*

10. Are you pregnant?

    ☐ No ☐ Yes *(if yes you are unfortunately not able to take part)*

11. How many times (if any) have you dieted to lose weight in the past year?

(By dieting we mean attempting to lose weight by trying to alter your normal eating habits).

☐	☐	☐	☐
I haven't dieted before	About 1-5 times	About 6 – 24 times	25 times or more

12. Are you currently dieting to lose weight?

☐ No ☐ Yes

13. If yes, when did you begin your **current** attempt to lose weight?

………………weeks ago or ……………months ago

14. How much weight have you lost on your **current** attempt?

………………kg or ……………lb

15. Type of diet?

……………………………………………………………………………

16. Are you vegetarian?

☐ No ☐ Yes

17. Email Address

……………………………………………………………………………

Appendix E

Food Diary

Thank you for agreeing to take part in this study. The information below should help you complete the diary. Please take time to read it carefully before you proceed. If you require any additional information you can contact me (Ms Louise Cleobury) on 01792 602282.

What do I have to do?

You should carry this diary and a pen with you all day for the five days allocated on the front page. Whenever you eat something during each of the five days, as soon as possible, you should answer the appropriate questions in the diary, making a note of the approximate time that you recorded your answers.

What do I write in the food section?

When asked what you have eaten in question 3, you should provide as much detail as possible. Please give details of ALL the food items you have consumed, including preserves, sauces, pulses, condiments, etc. Examples have been provided for you.

When should I fill in the diary?

You should complete one of the Eating Episode sections of the diary each time you eat something. You should do this throughout the entire day, for five days. The End of Day section should be completed just prior to going to bed in the evening (when you will not be eating or drinking anything else that day). Please ensure that you complete one Eating Episode section of the diary every time you eat. The diary should be completed on the days indicated on the front page.

What about snacks and drinks?

You should complete an Eating Episode section for all main meals as well as any in-between meal snacks, and snacking during food preparation. You need not include drinks in the Eating Episode sections as there is space for you to record these in the End of Day section.

What if I can't fill it in at the time of eating?

If for any reason you cannot complete the diary at the time of eating then it is important that you complete the relevant section/s as soon as possible to ensure you do not forget any details. Enter the time that you ate the meal or snack as well as the time at which you are completing that particular section.

What if I miss a meal?

Only fill the diary in for foods you have *actually* eaten throughout the day, not meals you think you would *usually* eat.

How do I complete the End of Day section?

At the end of each day you should record the different types of drinks you have consumed throughout the day and also the total number of each of these drinks. You may find it easier to fill in this section if you keep a note of all your drinks as you go through your day. If you have consumed alcohol at any time during the day, you should answer the additional alcohol questions.

In the End of Day section you will also be asked about anything you have found to be a 'hassle' or an 'uplift'. For each of the items listed you should indicate how much of a hassle or an uplift they have been during the course of the day.

What do I need to do once I have completed the diary?

Once you have completed the diary you need to return to the Psychology Department with the diary, to complete a number of questionnaires. Once these questionnaires have been completed you will be entered into the prize draw for £100 of High Street vouchers. These can be used in over 20 popular retail stores including Argos, Boots, Comet, Carphone Warehouse, Boots, Focus DIY, JJB Sports, Halfords, H.Samuel, Hard Rock Café, Homebase, HMV, Iceland, La Senza, River Island, Shoe Zone, Virgin Megastores, Waterstones, Warehouse, WH Smith, Wilkinson, Woolworths and many more.

As an additional token of our appreciation for participating in this research, you will be sent a personal Eating Profile a couple of weeks after completing the questionnaires. This profile will consist of a brief analysis of the information you have provided in the diary together with short explanations of different eating styles. It is important to note that this information is not diagnostic in any way. However we hope that it will provide you with an interesting insight into your own eating behaviour.

What will you do with the information?

All the information about your participation in this study will be kept strictly confidential and you are free to withdraw at any time. The information will be used as part of the write up for a PhD thesis and may also be published in academic journals and related media.

If you require any additional information you can contact me (Ms Louise Cleobury) on 01792 602282.

Appendix F

Why did you decide to eat? *Please read each statement and decide to what extent it is true for you by using the rating scale provided. Tick the box that corresponds to your rating.*

	1 Disagree a lot	2 Disagree a little	3 Neither agree nor disagree	4 Agree a little	5 Agree a lot
1 I decided to eat because I was hungry	☐	☐	☐	☐	☐
2 I decided to eat to avoid being hungry later	☐	☐	☐	☐	☐
3 I decided to eat because the food looked / smelt so tempting	☐	☐	☐	☐	☐
4 I decided to eat because I was feeling fed up	☐	☐	☐	☐	☐
5 I decided to eat because I was bored	☐	☐	☐	☐	☐
6 I decided to eat because I was stressed	☐	☐	☐	☐	☐
7 I decided to eat because I couldn't stop thinking about food	☐	☐	☐	☐	☐
8 I decided to eat to keep somebody else / other people company	☐	☐	☐	☐	☐
9 I decided to eat because I usually eat at this time	☐	☐	☐	☐	☐
10 I decided to eat because I felt I needed the energy	☐	☐	☐	☐	☐
11 I decided to eat because I felt obliged to	☐	☐	☐	☐	☐
12 I decided to eat because I wanted to avoid food going to waste	☐	☐	☐	☐	☐
13 I don't recall deciding to eat – I just found myself eating	☐	☐	☐	☐	☐
	1 Disagree lot	2 Disagree a little	3 Neither agree nor disagree	4 Agree a little	5 Agree a lot

Appendix G

If you have consumed any alcohol during your day, please answer the questions on the following page, *only* in relation to these alcoholic drinks. Why did you decide to drink? *Please read each statement and decide to what extent it is true for you by using the rating scale provided. Tick the box that corresponds to your rating.*

	1 Disagree A Lot	2 Disagree a little	3 Neither Agree nor Disagree	4 Agree a little	5 Agree A Lot
1 I decided to drink alcohol because I was thirsty	☐	☐	☐	☐	☐
2 I decided to drink alcohol because it looked so tempting	☐	☐	☐	☐	☐
3 I decided to drink alcohol because I was feeling fed up	☐	☐	☐	☐	☐
4 I decided to drink alcohol because I was bored	☐	☐	☐	☐	☐
5 I decided to drink alcohol because I was stressed	☐	☐	☐	☐	☐
6 I decided to drink alcohol because I couldn't stop thinking about it	☐	☐	☐	☐	☐
7 I decided to drink alcohol to keep somebody else / other people company	☐	☐	☐	☐	☐
8 I decided to drink alcohol because I usually have a drink around this time	☐	☐	☐	☐	☐
9 I decided to drink alcohol because I felt obliged to	☐	☐	☐	☐	☐
10 I decided to drink to enjoy the taste or add to the enjoyment of a meal	☐	☐	☐	☐	☐
11 I decided to drink alcohol because I was celebrating	☐	☐	☐	☐	☐
12 I decided to drink alcohol to be social with my friends	☐	☐	☐	☐	☐
13 I decided to drink alcohol to increase my confidence	☐	☐	☐	☐	☐
14 I decided to drink to help me relax	☐	☐	☐	☐	☐
15 I don't recall deciding to drink – I just found myself drinking	☐	☐	☐	☐	☐
	1 Disagree A Lot	2 Disagree A little	3 Neither Agree nor Disagree	4 Agree A Little	5 Agree A Lot

Appendix H

Aero snack size bar -
http://www.nestle.ca/en/products/brands/Aero/aero_snack_size.htm?subGroup=Chocolates
After Eights - http://www.fitbit.com/foods/After+Eight+Chocolate+Mints/10524
Apricots - http://www.nutritiondata.com/facts/fruits-and-fruit-juices/1838/2

Bassett's Jelly Babies – Tesco
Batchelors Mediterranean slim-a-soup - http://caloriecount.about.com/calories-batchelors-soup-i79428
Beef jerky - http://caloriecount.about.com/calories-beef-jerky-i19002?size=2
Beef sausages - http://www.nutritiondata.com/facts/sausages-and-luncheon-meats/7266/2
Blueberry muffin - http://www.nutritiondata.com/facts/baked-products/5045/2

Cadburys Animal Biscuits - http://caloriecount.about.com/calories-cadburys-biscuits-i70100
Cadburys Clusters - http://www.ciao.co.uk/Cadbury_Clusters__Review_5839563
Cadburys Dairy Milk chocolate - http://caloriecount.about.com/calories-cadburys-dairy-milk-i100087
Cadburys double chocolate chunk cookies - http://www.mysupermarket.co.uk/tesco-price-comparison/Biscuits/Cadbury_Cookies_Double_Choc_Chunk_150g.html
Cadburys Flake Cake – Tesco
Cadburys Milk Chocolate Cake Bars - http://www.mysupermarket.co.uk/asda-compare-prices/Patisserie/Cadbury_Milk_Chocolate_Cake_Bars_5.html
Calippo lolly -
http://www.walls.co.uk/uk_en/products/calippo/calippo/2/default.aspx
Cheese on toast - http://caloriecount.about.com/cheese-toast-recipe-r38085
Cheese Quavers - http://www.fatsecret.com/calories-nutrition/walkers/quavers-cheese-crisps
Chocolate and raisin cereal bar - http://caloriecount.about.com/calories-seeds-change-cereal-chocolate-raisin-i69670
Chocolate brownie - http://caloriecount.about.com/calories-boston-market-family-size-chocolate-i52648
Custard slice - http://www.thedailyplate.com/nutrition-calories/food/generic/custard-slice

Dime bar - http://www.ciao.co.uk/Dime_Bar__Review_5539141
Devils on horseback -
http://www.wholefoodsmarket.com/recipes/recipe.php?recipeId=135
Doritos - http://www.smiths.com.au/nutrition/nutrition-doritos.htm

Fortune cookie - http://www.nutritiondata.com/facts/baked-products/4946/2
Fried egg on toast -
http://www.fatsecret.com/member/lissy/meals/1783/fried+egg+and+toast

Gingerbread biscuit - http://caloriecount.about.com/calories-caffe-nero-gingerbread-santa-biscuit-i121629
Greens and Blacks Dark choc with crystallised ginger - Tesco

Haribo Star Mix – Tesco
Hash brown - http://www.thedailyplate.com/nutrition-calories/food/no-name/hashbrowns
Hot dog - http://www.dietfacts.com/html/nutrition-facts/generic-hot-dog-bun-22685.htm

Lion bar - http://www.chocolatebar.com/images/lion_3_panel.gif
Low fat Mozzarella cheese - http://www.dietfacts.com/html/nutrition-facts/best-choice-string-cheese-low-moisture-part-skim-mozzarella-cheese-37074.htm
Low fat Walnut cake - http://www.ciao.co.uk/Tesco_Healthy_Eating_Date_and_Walnut_Cake_Slices__Review_5403780
Lurpak light butter - http://www.lovelurpak.co.uk/aboutLurpak/ourFamily/spreadableLighter/

Malted milk biscuit - http://en.wikipedia.org/wiki/Malted_milk_(biscuit)
McFlurry - http://www.nutritiondata.com/facts/foods-from-mcdonalds/6287/2

Onken wholegrain yoghurt, peach flavour - http://caloriecount.about.com/calories-onken-wholegrain-peach-i125172
Orange and lemon muffin - http://caloriecount.about.com/calories-pret-manger-orange-lemon-muffin-i104923

Pasta sauce - Tesco Italian Sauce
Plain yoghurt - http://www.nutritiondata.com/facts/dairy-and-egg-products/106/2
Pringles – Tesco

Ryvita minis, salt and vinegar - http://www.ryvita.co.uk/our-brands/minis/salt-and-vinegar.php

Sausage sandwich - http://www.fatsecret.com/calories-nutrition/generic/sausage-sandwich?portionid=51534&portionamount=100.000
Shortbread biscuit - http://www.walkersshortbread.com/onlineShop/Product.aspx?Category=73&Product=1570
Skittles - http://caloriecount.about.com/calories-skittles-original-fruit-i95584
Slice wholemeal bread - http://caloriecount.about.com/calories-lowan-country-style-wholemeal-bread-i117335
Smoked salmon sandwich - http://www.thedailyplate.com/nutrition-calories/food/pret-a-manger/smoked-salmon-sandwich
Snack-a-Jacks - http://caloriecount.about.com/calories-quaker-snack-jacks-rice-corn-i11
Starbucks biscotti - http://www.nutritiondata.com/facts/foods-from-starbucks/9682/2
Strawberry jam sandwich - http://www.thedailyplate.com/nutrition-calories/food/generic/strawberry-jam-sandwich
Sugar snap peas - http://www.nutritiondata.com/facts/vegetables-and-vegetable-products/2516/

Tesco value marshmallow teackes - http://www.ciao.co.uk/Tesco_Value_Mallow_Teacakes__Review_5846138

Terry's Chocolate Orange -
http://www.coheso.com/nutridata/index.php?mode=item_details&ma_name=Terrys_Chocolate&search=&fd_name=Terrys_-_Chocolate_-_Orange_Milk&count=100&servings_option=servingweight
Tesco Finest Roast Beef sandwich -
http://www.mysupermarket.co.uk/Shopping/ProductDetails.aspx?Store=1&Product=27646
Tesco fresh cream slice -
http://www.ciao.co.uk/Tesco_Fresh_Cream_Slices__Review_5797445
Tesco value marshmallow teacakes -
http://www.ciao.co.uk/Tesco_Value_Mallow_Teacakes__Review_5846138
Toblerone - http://www.toblerone.co.uk/toblerone1/page?siteid=toblerone1-prd&locale=uken1&PagecRef=575
Toffee crisp -
http://www.nestle.co.uk/OurBrands/nutritionalinformation.htm?category=confectioneryandcakes&brand=Toffee%20Crisp
Tuna - http://www.nutritiondata.com/facts/finfish-and-shellfish-products/4146/2
Tunnocks chocolate marshmallow teacakes -
http://www.weightlossresources.co.uk/calories-in-food/bakery-products/Tunnocks-Chocolate-Marshmallow-Teacakes.htm

Welsh cake - http://caloriecount.about.com/calories-braces-fruit-welsh-cakes-i123468
Weight Watchers carrot cake - http://www.thedailyplate.com/nutrition-calories/food/weight-watchers/carrot-cake
Weight Watchers chocolate éclairs -
http://www.ciao.co.uk/Weight_watchers_eclairs__Review_5836237
Wheat crunchies, crispy bacon - http://www.thedailyplate.com/nutrition-calories/food/generic/wheat-crunchies-crispy-bacon

http://www.burtonsfoods.com/

http://www.costa.co.uk/pdf/food_nutrition.pdf

http://www.mullerdairy.co.uk/

Appendix I

Instructions for coding diary snacks

Coding categories:

0 = low/medium fat/sugar
1 = high in fat only
2 = high in sugar only
3 = high in both fat and sugar

Fat/Sugar content:

According to the FSA (http://www.eatwell.gov.uk/):

- Foods high in fat are those that contain more than 20g of fat per 100g, and those that are low contain 3g or less per 100g.
- Foods that are high in sugar contain more than 15g of sugar per 100g, and those low contain 5g or less per 100g.
- Anything that falls in between these values is classed as a medium level of sugar and fat.

Coding Scheme:

1) Determine what the particular snack is. For example, if the participant has named each individual food item that makes up the snack, such as 2 slices of white bread with margarine and ham, you can assume that this particular snack was a ham sandwich, coding the whole snack and not the individual ingredients.

2) In the case where a participant has written down 2 or more items but is clearly one snack (as in the example above), but it is difficult to determine the nutritional value for the snack as a whole (e.g. weetabix and semi skimmed milk), then code as separate items for these cases.

3) Locate the snack in the *Food Index* at the back of McCance and Widdowson's 'The Composition of Foods' (see reference below) and use the 'publication number' to then locate the food item within the main section of the book.

4) The book provides information on the composition of the foods, with each food item spanning 4 pages. The first page gives the fat content and the second page gives total sugar content per 100g edible portion. Therefore, out of the 4 pages of data, the only 2 pages relevant for this particular coding scheme are the first 2 pages.

5) Once the food is located within the main body of the atlas, read across and locate the *'Fat'* content per 100g edible portion, and the *'Total Sugars'* content per 100g edible portion. Make a note of these figures.

6) Each snack then needs to be assigned a coding from the categories above (i.e. 0, 1, 2 or 3), based on the fat/sugar content also described above. For example, if a participant has eaten an apple, which has a fat content of 0.1g and a sugar content of 11.8, this would receive the coding of 0 because it is low in fat and has a medium level of sugar.

7) Where the participant has eaten 2 clearly separate snacks in one episode (e.g. cuppa soup and a pear) code each of these and then in the final coding section devise 'overall' coding. For example, if the participant has had one snack that is high in sugar only (2), and another that is high in fat only (1), then the 'overall' coding would be high in both fat and sugar (3), but if both snacks were high in sugar only, then the 'overall coding would be high in sugar only (2). Similarly, if one item is low/medium in fat/sugar (0) and the other is high in fat only, then the 'overall' coding for that particular episode would be high in fat only (1).

Notes

- If the food item cannot be located in McCance and Widdowson, use http://nutritiondata.self.com/ to locate the item and composition information. On the top right hand side of the home page there is a search box in which food items can be typed. Search for the snack and choose the appropriate item in the list provided.
- If the food items cannot be located in Widdowson and McCance or http://nutritiondata.self.com/, but the participant has provided the brand name for the product consumed, e.g. wagon wheel, carry out a Google search for the item and locate the nutritional information from the website. Alternatively these items can be located in supermarkets if not from the websites.
- When using the internet (i.e. nutritiondata.com or branded websites), if you are unable to find nutritional value per 100g, then calculate as appropriate (e.g. if you can only find 'cheese on toast' per 160g, then calculate the fat and sugar content from the values given for 100g – so 100/160 = 0.625*fat/sugar content for 160g).
- If you have difficulty finding a particular food item (e.g. corned beef pasty) but can find a near alternative (e.g. Cornish pasty), then code the near alternative.
- Widdowson and McCance may not record all brands and makes of food items (e.g. Stollen cake), so in this instance look for the type of food (e.g. Stollen cake is a rich fruit cake) and record that, or alternatively find supermarket brand stolen cake and record that.
- Where bread is not specified assume white sliced.
- An apple could be assumed to be apple, eating, average, raw (similar descriptions for other fruits).

References

Food Standards Agency (2002). McCance and Widdowson's The Composition of Foods, sixth summary edition. Cambridge: Royal Society of Chemistry.

http://nutritiondata.self.com/

Appendix J

Date of Completion: **Participant Number:**

Dieting

11. Diary Completion...

12. Current Height....................

13. Current Weight....................

14. BMI.................................

11. How many times (if any) have you dieted to lose weight in the past year? *(By dieting we mean attempting to lose weight by trying to alter your normal eating habits).*

☐	☐	☐	☐
I haven't dieted before	About 1-5 times	About 6 – 24 times	25 times or more

6. Are you currently dieting to lose weight?

☐ No ☐ Yes

7. If yes, when did you begin your **current** attempt to lose weight?

.................weeks ago or ....months ago

8. How much weight have you lost on your **current** attempt?

.................kg or ....lb

9. Type of diet?

....

10. Email Address (if different from previous)..

Appendix K

Participant Number............

Making Plans

It can sometimes be difficult to find the time to exercise. We may not quite get round to it or we may simply forget. Research shows that 'implementation intentions' can be an effective way of helping you achieve your exercise goals. Implementation intentions are statements that specify WHEN, WHERE and HOW you will do something. They tend to be most effective when they are framed as 'if-then' statements. For example:

- If it is Thursday at 5pm, then I will spend 20 minutes jogging round the park.
- If I am going to the office in the morning, then I will take the stairs instead of the lift.
- If it is a Saturday or a Sunday and I have just got out of bed, then I will do 10 minutes of press-ups or squats in my bedroom before I do anything else.

We would like you to form a series of implementation intentions to help you get fit. These can relate to any type of exercise you like, wherever you like, as often as you like. You might want to make plans to do a bit of exercise every day (for example by walking to work), or you might prefer to plan for less frequent exercise (for example by going to the gym twice a week). The important thing is to make a plan you think you can stick to over the next 6 months.

Write your implementation intentions here:

Appendix L

Leaves on a Stream Exercise

Although we are always thinking, we rarely actually notice our thoughts. This can lead to us automatically following our thoughts, even when they are not very helpful. The aim of this exercise is to practice noticing your thoughts. By becoming more aware of your thoughts you may be better able to prevent them getting in the way of your exercise plans.

Spend some time reading through the following instructions until you feel confident you know what to do, then tell the researcher you are ready to begin.

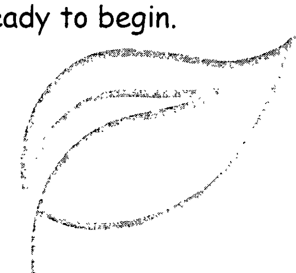
Imagine a beautiful slow-moving stream. The water flows over rocks, around trees, descends downhill, and travels through a valley. Once in a while, a big leaf drops into the stream and floats away down the river. Imagine you are sitting beside that stream watching the leaves float by.

Now become conscious of your thoughts. Each time a thought pops into your head, imagine that it is written on one of those leaves. If you think in words, put them on the leaf as words, if you think in images, put them on the leaf as an image.

The aim is to stay beside the stream and allow the leaves on the stream to keep flowing by. 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, or if you mentally go somewhere else, or if you find that you are in the stream or on a leaf, just stop and notice that this has happened. Then once again return to the stream, watch a thought come into your mind, put it on a leaf, and let the leaf float away down the stream.

It is likely that you will find this task extremely difficult at first. And the chances are, you will always find it a quite tricky, especially on days when you have a lot on your mind. However, with continued practice, and a bit of perseverance, you should notice it getting a little easier.

If you have any questions regarding this exercise, please ask the researcher now. Otherwise, please let the researcher know you are ready to begin.



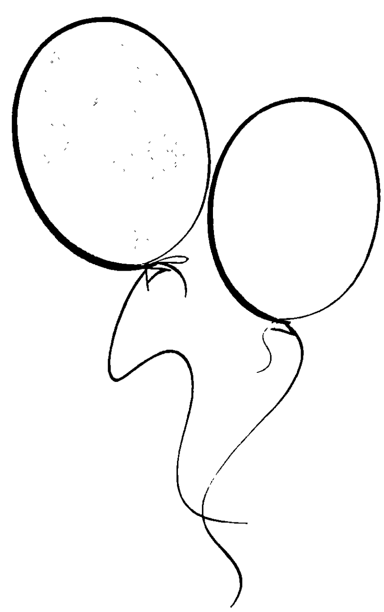
Participant Number............

Practicing Noticing Your Thoughts

Being able to view your thoughts as separate from yourself, and being able to stick to your original plans despite what your thoughts are telling you, takes practice. However, research shows that the more you practice this type of behaviour, the better you become at it - and the more you will be able to resist temptation and stick to your plans.

> Over the next 2 weeks we'd like you to set aside 5 minutes every day to practice seeing your thoughts as thoughts. This might be when you are in the shower, walking to work, eating breakfast or simply sitting quietly. During these 5 minutes you can either use the Leaves on a Stream exercise, or you can choose another method that you find more helpful. Some people prefer to imagine their thoughts on clouds or balloons or written on a wall. If you are doing this exercise with your eyes open you may find it easier to simply verbalise your thoughts without using any visual imagery. How you go about this task is up to you. The important thing is to try to notice your thoughts as they occur and, if you find your attention wandering, simply bring it

In the space below use an implementation intention to write down when and where you will spend 5 minutes noticing your thoughts:



Sticking To Your Plans

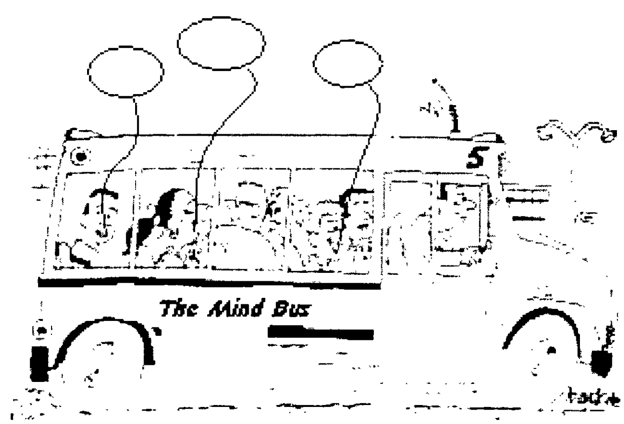
Sometimes it's difficult to stick to our plans, particularly when it comes to exercise. We tell ourselves we haven't got time to walk to work, are too tired to go to the gym or would rather watch TV than go to our exercise class. We may even tell ourselves we'll 'make up for it tomorrow'.

In situations like these it can sometimes be helpful to think of yourself as DIFFERENT from your thoughts. Imagine you are the driver of a bus, driving to the gym to do some exercise. Your thoughts are a bit like passengers on the bus. They may say 'I'm too tired to exercise', 'I haven't got time', 'I'll go tomorrow instead'. Your job as the driver of the bus is to stick to your planned route and keep driving to the gym, regardless of what your thoughts are saying.

Certain strategies can help make this easier. Here are a few examples:

- Describe what the passengers on your mind bus are saying. For example, 'This passenger is telling me I'm too tired to exercise this evening'.
- Comment on what is going on in your mind. For example, 'I'm having the thought that I can't be bothered to climb all those stairs this morning'.
- When you find yourself using the word 'but', replace it with the word 'and'. For example, change 'I want to walk to work but it's raining' into 'I want to walk to work <u>and</u> it's raining'.

Over the next 2 weeks we would like you to notice your thoughts about exercise. And, if you find yourself making excuses not to exercise, we'd like you to try one of the strategies listed above.



Remember, you are the driver of the bus – your thoughts are simply passengers!

Appendix O

Participant Number…… **Date………………**

Demographics

15. Date of Birth…………..

16. Gender

☐ Male ☐ Female

17. Occupation……………………………………………………………………

18. Highest Level of Education……………………………………………………………

19. Are you pregnant?

☐ No ☐ Yes *(if yes you are unfortunately not able to take part)*

20. Email Address

………………………………………………………………………………

Thank you!

For Researcher Use only:

1. Current Height…………………

2. Current Weight…………………

3. BMI……………………………

4. Body Composition……………………

Participant Number......... **Date.................**

Making Plans

Please indicate on the scale below the extent to which you have stuck to your exercise implementation intentions over the previous week.

1	2	3	4	5
Not at all	A little	About half the time	Most of the time	All the time

Appendix Q

Participant Number………   **Date………………**

Practicing Noticing Your Thoughts

During the previous week, on approximately how many days did you spend 5 minutes practicing noticing you thoughts?

1	2	3	4	5	6	7
One day	Two days	Three days	Four days	Five days	Six days	Seven days

Appendix R

Participant Number......... **Date..................**

Sticking to your plans

Please indicate on the scale below the extent to which you have noticed your thoughts about exercise over the previous week.

1	2	3	4	5
Not at all	A little	About half the time	Most of the time	All the time

Appendix S

Participant Number......... **Date.................**

Over the previous week, when you have found yourself making excuses not to exercise, to what extent have you employed the strategies suggested on the 'Sticking To Your Plans' sheet? (e.g., 'Mind Bus', 'I'm having the thought…', 'But / And')

1	2	3	4	5
Not at all	A little	About half the time	Most of the time	All the time

Appendix T

Participant Number......... **Date.....................**

White Bear

This next task is about thoughts. In the next 5 minutes, I would like you to try not to think about a white bear. Every time you say 'white bear' in your head, or have a white bear come to mind, please make a tally mark on this sheet below.

Thank you.

Department of Psychology

ETHICS COMMITTEE

Memo

To: **Louise Cleobury**

From: Dr. Phil Tucker, on behalf of Departmental Ethics Committee

Copy: **Dr. Katy Tapper and Dr. Michelle Lee**

Date: Wednesday, 11th April, 2007

Re: **Reasons for eating: A one-day diary study**

Your proposed study, "Reasons for eating: A one-day diary study", has now been reviewed. Provided the information obtained is kept absolutely confidential and that no personally identifiable is entered on computer, it was agreed that no substantive ethical issues are raised and you may therefore proceed with your study.

Please ensure that the signed copy of your Ethical Approval, together with any other paperwork associated with your research, is included in your final write up.

In order for your study to be displayed on the **Experiment Management System (Subject Pool):**

1. Leave a copy of this approval letter in the blue folder outside Phil Tucker's room (room 811)
   AND
2. Send a request for your study to be made visible, via the link on EMS website (see Researcher Documentation for details)

Department of Psychology

ETHICS COMMITTEE

Memo

To: **Louise Cleobury**

From: Dr. Phil Tucker, on behalf of Departmental Ethics Committee

Copy: **Dr. Katy Tapper**

Date: Tuesday, 27th September, 2007

Re: **Reasons for eating: A diary study**

Your proposed study, "Reasons for eating: A diary study" has now been reviewed. Provided the information obtained is kept absolutely confidential and that no personally identifiable information is entered on computer, it was agreed that no substantive ethical issues are raised and you may therefore proceed with your study.

Please ensure that the signed copy of your Ethical Approval, together with any other paperwork associated with your research, is included in your final write up.

Department of Psychology

ETHICS COMMITTEE

Memo

To:	**Louise Cleobury**
From:	**Dr. Jo Saunders**
	for Departmental Ethics Committee
Copy:	**Dr. Katy Tapper**
Date:	**Wednesday, 10th December, 2008.**
Re:	**Mindfulness and implementation intentions in people actively attempting to lose weight**

Your proposed study, "Mindfulness and implementation intentions in people actively attempting to lose weight", has now been reviewed. Provided the information obtained is kept absolutely confidential and that no personally identifiable information is entered on computer, it was agreed that no substantive ethical issues are raised and you may therefore proceed with your study.

Please ensure that the signed copy of your Ethical Approval, together with any other paperwork associated with your research, is included in your final write up.

In order for your study to be displayed on the **Experiment Management System (Subject Pool):**

1. Leave a copy of this approval letter in the blue folder outside Dr. Phil Tucker's office (room 811)
   AND
2. Send a request for your study to be made visible, via the link on the EMS website (see Researcher Documentation for details).

Please note that because the EMS system has been modified, an EMS Approval Code and Date of Expiry are no longer required.

Department of Psychology

ETHICS COMMITTEE

Memo

To: **Louise Cleobury**

From: **Dr. Rob Lowe**

for Departmental Ethics Committee

Copy: **Dr. Katy Tapper**

Date: **Monday, 23rd March, 2009**

Re: **Strategies for promoting existing levels of physical activity**

Your proposed study, "Strategies for promoting existing levels of physical activity", has now been reviewed. Provided the information obtained is kept absolutely confidential and that no personally identifiable information is entered on computer, it was agreed that no substantive ethical issues are raised and you may therefore proceed with your study.

Please ensure that the signed copy of your Ethical Approval, together with any other paperwork associated with your research, is included in your final write up.

In order for your study to be displayed on the **Experiment Management System (Subject Pool):**

1. Leave a copy of this approval letter in the blue folder outside Dr. Phil Tucker's office (room 811)
   <u>AND</u>
2. Send a request for your study to be made visible, via the link on the EMS website (see Researcher Documentation for details).

Please note that because the EMS system has been modified, an EMS Approval Code and Date of Expiry are no longer required.