Supporting Weight Loss Maintenance: The Role of Planning, Problem Solving and Recommendations for Future Interventions

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Chapter 2: Paper One

Dibb-Smith, A. E., Brindal, E., Chapman, J., & Noakes, M. (2016). A mixed-methods investigation of psychological factors relevant to weight maintenance. *Journal of Health Psychology*. doi:10.1177/1359105316678053.

Chapter 5: Paper Two

Dibb-Smith, A., Chapman, J., & Brindal, E. (2019). Breaking habits with mindful snacking? An email-based intervention targeting unwanted snacking habits in an Australian sample. *Eating Behaviors*, *32*, 37-43.

Abstract

Relapse after weight loss is a prevalent issue and maintenance outcomes require improvement. This thesis investigates the role of planning in weight loss maintenance, the context in which good planning occurs and produces recommendations for the development of future interventions. After reviewing the literature relevant to this body of work, the need for research in this area and potential gains in supporting behaviour change maintenance are discussed. The first study investigates common perceptions of planning in a sample of participants who had been attempting weight loss maintenance for a period of six months (N = 53), using a mixed method approach. Quantitative findings indicate that maintainers engaged in more planful (rational) problem solving styles, and exhibited less impulsive and less avoidant problem solving styles. Qualitatively, maintainers constructed more plans and showed more accepting and forgiving attitudes in the face of mistakes or lapses than did their counterparts. The second study investigates the capacity for an email-based mindful snacking intervention to cultivate more mindful and less habitual snacking over two weeks, among participants who self-identified as wanting to change their snacking habits (N = 78). A secondary aim examines the potential to cultivate self-compassion alongside mindful snacking. Both mindful eating and action-planning are used within the intervention. Results show that while mindful eating significantly increased, snacking habit strength also significantly increased and self-compassion significantly decreased over the two week intervention period. Likely mechanisms and implications of these changes are discussed. The third study investigates the role of plan quality, problem solving style, coping style and self-compassion in predicting engagement/disengagement intentions following different feedback conditions. Participants who completed the intervention in

study 2 and additional measures for study 3 (N = 72) were provided with either positive or negative feedback regarding their intervention outcomes and subsequently asked about their intentions to either continue or discontinue their practice. Findings indicate that neither the feedback condition (positive vs negative), nor actual improvement in habit scores significantly predicted future intentions. However, self-compassion, problem-solving skill and coping style as well as the degree of perceived helpfulness of the intervention each significantly predicted future intentions in univariate models. Backwards-entry logistic regression was used to explore the strongest predictors and only disengagement coping and perceived helpfulness remained as significant predictors, controlling for the effects of feedback, habit improvement, plan quality, problem-solving skill, engagement coping and self-compassion. The thesis concludes with a critical appraisal of the presented studies, a discussion of methodological considerations and interpretations within the broader context of the behaviour change maintenance literature. Recommendations for future interventions are presented and the clinical implications of this research are highlighted.

Declaration

I, Amanda Ellen Dibb-Smith, certify that this work contains no material which has been accepted for the award of any other degree or diploma in my name in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. In addition, I certify that no part of this work will, in the future, be used in a submission in my name for any other degree or diploma in any university or other tertiary institution without the prior approval of the University of Adelaide and where applicable, any partner institution responsible for the joint award of this degree.

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And to my son, baby Arthur, who was born just weeks after the examination of this thesis; you bear a powerful name my precious boy, crafted for you in love and in the hope of a wonderful life. Thank you for coming into ours at

such a perfect time, and in such a gentle way. It was a joy to carry you with me across the finish line of this great work.

Outline of Candidature

The current thesis represents work undertaken as part of the requirements of a combined Doctor of Philosophy/Master of Psychology (Clinical) degree, at the University of Adelaide, South Australia. This program (equivalent 4 years fulltime) combines a Psychology Masters (Clinical) course load (equivalent 2 years fulltime) with a Doctor of Philosophy research load (equivalent 3 years fulltime). The two papers and single manuscript presented in this body of work, along with seven masters-level subject courses and three clinical placements (with a combined total of over 1000 hours) were completed within the candidature timeframe for this course. The standard level of funding allotted for PhD support was provided by The University of Adelaide, and the School of Psychology, allowing for the purchase of measures and support in travelling to a single conference. CSIRO provided additional support including licences to access the websites which hosted online data collection (Survey Monkey in Study 1, and Survey Gizmo in Studies 2 and 3).

Chapter 1: Introduction and Literature Review

1.1 Prologue

This first chapter reviews the current literature on obesity and associated health risks, weight loss and weight maintenance, and establishes the basis for this body of research. The thesis will begin by defining and establishing obesity as a health risk. It will then establish that successful weight maintenance is a way to mitigate this risk, and that it is a priority in current health research. The difficulty associated with weight maintenance following weight loss is considered from biological, environmental and psychological perspectives, including the role that habit plays in the maintenance of counter-intentional lifestyle behaviours. The thesis then outlines psychological skills supportive of weight maintenance and the importance of effective planning and problem solving skills. Theory and models traditionally applied to public health and behaviour change in this area are then discussed in relation to this body of work and the need for further research is discussed in relation to the thesis aims. Specifically, this thesis aims to investigate planning and problem solving skills from the perspective of those attempting weight maintenance, and to construct an understanding of the context in which these effectively occur.

1.2 What is Obesity?

As this thesis aims to contribute to knowledge in the area of obesity treatment, it is important to begin by first defining obesity. The following section will outline the definition of obesity adopted by this thesis and will provide an overview on the unit of measurement utilised in this definition.

According to the World Health Organisation (2016, p1), the terms "overweight" and "obese" are defined as "abnormal or excessive fat accumulation

that may impair health" (World Health Organisation, 2016, p. 1). This fat accumulation can be measured in multiple ways. For example, waist circumference and hip-to-waist ratio measurements, can be used to capture information about the distribution of an individual's body fat. Most commonly, weight status is measured using the Body Mass Index (BMI) calculation, which takes into account a person's height and weight information. It is generally acknowledged that the BMI measurement is limited in its ability to accurately capture the more nuanced aspects of weight-related health risk (such as fat distribution, and accounting for muscle mass or bone density), and that the use of other measures alongside BMI will yield a more accurate correlation between weight status and risk of ill health and mortality than the use of just BMI alone (World Health Organisation, 2016). However, perhaps because of the utility of the BMI measurement, it remains the primary standard used to determine healthy and unhealthy weight status; it is the measurement criterion adopted by the 10th revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-10; World Health Organisation, 1992), and by the World Health Organisation (World Health Organisation, 2016) when defining the diagnostic criteria for both overweight and obesity. The formula for calculating one's BMI is: weight in kilograms / (height in meters)^2. In adults, the World Health Organisation defines a BMI greater than 25 as being overweight, and a BMI greater than 30 as being obese (World Health Organisation, 2016). Researchers have found it useful at times to further distinguish between different classes of obesity, as defined by a participant's BMI: obese, class I (BMI 30-34.9), obese class II (BMI 35-39.9) and obese class III, also referred to as "morbidly obese" (BMI > 40) (e.g. Cancello et al., 2005). It should be noted that these classifications are only relevant to adult populations and that separate guidelines for the responsible classification of weight in children and adolescents

have been established (World Health Organisation, 2016). In addition to these guidelines being age-specific, population differences in obesity-associated disease-risk have spawned debate about whether these guidelines are equally applicable to all adult populations. In particular, the utility of ethnically-specific cut-off points have been widely discussed, as the vast majority of research used to originally define the BMI cut-off points was conducted utilising Caucasian samples (Wen et al., 2009). There appears to be a general consensus in the literature that the considerable health risks associated with being overweight and obese (detailed in section 1.2.2) may be influenced to some extent by ethnic background. For example, in a 20-year long prospective cohort study which followed the health of 78,419 women nurses living in America, Shai et al. (2006) compared the risk of diabetes in participants with identical BMIs who self-identified as either "White" (defined as Southern European/Mediterranean origin, Scandinavian and other Caucasians), "Asian" (defined as Asians other than whites), "Hispanic" (defined as Hispanic other than whites and Asians) and "Black" (defined as African American other than the above mentioned ethnic groups; Shai et al., 2006, p. 1586). Shai et al. found that women who self-identified as having an Asian background had more than double the risk of women who self-identified as White of developing type 2 diabetes despite being at the same BMI. Shai et al. further reported that women who self-identified as Hispanic or Black also had significantly elevated risk. They concluded that the ethnicity-related risk of type 2 diabetes existed both before and after taking into account any differences in BMI (Shai et al., 2006). Similar findings have been reported in several population cohort studies investigating other aspects of obesity-related morbidity and mortality across different ethnicities (e.g. Pan et al., 2004; Wen et al., 2009). In 2004 a World Health Organisation expert consultation eventually concluded that the global BMI cut-off points should remain unchanged

for the purposes of international classification, citing a lack of agreement among researchers as a major factor in them being unable to establish new lowered cut-offs specific to different ethnic populations. Rather than proposing new, ethnically-specific cut-off points, they have instead proposed methods to assist countries in establishing their own definitions of risk. Several countries have elected to do so and both Japan and China have subsequently redefined overweight as a BMI of 24 or higher, and obesity as a BMI of 28 or higher (Misra et al., 2009).

In summary, it is important to acknowledge that there are multiple ways to categorise weight status. However, BMI is the measurement most commonly utilised in order to classify weight status and associated risk. It is also important to acknowledge that BMI cut-off points are different for children and adults, and can vary across populations of different ethnicity and across nations. As the World Health Organisation and the Australian Government (Department of Health, 2009) both define overweight and obesity as a BMI of 25 and 30 respectively, and as this thesis aims to examine weight maintenance within an Australian context, the body of work which follows will adopt these cut-off points when making reference to weight status.

1.2.2 Obesity and health.

Obesity is a serious, multifaceted health risk. When obesity occurs, there is an excessive accumulation of fat, or adipose tissue in the body. Adipose tissue is not only a site of storage for excessive energy in the form of fat, but it is also recognised as an endocrine organ (Jung & Choi, 2014). The accumulation of adipose tissue produces a product called adipocytokines, and these cause chronic, low-grade inflammation. This chronic inflammation is a risk factor in and of itself because it interacts with a number of processes in many different organs

throughout the body, and is associated with human aging and age-related diseases (Franceschi & Campisi, 2014) as well as obesity-related diseases (Jung & Choi, 2014). In a meta-analysis which examined the combined evidence from 89 prospective cohort studies, obesity was significantly associated with chronic diseases such as various forms of cancer (kidney, colorectal, ovarian, uterine/endometrial, pancreatic, and post-menopausal breast cancer); cardiovascular risk factors (hypertension, coronary artery disease, congestive heart failure, pulmonary embolism, stroke and dyslipidaemia), type 2 diabetes, gallbladder disease, chronic back pain, osteoarthritis, asthma, and sleep apnoea (Guh et al., 2009). Obesity is also associated with the increased presence of fat molecules which pose a risk to cardiovascular health such as triglycerides and LDL cholesterol (Nordestgaard & Vabo, 2014; Ridker, 2014). Many of these chronic health conditions can become fatal and according to a meta-analysis and systematic review of 97 different studies, which compared hazard ratios across BMI categories, obesity classes 2 and 3 (BMI < 35), are associated with significantly higher all-cause mortality (Flegal, Kit, Orpana & Graubard, 2013).

There is also evidence linking obesity to poorer mental health. Obesity has been repeatedly associated with depression, though the relationship between the two factors appears to be reciprocal. A meta-analysis of 16 longitudinal studies concluded that there is support for a causal model wherein depression increases the risk for later weight gain and obesity, theoretically though potential mechanisms such as emotional eating, the eating of more calorie-dense foods and increased sedentary behaviour (Blaine, 2008). However, a more recent meta-analysis, which analysed 15 longitudinal prospective cohort studies has concluded that the relationship between depression and obesity is bidirectional (Luppino et al., 2010). While depressed persons had a 58% increased risk of becoming obese

over time, obese persons also had a 55% increased risk of developing depression over time (theoretically though such mechanisms as increased inflammation and the experience of increased stigma) (Luppino et al., 2010).

Obesity has also been linked to poorer outcomes in women's health and reproduction. In an evidence-based review summarising recent research, Kulie et al. (2011) found that maternal obesity negatively affected both contraception and fertility, and was linked with higher rates of caesarean section births, as well as neonatal mortality and malformations. Maternal obesity was also associated with a decreased intention, initiation of and duration of breastfeeding (Kulie, 2011).

1.2.3 Obesity is impacted by lifestyle.

Given that obesity is a significant health risk, it becomes important to understand the ways in which this risk can be mitigated. Central to this thesis is the notion that cultivation of certain behavioural and lifestyle factors assists in sustainable weight loss, and thus may be useful in mitigating the risks associated with untreated obesity. It is therefore important to establish that obesity is impacted by the adoption of such factors and that the cultivation of some behaviours and lifestyles are advantageous over others.

Diet is an important factor in weight control, as what we eat has a direct impact on what we weigh. According to the World Health Organisation (2019) the fundamental cause of both obesity and overweight is an energy imbalance between the amount of calories consumed and the amount of calories expended, such that more calories are consumed than is required for the maintenance of weight. The consumption of energy-dense foods and drink, which contain large amounts of calories has been associated with weight gain (Rolls, 2009), whereas the adoption of low-calorie diets have been repeatedly associated with weight loss. For example, a 2014 systematic review and meta-analysis investigating

weight maintenance recently analysed the results of 27 randomised controlled trials investigating weight loss and maintenance (Johansson, Neovius & Hemmingsson, 2014). The weight loss phase of each of these controlled trials consisted of participants utilising various low-calorie diets (< 1000 kcal per day). Participants engaged in these diets for a median duration of 8 weeks (range: 3-16 weeks), and participants in these studies lost a pooled mean of 12.3kg (Johansson et al., 2014). These studies mirror findings throughout the weight management literature, which also support the notion of low-calorie diets being linked with weight loss. The precise nature and nutrient make-up of the diets best associated with weight loss is somewhat debated, although many diets include rules around similar target nutrients such as sugar, carbohydrates, protein and fat (Johnston et al., 2014). In a meta-analysis comparing 48 randomised controlled trials using diet to attempt weight loss, Johnston et al. (2014) investigated the efficacy of three different types of diets: low carbohydrate diets, which restricted carbohydrate intake, moderate macronutrient diets, which provided recommendations for daily macronutrient intake, and low fat diets, which restricted fat. Although some differences between these different classes of diets were reported (e.g. low-carbohydrate diets produced significantly greater weight loss than moderate macronutrient diets at the 6-month mark), each category of diet produced weight loss (between 6 and 8kg) and significantly more weight loss than their respective no-diet controls. However, the differences in weight loss achieved between different diets were relatively small. Ultimately, as different diets are variably tolerated by different individuals, Johnston et al. recommended that best practice guidelines in dietary weight loss contexts should involve supporting the participant in whichever diet they feel that they can adhere to the longest.

While weight loss is achieved through the construction of negative energy balance (that is, ensuring that energy expenditure is greater than energy intake), weight maintenance is achieved through the construction of energy balance, such that intake and expenditure are equal and maintained (Fleming & Kris-Etherton, 2016). Constructing a state of positive energy balance, (where too many calories are consumed relative to expenditure, and where weight is gained) has become easier over the past several decades in western society, as the prevalence and availability of energy-dense foods (e.g. high calorie snack-foods) has significantly increased (World Health Organisation, 2016). In a narrative review describing the way in which available foods have changed throughout the western world in the past few decades, Morris, Beilhartz, Maniam, Reichelt and Westbrook (2015) describe that consumption in Australia has shifted such that almost 36% of adults' and 41% of children's total energy intake now comprises of low-cost, but energy-dense and often nutrient-poor foods. Therefore, lifestyles that are conducive to reducing obesity and maintaining weight losses will be the ones which are able to account for these environmental changes and still emphasise a good caloric balance between intake and expenditure. As intake is half of this equation, diet and eating behaviours must be considered and regulated against over-consumption.

Energy expenditure, in the form of physical activity, is the second half of the weight equation. According to the World Health Organisation (2019, para. 3), physical activity is "fundamental to energy balance and weight control". A large body of evidence supports the notion that regular physical activity is an important component of weight control, and it may be especially important in weight maintenance. A recent meta-analysis, comparing the long-term outcomes of diet, exercise and combination interventions concluded that behavioural weight

management interventions which incorporated both dietary and physical exercise components showed greater weight loss results at the 12 month follow-up mark, than interventions which incorporated either exercise or diet alone (Johns, Hartmann-Boyce, Jebb, Aveyard & Group, 2014). This echoes repeated findings throughout the literature that support physical activity as being important, especially in the contexts of weight prevention and weight-loss maintenance (Swift, Johannsen, Lavie, Earnest & Church, 2014). The achievement of weight loss through physical activity alone is generally acknowledged as being difficult and unlikely, except in instances of high doses of high intensity physical activity (Johns et al., 2014; Swift et al., 2014). However, the efficacy of physical activity, both as an adjunct to diet in weight loss programs, and in weight prevention and weight maintenance contexts further establishes that physically active behaviour is helpful when trying to eliminate or mitigate health risks associated with overweight and obesity.

Finally, additional lifestyle factors tend to impact weight status, by indirectly moderating or mediating either food intake or physical activity. For example, Badland and Schofield (2006) reported significant changes in urban living which promote increased reliance on vehicles and labour-saving devices, which in turn increases sedentary behaviour. Short sleep duration has also been linked with increased risk of obesity, presumably via feelings of tiredness and compensatory overconsumption (Chaput, Perusse, Despres, Tremblay & Bouchard, 2014) and shiftwork (Peplonska, Bukowska & Sobala, 2015) has similarly been linked to an increase in BMI for presumably similar reasons, with outcomes for night shift workers being particularly poor.

In short, the lifestyle that we lead and the behaviours inherent in that lifestyle impact greatly on our energy balance and our subsequent weight status.

An urgent need for research in this area becomes apparent when the considerable health risks of obesity are highlighted against the facts that: (a) the prevalence of obesity appears to be increasing worldwide (World Health Organisation, 2016), (b) obesity is both preventable and able to be impacted through the implementation of lifestyle changes (Thomas, 1995; Ofei, 2005; World Health Organisation, 2016), and (c) small, regular changes in daily behaviour (such as eating a few less bites each meal or walking 15 minutes/day) can yield considerable health benefits for those who are already overweight/obese (Hill, 2009).

1.3 Obesity in Australia: Prevalence and Burden

A large body of literature has highlighted an increasing rate of obesity throughout the developed world, often referred to as an epidemic (World Health Organisation, 2000). Australian population data has shown a similar increasing trend towards overweight and obesity. In an early review compiled by Thorburn (2005), it was indicated that in 1999-2000, the prevalence of obesity in adults was 2.5 times higher than it had been in the year 1980, and that in children, the prevalence of obesity in 1995-1997 was 2-4 times higher than it had been in 1985. Thorburn (2005) indicated that 19% of men and 22% of women were obese at that time, and more recent research has continued to track the increasing prevalence of obesity in Australia. In an analysis which incorporated three different data sets from the Australian Bureau of Statistics (the National Nutrition Survey in 1995, the National Health Survey in 2007–8 and the Australian Health Survey in 2011–12), Keating et al. (2015) found that between 1995 and 2012, the prevalence of obesity increased overall from 19.1% to 27.2%. Furthermore, Keating et al. (2015) reported that the greatest increase in obesity was in the class III (BMI > 40) category, with one in every ten people being severely obese, increasing from

one in twenty in 1995 (2% of Australian men and 4.2% of women). In 2011—12, one in every four adults was obese and one in every ten adults was severely obese (Keating et al, 2015). Finally, after analysis of the National Health Survey of 2014-15 the Australian Bureau of Statistics reported that in 2014-15, 63.4% of Australian adults are now overweight or obese; as compared to 62.8% overall in 2011-12 and 56.3% in 1995 (Australian Bureau of Statistics, 2018).

Given the smaller increase reported between the years of 2011-12 and 2014-15, some reports have indicated that the growing rate of overweight and obese adults in Australia may be stabilising. However, even if the rate of obesity occurrence were to completely stabilise, given the reported rate of obesity in the 2014-15 National Health Survey (Australian Bureau of Statistics, 2018) the overall prevalence would still be high, with 70.8% of Australian men still classed as being overweight or obese, and 56.3% of women (Australian Bureau of Statistics, 2018).

The burden of obesity in Australia is significant. Increased weight can impact on a person's health via a variety of different pathways, predisposing overweight individuals to many of the chronic health issues mentioned previously. These health issues cost Australians both in terms of their quality of life, and also financially. When examining financial costs, it is important to note that published estimates of health and economic burden are likely to be underreported, given that the methodology of these reports does not capture the indirect effects of obesity (Department of Health, 2009). Direct costs associated with obesity are most commonly calculated in estimates of burden (Dee et al., 2014) and include healthcare and spending that directly targets obesity (Trogdon, Finkelstein, Hylands, Dellea & Kamal-Bahl., 2008). According to Trogdon et al., indirect costs may be categorised into six different domains and include: absenteeism from

work (or other roles), disability, premature mortality, presenteeism (a term denoting one's presence, but decreased productivity as a result of their health condition), workers' compensation, and total indirect costs. After conducting a review of the literature on indirect costs, Trogdon et al. concluded that these costs are important to capture when estimating the total burden of obesity, as compared with non-obese workers, obese workers miss more workdays due to illness, injury, or disability, resulting in significant costs to a nation's economy (Trogdon et al., 2008). In fact, in a systematic review which compared the direct and indirect costs of obesity internationally between 2001-2011, Dee et al. (2014) found that indirect costs were unilaterally higher than direct costs, accounting for somewhere between 54% and 59% of total estimated costs.

Rough and early estimates for Australian economic costs by Crowley in 1995/6 (Department of Health, 2009) placed the direct costs of obesity between $680 and $1239 million at that time. More recent estimates of direct health care costs in 2004 (Thorburn, 2005) place the minimum estimate even higher (AU$830 million), and a recent analysis on the comparative healthcare costs of a healthy-weight vs overweight Australian indicate that annual spending for adults with a BMI > 30 is roughly 30% higher than otherwise similar, healthy weight individuals (Buchmueller & Johar, 2015). More specifically, Buchmueller and Johar reported in 2015 that Australians with category III obesity (BMI > 35) have an annual health spending roughly 50% greater than that of their normal-weight counterparts (AU$2,233 higher). According to Buchmueller and Johar (2015), these individuals make up approximately 30% of Australia's obese population (or 8% of the general population); the remaining 70% of obese individuals (those with a BMI between 30 and 35) still spend 19% more than Australians who are not obese (AU$850). This is of particular concern in light of findings that the

prevalence of category III obesity is increasing (Keating et al., 2015). Finally, in a recent Australian microsimulation of health cost, where future health expenditure was modelled based solely on diabetes status, CVD event and BMI group, the projected total health expenditure increased almost 40 per cent from $AU 393,415 million in 2011-2015 to $AU544,513 (Lymer et al., 2016). Clearly, the cost of obesity in Australian healthcare spending is significant.

Obesity-related health issues do not only cost Australians financially. One of the indirect costs of obesity is lost productivity in the Australian workplace, due to both death and absenteeism. One way to conceptualise the productivity cost of a disease is via the use of Disability Adjusted Life Years (DALYS), which is a measure that captures the burden of a disease in terms of the work days and years lost due to disability. Investigations into the impact of obesity have revealed that it is responsible for a significant amount of time taken away from work, with an estimate in 2003 revealing 197,632 working days lost due to hospitalisations, medical treatment and interventions, and recovery time (Beg et al., 2007). This estimate was likely to be conservative, as it did not include days lost from work for more minor help-seeking behaviours or associated conditions (e.g. GP appointments) and DALYS for more recent years are likely to have risen alongside the prevalence of obesity in Australia. This analysis also estimated approximately 9,525 deaths due to high body mass in 2003, further impacting the productivity, health and wellbeing of Australians (Beg et al., 2007). In summary, weight management issues cost Australians a significant amount in terms of health, productivity and economic burden.

1.4 Treatment for Obesity: Weight Loss

Current treatments for obese Australians typically involve weight loss programs, with participants frequently being asked to restrict the amount of

kilojoules (kJ) of energy that they consume each day, and to engage in regular physical activity.

There appears to be a consensus that participants in these weight loss programs are generally able to attain a reasonable measure of success; in a recent systematic review and meta-analysis summarising the weight loss and maintenance outcomes from 45 weight loss intervention studies, Dombrowski, Knittle, Avenell, Araujo-Soares and Sniehotta (2014) found that weight loss for participants ranged from 4.03-21.3kgs, with a weighted average of averages of 10.8kgs. This echoes the findings of earlier meta-analyses (e.g. Dansinger, Tatsiono, Wong, Chung & Balk., 2007; Franz et al., 2007), which find that clinically significant weight losses are able to be produced in behavioural interventions, emphasising changes to diet and physical activity.

In an earlier systematic review, Dombrowski, Avenell and Sneihott (2010) examined 44 randomised controlled intervention studies, targeting weight loss in obese participants (BMI < 30). They compared several types of intervention (diet only, physical exercise only and diet and physical exercise combined) and found that, in line with research mentioned earlier in this chapter, each intervention type managed to produce some degree of weight loss. They also found that the greatest amount of weight loss occurred at about the 6-month mark, and with a general plateau at 6 months and a slow weight-regain in the following months. Interventions combining both diet and physical exercise were the only interventions still producing weight loss at the 12 month mark. This review also found that the weight loss programs successfully resulted in behavioural changes (fewer calories consumed/day), and lowered overall health risks (with diet-only interventions inducing significant improvements in total and LDL cholesterol, triglycerides, blood pressure (risk factors for cardiovascular disease).

Combination interventions produced similar improvements with the addition of improved HbA1c – a key indicator in diabetes management. The effectiveness of intentional weight loss in improving key health indicators in at-risk people who are overweight or obese is also echoed elsewhere throughout the literature (e.g. Thomas, 1995; Harrington, Gibson & Cottrell, 2009)

1.4.1 After weight loss: weight maintenance.

However, these considerable health benefits are often short-lived. After initially losing weight, participants are then required to enter a lifelong phase of "weight maintenance" – that is, maintaining their new, lower weight. Successful weight maintenance has been defined by Wing & Hill (2001) as occurring after an intentional loss of weight, to the amount of at least 10% of a person's original (baseline) body weight (though more recent research often finds more modest weight losses acceptable when classifying maintenance (e.g.Gilardini et al., 2016).

Wing and Hill's (2001) definition of weight maintenance further requires that a person must maintain this new, lower weight for at least one year in order to qualify as successfully maintaining their weight. This guideline was developed in line with the literature on the health benefits of weight loss; is in keeping with the criteria released by the US National Academy of Medicine (formerly called the Institute of Medicine; Thomas, 1995), and has been widely adopted as a measure of weight maintenance success (Wing & Phelan, 2005). Though there appears to be some flexibility in how much weight loss needs to be achieved, the weight maintenance literature seems to be firmly in agreeance that weight must be monitored over a period of a year or more in order to capture proper maintenance, as weight regain often occurs slowly over a period of months or years, rather than weeks (e.g. Perri, 1998; Wing & Phenlan 2005).

Most people who do manage to lose weight will not meet this criteria for successful weight maintenance, with the majority of prospective weight maintainers regaining 30-40% their original weight within their first year post treatment (Perri, 1998). Longitudinal follow-up studies have found "gradual, but reliable returns to baseline weight" within 2-5 years post treatment (Perri, 1998, p. 527). In a weight maintenance needs assessment, which investigated the facilitators and obstacles of weight maintenance in a sample of post-weight loss participants, Depue, Clark, Ruggiero, Medeiros and Pera (1995) reported a relapse rate of 71% in the first 10-38 months post-weight-loss-treatment. More recent studies (Wing & Phelan, 2005) have similarly found that 80% of weight loss participants will regain their lost weight. Investigations into the weight outcomes of people attempting long-term weight loss maintenance commonly group participants into two categories: maintainers and regainers. The term "maintainers" is generally used to refer to those who have sufficiently maintained their new lower weight, though as previously mentioned, considerable variability exists in how this is defined. The term "regainers" is commonly used to refer to cohorts of participants who have regained sufficient weight to be deemed not successful at weight maintenance (e.g. Karfopoulou, Anastasiou, Avgeraki, Kosmidis & Yannakoulia, 2016).

The high rate of relapse means that the majority of people who lose weight will eventually become at risk once more for the health complications associated with obesity. Even more alarmingly, after a significant amount of weight has been lost and then regained, participants may become even more at risk due to weight cycling. Weight cycling (also known as weight variability or "yo-yo-dieting"; Brownell & Rodin, 1994; Friedman, Schwartz & Brownell, 1998) occurs when an individual repeatedly loses and gains weight. Definitions and measurements of

this phenomenon can vary widely across the literature (Friedman et al., 1997). However, multiple health risks have been associated with repeated weight cycling, over and above the risks already associated with being overweight and/or obese. These include increases in chronic inflammation (Strohacker & McFarlin, 2010), redistribution of body fat to the upper body – a factor associated with cardiovascular disease, insulin resistance type 2 diabetes and all-cause mortality, (Brownell & Rodin, 1994; Karpe & Pinnick, 2015; Wallner et al., 2004). Clearly, the long term efficacy of weight loss treatments is problematic, and some researchers have questioned the ethical implications of even attempting to treat obesity in the first place, until such time as better long-term maintenance strategies are able to be delivered (Brownell, 2010).

However, as mentioned above, the health benefits to be gained from sustained weight loss in obese individuals remain considerable. As obesity is associated with significantly increased morbidity and mortality, as the prevalence of obesity is high, and as many efficacious treatments for short-term weight loss do exist already, cultivating techniques for successful weight maintenance is now a priority in health research (Hill, Thompson & Wyatt, 2005).

1.5 Why is Weight Maintenance so Difficult?

If the general population is able to lose weight with a reasonable amount of success, then why are they not able to maintain these losses? Weight status remains a complicated issue with a multitude of impacting factors – as such, a wide body of research has attempted to answer this question and different hypotheses have been proposed from a variety of fields. Three broad areas of research have investigated the biological, environmental and psychological factors relevant to weight maintenance, and a brief summary of each is offered below.

1.5.1 Biological factors impact on weight maintenance.

There are biological factors to be considered in weight maintenance. According to a recent commentary by Ochne, Tsai, Kushner and Wadden, (2015) the development of obesity triggers certain biological adaptations inside a person's body, such that bodyweight is more likely to be maintained or even increased over time. For example, a type of cell known as a preadipocyte becomes more common in the body, which ultimately increases fat storage capacity, leading to a higher probability of increased adipose tissue in the long-term. Dopamine, a neurotransmitter highly associated with feelings of reward when it is released, also becomes habituated when there has been a history of palatable food over-consumption. This leads to the perception of a reward deficit when eating foods in the present and this is often compensated for via increased consumption (Ochner, Tsai, Kushner & Wadden, 2015). These biological adaptations often persist indefinitely according to Ochner et al., so that they continue even when a person loses weight and re-attains a healthy BMI.

Should an obese individual succeed in re-attaining a healthy BMI, or even in attaining a 10% weight loss of their original baseline bodyweight, then the process of sustaining those changes causes further biological adaptations in the body which favour the re-gain of weight. In a review of the prominent metabolic changes in response to weight loss maintenance attempts, Rosenbaum and Leibel (2010) described three major metabolic factors which become relevant in sustained weight loss. First, daily energy expenditure, and especially non-resting energy expenditure (that is, energy expended during times of physical activity) decreases. This occurs as skeletal muscle chemomechanical efficiency increases; Rosenbaum and Leibel (2010) reported that the maintenance of a 10% reduction in body weight was associated with an approximate 20% increase in efficiency.

This means that a previously obese or overweight person who has lost 10% of their bodyweight must now work 20% harder to expend energy through physical activity than a same-weight person who is not maintaining weight loss.

Secondly, neuroendocrine changes in the brain and hormone systems seem to occur during weight loss, working against weight loss maintenance. Thyroid hormone increases energy expenditure via several mechanisms (such as increasing heart rate, blood pressure and muscle-consumption of the adenosinetriphosphate (ATP) energy molecule) and thyroid-hormone deficient patients therefore tend towards lethargy and weight gain (Rosenbaum & Leibel, 2010). As production of thyroid-releasing hormone is decreased following weight loss, this places people at higher risk for weight-regain (Rosenbaum & Leibel, 2010).

Thirdly, attempts to maintain a reduced bodyweight are associated with significant changes in the central nervous system – specifically, with declines in the sympathetic nervous system tone, and with increases in the parasympathetic nervous system tone. Since increases in the parasympathetic nervous system lead to slowed heart rate and decreases in resting energy expenditure, and since the sympathetic nervous system influences the thyroid gland to increase secretions of the thyroid hormone, these changes in response to weight loss have additional implications for poor weight maintenance outcomes (Rosenbaum & Leibel, 2010).

The combined influence of these three factors alone are such that people maintaining weight loss are both hungrier (willing to eat more often), and less satiated (willing to eat more per meal). Ultimately, it has been concluded that "the simultaneous declines in both energy expenditure and satiety following weight loss conspire to create the optimal biological circumstance for weight regain" (Rosenbaum & Leibel, 2010, p. 7).

Finally, genetic and epigenetic factors have been implicated in obesity, such that monogenetic and polygenetic (or common) obesity have now been identified within the scientific community and are considered to have differing underlying genetic aetiologies (Albuquerque, Stice, Rodriguez-Lopez, Manco & Nobrega, 2015). Monogenetic obesity refers to obesity which is caused by a mutation on a singular gene. This affects only about 5% of the population, and is often characterised by an early onset and an extreme presentation (Albuquerque et al., 2015). Far more commonly, obesity is polygenetic, involving the interaction of several genes, which may be expressed more or less strongly due to epigenetic interactions with the environment (Albuquerque et al., 2015; Herreraa, Keildson & Lindgren., 2011). Although it is now widely acknowledged that genes and epigenetic factors contribute to obesity, more research is required to fully understand the specific loci of the genes involved and the mechanisms by which they lead to obesity (Albuquerque et al., 2015; Herreraa et al., 2011).

1.5.2 Environmental factors impact on weight maintenance.

In addition to the biological factors which work against long-term weight maintenance, there are also strong environmental factors present within most westernised cultures, providing what has been described as a "toxic" environment for weight management (Mann, 2015), or simply an "obesogenic environment" (Mackenbach et al., 2014). Broadly speaking, this refers to the way in which our environment is often structured to prompt towards overconsumption and/or under-activity. One such way is through the frequent use of food cues – these are sensory prompts or cues provided by the environment, inviting us to eat and can include the effects of deliberate advertising (e.g. signs and television commercials), as well as incidental exposure to food (e.g. walking past a café and seeing or smelling the food there). In a recent meta-analysis of 45 studies

investigating the effect of food cues on cravings and eating behaviour, Boswell and Kober (2016) confirmed that exposure to food cues significantly influenced and contributed to eating behaviour and subsequent weight gain via the invocation of food cravings. They further found that visual food cues (e.g. pictures and videos) were similarly effective to real-life food exposure, and produced a stronger effect size than olfactory cues. This provides evidence that visual food advertisements in our environment could prompt us to overconsume and constitute a barrier to those attempting weight loss maintenance (Boswell & Kober, 2016). Modern environments also offer a high availability of energy-dense foods (Berthoud, 2004), and modern routines tend towards more sedentary, office-like environments, both in the workplace and for recreational activities in the home (Berthoud, 2004). Home cooking has declined and ready-made food markets have become more prevalent (Hill, Wyatt, Reed & Peters, 2003; World Health Organisation, 2016). All of these environmental factors may make it more difficult for a person to routinely exercise and to eat healthily.

1.5.3 Psychological factors impact on weight maintenance.

Psychological factors have also been identified as significant stumbling blocks for people attempting weight maintenance. As previously outlined, the aim of this thesis is to investigate several psychological factors which have been identified as important to the process of ongoing weight maintenance – and thus it is in this area of the literature that this body of work is positioned.

Firstly, Mann (2015) refers to people having limited cognitive resources (such as attention and willpower) which are regularly drained by the uniquely unforgiving nature of a weight maintenance task. Weight maintenance requires a delicate balance of energy intake and expenditure, and even small imbalances of energy can impact on weight over time. Because of this delicate balance, a single

lapse in attention or willpower that results in a high calorie or energy dense snack being consumed can be sufficient to disrupt that day's energy balance, weighting energy intake as more than energy expenditure. Single lapses are of course inevitable and to be expected in the context of long-term weight loss maintenance, and single lapses in and of themselves are not necessarily problematic. However, the delicate balance required for weight maintenance to be achieved on a daily basis combined with the high availability of energy dense snacks in most modern environments results in the need for cognitive resources to be consistently employed against food cues, habits and other snacking opportunities that can easily predispose to weight regain (Gore, Foster, DiLillo, Kirk & West, 2003).

In addition to limited cognitive resources, Mann (2015) also notes that people experience several qualitative differences in food-related cognitions after experiencing a decrease in food intake, such that as long as the body experiences a lower intake of food than it has previously become used to, the person will experience more frequent cravings for food, more intense cravings for food and more frequent cognitions about food, making it even more difficult for such a person to continually resist. This is further supported by the research mentioned above, which implies that biological mechanisms (e.g. decreased satiety due to metabolic responses) may underlie these changes in cognition.

Another psychological factor can include the use of food as a coping mechanism to deal with stress or unpleasant emotions (Masheb & Grilo, 2006). Referred to as "emotional eating", this is defined as "the tendency to overeat in response to negative emotions such as anxiety or irritability" (van Strien et al., 2007, p. 106).

Emotional eating occurs when one is unable to differentiate between internal hunger cues, and the physiological discomfort which naturally arises from the experience of negative emotions (Adriaanse, de Ridder & Evers, 2011).

Consequently, people who emotionally eat tend to respond to their negative emotions by consuming food, which may be problematic as it predisposes them to overconsumption. Emotional eating is highly prevalent, and to some extent encouraged or normalised in many westernised cultures (Masheb & Grilo, 2006). Unsurprisingly, emotional eating has been linked overconsumption in times of stress, to increases in fat intake (Cornelis et al., 2014) and to the development and relapse of obesity (Torres & Nowson, 2007).

1.5.3.1 Habit: an important psychological factor.

Habits are an important psychological construct to consider in the context of weight maintenance. A habit, according to Neal, Wood and Quinn (2006), is a mental link which occurs between an environmental cue, and a particular behaviour. When the person encounters a cue in the environment (e.g. walking past a familiar bakery), a behavioural response is triggered (e.g. go in and buy a cake). As this behaviour is repeatedly performed on encountering the cue, an associative mental link is formed, which is reinforced with each repetition – allowing the habit to strengthen over time (Holland, Aarts & Langendam, 2006). When the link is of sufficient strength, it begins to automatically invoke the now-familiar behaviour, bypassing much of the conscious decision-making process (Verplanken, 2006). Another example would be if a person were to snack while watching a daily television show; a mental link would then begin to form between the familiar sound and sights of the television show's introduction and the behavioural snacking response. With repeated performances, the television show would likely become a cue for that person to begin habitually snacking (and

indeed, research by Gore et al. (2003) has indicated that television snacking is a particularly common and problematic habit which can undermine weight maintenance attempts).

In many situations, habits are useful mental constructs, as they allow a person to react automatically to familiar cues in their environment (Verplanken & Orbell, 2003). In the absence of any pre-formed habits, one must rely on deliberate, reasoned action and decision making to guide subsequent behaviour which is both slower, and more cognitively taxing. However, habitual action is thought to be more automatic – that is, it occurs in response to an environmental cue and is less effortful as it does not require any conscious reasoning nor decision making (Aarts & Dijksterhuis, 2000; Neal & Wood, 2007; Verplanken, 2006). Habits may also be self-reinforcing, as so long as the environmental cue continues to appear, the mental link will continue to activate in response and the behaviour will continue to be executed.

However, habits are not necessarily built intentionally and many people develop counter-intentional habits – these are habits which produce behaviour that we do not intend and do not wish to promote (Verplanken, 2006; Orbell & Verplanken, 2010). For example, a person who wishes to eat healthier may have a longstanding habit of ordering dessert in response to having finished a meal when dining out at their favourite restaurant. Despite this being a behaviour that they no longer intend to enact, if a strong mental link exists between the behaviour of ordering dessert and the environmental cue of finishing a meal, then the mental link will still activate when the environmental cue – a finished meal – is present (Verplanken & Wood, 2006). In order to not order dessert, the person must notice and countermand their established and automatically activated habit. In order to do this, they must use some attentional resources – that is, they must notice that

they are habitually drawn, for example, to respond “yes” when asked if they would like dessert. They must then enact a process of consciously reasoned action, rather than less effortful habitual action and decide to respond “no” in this particular instance at this particular time. This process of reasoned action is reportedly more stressful and taxing on cognitive resources (Wood, Quinn & Kashy, 2002).

Over time, repeated performances of saying “no” may erode the established habit of ordering dessert and even build a new habit of declining dessert at this restaurant. However, this requires consistent exertions of cognitive effort over time and in response to the appropriate environmental cue, and can be difficult if the underlying habit is strong (Verplanken & Wood, 2006).

It is not difficult to see therefore, how weight maintenance can be made more challenging when habits are taken into consideration. A multitude of long-term dietary and exercise habits are likely to have been developed over the course of a person becoming overweight or obese in the first place, and each of these will exert pressure in different circumstances to enact behaviour in line with relapse. While expending cognitive resources in the short-term to counter these habits is highly possible, in the long-term, consistent counter-habitual action will likely be draining, and a common stumbling block for those attempting weight maintenance.

In summary, it is important to acknowledge the complex and multi-factorial nature of obesity, and the many reasons that long-term weight maintenance is difficult to achieve. Biological, environmental and psychological factors all play an important role in the development and maintenance of obesity, as well as presenting significant barriers to the achievement of long-term weight maintenance. However, despite these significant difficulties, it is important to

recognise that weight maintenance is possible; approximately some 20% of weight-loss participants do in fact manage to successfully maintain their new lower weight (Wing & Phelan, 2005). In fact, despite the obstacles reviewed above, there is some evidence that weight loss maintenance becomes easier to sustain over time and does not lead to a sense of lifelong struggle (Wing & Phelan, 2005). Thus, it becomes crucial to assist those attempting the difficult task of achieving weight loss maintenance to overcome the biological, environmental and psychological obstacles that they will undoubtedly face. Specifically, this thesis seeks to examine some of the psychological factors that are linked to weight maintenance outcomes, and to investigate the context in which these psychological factors can be used work in favour of those attempting weight loss maintenance.

1.6 Psychological Skills to Support Weight Maintenance

Thus far the thesis has established that the prevalence and burden of obesity in Australia requires addressing, and that although efficacious treatments for weight loss already exist, the lifelong task of weight loss maintenance after losing weight is difficult, and that the rate of relapse is currently high. The reasons for this high rate of relapse have been explored and it has been established that weight maintenance is multifaceted, complex and difficult, involving the interplay of multiple biological, environmental and psychological factors. One such psychological factor is the construct of habit, which involves a mental link between an environmental stimulus and the performance of a particular behaviour. It has been established that habits can self-reinforce over time without conscious effort, as they rely only on the pairing of an environmental cue with the performance of a behaviour and that they can be counter-intentional in nature. This can be particularly problematic given the obesogenic environments that are

frequently constructed in westernised countries like Australia, as environment-driven, counter-intentional habits that establish poor eating behaviours (such as unhealthy snacking, meal preparation or food choice) can predispose people to overconsumption (Immaneni & Shankar, 2015; Mohamed, 2017). This places them at risk for both developing and relapsing into obesity.

In the section below, the thesis will explores the way in which two psychological factors, planning and problem solving, can be supportive of weight maintenance through their interplay with both habit and intentional behaviour.

1.6.1 Planning, problem solving and weight loss maintenance.

A large body of literature has investigated which kinds of behaviours are associated with long-term weight loss maintenance. Previous qualitative research has compared cohorts of successful weight maintainers with weight re-gainers in focus groups and interviews (e.g. Byrne, 2002; Kayman, Bruvold & Stern, 1990; Reilly et al., 2015) to investigate what kinds of behaviours and psychological traits are associated with being a successful weight maintainer. Other studies have extended these findings by conducting comparative randomised controlled trials (RCTs) where particular skills are differentially cultivated and their subsequent impact on weight maintenance is documented (e.g. Murawski et al., 2009).

Two identified factors that are predictive of successful long term weight maintenance are planning and problem-solving skills (Wing & Phelan, 2005). In a series of interviews, Stuckey et al. (2011) identified that successful weight maintainers engaged in planning meals, tracking calories, fat consumed and weight. Two further qualitative studies have conducted interviews with weight maintainers, re-gainers and healthy controls and found similar differences regarding planning and problem solving behaviours (Kayman et al., 1990; Kitsantas, 2000). Kayman et al. (1990) identified that maintainers are more likely

than re-gainers to confront their problems directly, to show a conscious awareness of their behaviour, and to develop personalised strategies to help themselves. Kitsantas (2000) similarly identified that individuals who were successful in losing and maintaining weight loss were more likely to use self-regulatory strategies such as goal setting, self-monitoring, self-evaluation, environmental restructuring, time management and seeking information and social support when needed. In a 3-arm randomised controlled trial (comprising of a control, newsletter-only group, and two self-regulation intervention groups – delivered by internet and face-to-face), Wing, Tate, Gorin, Raynor and Fava (2006) demonstrated that a weight maintenance program based on self-regulation strategies, including planning, was more effective for maintaining weight loss than the control, no-intervention, newsletter group.

Identified predictors of poor weight maintenance outcomes from the qualitative literature include dichotomous ("black and white") thinking, poor coping skills and passive or poor problem solving skills (Byrne, Cooper & Fairburn, 2003; Byrne, 2002; Byrne, Cooper, & Fairburn, 2004; Kayman et al., 1990).

Taken together, this suggests that planning and problem solving skills are advantageous when it comes to weight maintenance, and a further investigation of these constructs is warranted.

1.6.1.1 The Problem Solving Process

Problem solving involves a set of cognitive behavioural activities which are activated in response to a recognised problem, through which the person attempts to discover or develop a solution or effective way of coping (Nezu, Nezu & D'Zurilla, 2013). Problem solving theory, as defined by D'Zurilla, Nezu and Maydau-Olivares (2002), includes two major components: a problem orientation

and a problem solving process, with five key stages. Problem orientation refers to a theoretical set of "cognitive affective schemas that represent a person's generalised beliefs, attitudes and emotional reactions about problems in living and one's ability to successfully cope with such problems" (Nezu et al., 2013, p. 11). These schemas manifest as a general attitude towards the occurrence of problems in life, and are thought to be relatively stable over time. A problem orientation can be either positive or negative in nature. A positive problem orientation typically involves seeing problems as challenges or opportunities. Persons with a positive problem orientation are more likely to believe that a problem is solvable and to have a strong sense of self-efficacy regarding their ability to cope with it. Having a positive problem orientation also involves understanding and accepting that successful problem solving requires both time and effort, and that negative emotions are an integral part of the overall problem solving process. These negative emotions are furthermore recognised as actually being helpful (Nezu et al., 2013). Negative problem orientations, on the other hand, typically characterise problems as threats, and expect that problems are often unsolvable. Persons with a negative problem orientation are likely to doubt their ability to cope with them, and become particularly frustrated and upset when faced with the normal negative emotions that problems evoke (Nezu et al., 2013). Rather than being two ends of the same continuum, D'Zurilla et al. (2002) report that these constructs are statistically independent (or "orthogonal"), so that while one orientation (positive vs negative) may likely to be dominant, it is possible for a person to hold both positively oriented and negatively orientated beliefs about a problem at the same time Furthermore, Nezu et al. (2013) reports that it is common for a single person to have domain-specific problem orientations, dependant on their personal experiences (e.g. a primarily positive problem orientation towards issues which

arise at work, but a negative problem orientation towards relational issues that arise in their social life).

The five key processes involved in Social Problem Solving are: (a) developing a definition and understanding of the problem, (b) generation of possible solutions, (c) deciding on a single appropriate solution to trial, (d) planning and implementing that solution and (e) the evaluation of its success or failure to inform subsequent future planning. The degree to which a person exhibits skill and engagement in each of these processes denotes their problem solving style. Three styles have been identified by D'Zurilla et al. (2002): Avoidant, Impulsive (also called Careless) and Planful (also called Rational). Avoidant problem solvers endorse strategies such as inaction (e.g. waiting to see if a problem will resolve itself) or distraction (e.g. trying not to think about the problem). Impulsive or careless problem solvers may endorse action strategies, but do so in a rushed or semi-disengaged manner (e.g. acting on the first possible solution that comes to mind, rather than taking time to carefully think of multiple possible solutions before judiciously deciding on the most appropriate strategy). Finally, planful or rational problem solvers endorse strategies that cost appropriate amounts of time, effort, and engagement, given the level of problem difficulty (e.g. they report genuinely engaging in each of the 5 key processes).

Social Problem Solving research has been further developed into a clinical therapy, known as Problem Solving Therapy (PST; Nezu et al., 2013). This involves psychoeducation and skill building in each of the five key areas, as well as supporting a positive problem orientation within the client. PST has formed the basis of successful randomised controlled interventions that assist people in adherence with weight management programs, both in the context of weight loss (Murawski et al., 2009) and with maintaining their weight afterwards (Perri et al.,

2001). According to Murawski et al. (2009), improvements in overall problem solving skill were found to mediate the relationships between treatment adherence and weight loss outcome. In a randomised controlled trial, Perri et al. (2001) investigated three types of post-weight-loss-intervention treatments, following a 20-week behavioural weight loss treatment among women participants. Compared with a group that received no further contact (weight loss treatment only), and a group who received relapse prevention training, women who participated in PST had significantly greater long-term weight reductions at 17-month follow-up.

1.6.1.2 Planning

Planning skills have also been established as an important component in behaviour change, particularly in contexts where there are long-established habits that need to be eroded (Webb, Sheeran & Luszczynska, 2009). As has been previously discussed, weight maintenance is clearly one such context, wherein people often fail to continue the healthy behaviours that helped them to lose weight, and instead fall back into older, more strongly established habits which are often counter-intentional. The ability to plan well may be linked with the ability to more quickly form intentional habits and erode counter-intentional ones, leading to less effortful weight maintenance behaviours, and less pressure from existing counter-intentional habits (Holland et al., 2006; Webb et al., 2009); and thus, less risk of relapse.

1.6.1.2.1 A Definition of Planning

According to foundational work by Endler and Parker (1999), planning is a cognitive process that has been identified as a form of adaptive, problem-orientated form of coping (Endler & Parker, 1999) and is an effective component of problem-solving (D'Zurilla, Nezu, & Maydeu-Olivares, 2002). More broadly, planning can also be viewed as a psychological process, which is ongoing and

cyclic in nature (Gollwitzer, 1990). In this sense, the planning process can include the use of monitoring and feedback in a cyclic manner that leads to continually updated and refined strategies, which move one ever-closer to obtaining one's goal. Thus, planning can be used as an adaptive way to build skills and aid long term change.

'Planning' can be used reasonably to refer to any type of cognitive preparation for a target activity or event. However the literature on planning is asymmetric, with much having been written on a few planning strategies and their effects (as is the case in the literature on implementation intentions – see below), and little existing literature on how these strategies might work in concert (Duckworth, Grant, Loew, Oettingen, & Gollwitzer, 2010; Hagger & Luszczynska, 2014). Perhaps one of the best known planning strategies is an "implementation intention" (also known as an "if/then" plan or an action plan). Whereas it is accepted that a goal intention may be mentally phrased as "I intend to reach Z!" (Gollwitzer & Sheeran, 2006), an implementation intention furnishes that goal intention with a specific plan of action, intended for a specific context ("if situation x occurs, then I shall initiate goal-directed action y!") (Gollwitzer & Sheeran, 2006).

However, the formation of an implementation intention may only be the end process of planning, whereupon a commitment is made to a specific course of action. Prior to the formation of an implementation intention, a person may go through other processes of mental preparation. For instance, one may first engage in outcome imaging (the imagining of an intended outcome), which allows one to simulate and therefore evaluate the expected benefits of that outcome (Knauper et al., 2011). One may also formulate and discard many potential actions or routes to a goal, before deciding on the most appropriate step (D'Zurilla et al., 2002).

According to Friedman and Scholnick (2014), a crucial part of the planning process is also the *decision to plan*, which is a process of cognitive evaluation and preparation for planning itself, determined by an individual's beliefs and past experiences regarding the value and efficacy of planning across a variety of contexts (Friedman & Scholnick, 2014). Each of these steps may impact on subsequent cognitive processes and action in the context of weight maintenance. As such, the current research will use a comprehensive definition of planning that encompasses not only the commonly encountered action planning, but also the wider cognitive processes that count as mental preparation in the service of goal-directed action.

1.6.1.2.2 Implementation intentions

A comprehensive definition of planning allows for a range of highly relevant mental processes to be examined within the scope of this thesis. This builds on a plethora of previous research in planning and behaviour change which tends to have focussed solely on implementation intentions, and as such, a clear understanding of this planning strategy is a necessary foundation. As previously stated, implementation intentions are concrete action plans that take on an "if/then" format. Previous work has established that these deceptively simple "if/then" plans often make the difference in ensuring that a person's intention is successfully translated into action (Gollwitzer & Sheeran, 2006). The implementation intention has been lauded as a crucial piece of the puzzle needed to solve the gap that often exists between intention and action (Orbell, Hodgkins, & Sheeran, 1997; Sheeran & Orbell, 1999). Furthermore, research applying implementation intentions has been credited as assisting with the advancement of theories of behaviour change - such as Theory of Planned Behaviour (Sniehotta, 2009).

While implementation intentions are only one component of what Gollwitzer (1990) calls the planning process, this particular component has important implications for the construction and deconstruction of habits and for weight maintenance generally. As such, it is important to examine the way in which they work. Research (Webb & Sheeran, 2008) investigating the underlying mechanisms supports two separate processes. Firstly, an implementation intention makes the situational cue (the "if" component) highly accessible in memory, so that when it is encountered, the person instantly recognises it as an opportunity to act (Gollwitzer & Sheeran, 2006; Webb & Sheeran, 2008). This cue is most effective when it is highly specified (Gollwitzer, Weiber, Myers, & McCrea, 2009). Secondly, the "if/then" format forges a mental link between the situational cue and the action specified in the "then" component, in a similar manner to a habit, which allows the person to forgo any on-the-spot deliberation and instead launch directly into the intended, goal-directed action (Gollwitzer et al., 2009; Webb & Sheeran, 2008). The goal-directed action may be singular, or it may be a complicated sequence, or even several nested actions may be cued, each of which may depend upon the success of predecessor actions (Gollwitzer et al., 2009).

Implementation intentions give the user an advantage over merely forming an intention to act, partly because as specified previously, they somewhat automate the target action (Gollwitzer & Sheeran, 2006). Because the intended action becomes somewhat automatic, it does not drain attentional and motivational resources in the same way that reasoned action does – and this results in faster, more immediate action directly after the cue is sighted (Gollwitzer & Sheeran, 2006). Furthermore, this results in the action being protected against "forgetting" – the most common reason participants give for not acting upon their intended health behaviours (Orbell et al., 1997). Implementation

intentions also allow the action to persevere in the presence of barriers or stumbling blocks that are also often reported as reasons for inaction. For example, a meta-analysis by Gollwitzer and Sheeran (2006) reported that action occurred despite the presence of aversive self-states (such as a bad mood) and in the presence of aversive contexts (such as driving slowly, even when primed by other motorists to speed). This same meta-analysis reports that implementation intentions also produce action that persists in the face of distractions and cognitive load (Gollwitzer & Sheeran, 2006).

Implementation intentions have been applied to assist goal achievement across a wide variety of areas. Gollwitzer and Sheeran (2006) identified eight different realms where the application of implementation intentions have been found to impact the rate of behavioural goal achievement, including the domains of health behaviour, academia, environmental, prosocial, counteracting racism, consumer habits and other personal goals, as well as performance goals in laboratory tasks. Specifically in the health domain, the effect of implementation intentions produces overall medium effect sizes and short term trials have been particularly successful (Gollwitzer & Sheeran, 2006). Implementation intentions have been known to produce successful weight loss (Prestwich et al., 2012), healthier diets (Adriaanse, Vinkers, De Ridder, Hox, & De Wit, 2011; Kellar & Abraham, 2005), reductions in unhealthy snacking behaviour (Kroese, Adriaanse, Evers, & De Ridder, 2011) higher levels of exercise (Milne, Orbell, & Sheeran, 2002; Prestwich et al., 2012), and higher engagement with health screening (Orbell et al., 1997). Particular interest has been given to using implementation intentions in decreasing dietary fat intake (Armitage, 2004) and increasing fruit and vegetable intake (Armitage, 2007; Chapman & Armitage, 2010, 2012), and these interventions have resulted in significantly more fruit/vegetable intake.

One limitation of implementation intentions may be their effect over time. Studies investigating the longer term effects of implementation intentions in fruit and vegetable consumption have shown less promising results (Jackson et al., 2005; Luszczynska, Tryburcy, & Schwarzer, 2007), and further investigation has suggested a general waning of the effect that the formation of a single implementation intention has on performance over time (Chapman & Armitage, 2010). This has prompted study into the possibility of utilising subsequent "booster" implementation intentions to sustain the effect, and again, the results have been promising (Chapman & Armitage, 2010).

Finally, and perhaps most importantly from a weight maintenance perspective, implementation intentions have been used to help combat unwanted habits (Adriaanse, Gollwitzer, De Ridder, De Wit, & Kroese, 2011). Implementation intentions have been used to weaken ingrained eating habits, smoking habits and laboratory-induced task performance habits (Tam, Bagozzi, & Spanjol, 2010; Webb et al., 2009) with varying degrees of success. The diversity of these findings can be largely explained by differences in habit strength. Investigations into the nature of habits and their mutability have reported an interaction effect such that when a particular habit is weak, implementation intentions can have quite pronounced effects in changing behaviour - however, in cases where a habit is strong, an implementation intention tends to have small, weaker effects (Webb et al., 2009).

1.6.1.3 Summary

In summary, this section of the thesis has outlined the problem solving process and reviewed the literature which supports problem solving as an important factor in supporting weight maintenance. It has further reviewed and defined the planning process for the purposes of this thesis. This section has

furthermore outlined the way in which implementation intentions or action planning strategies can also support weight maintenance, through the deliberate construction and deconstruction of habitual action.

There is an identified need for more research on planning, with a focus on developing a clear understanding of the context in which good planning and problem solving typically occurs (Hagger & Luszczynska, 2014). Specifically, there seems to be a lack of knowledge about how people attempting weight loss and weight loss maintenance view, value and implement planning, or how they approach and solve problems. Therefore, the current thesis focusses on conceptions of planning and problem solving skills, and identifying such contexts with the view to apply them to effective weight maintenance.

1.7 The Health Action Process Approach

This thesis investigates the process of maintenance (in this case weight loss maintenance) which occurs after an initial behaviour change. The work presented here has been informed by the Health Action Process Approach (HAPA; Schwarzer, 2008), because this model acknowledges that maintenance is not a singular or linear process, but rather that it begins with the initiation of action, occurs with ongoing action, and it incorporates inevitable lapses requiring recovery. Descriptions of the HAPA model (Schwarzer, 2008) make a distinction between a pre-action or "motivational" stage, (where several factors are cognitively appraised and ultimately culminate in an intention to act), and a post-intentional "volitional" phase - where action and coping planning interplay with the initiation, maintenance and recovery of sustained action, in order to produce ongoing behaviour (see Figure 1). More specifically, according to the HAPA model, in the pre-intentional phase, motivational factors such as risk perception (e.g. "I am at risk for type 2 diabetes") and outcome expectancies (e.g. "if I

change my diet such that my sugar intake is decreased and my vegetable intake is increased, I will reduce my risk of type 2 diabetes") are important factors, as they capture the information that is evaluated when one is weighing the pros and cons of changing behaviour. A third pre-intentional phase factor, action-self-efficacy, represents the degree to which a person believes that they are capable of enacting the behaviour that they are contemplating (e.g. "I am able to change my diet such that my sugar intake decreases and my vegetable intake increases"). Action self-efficacy has been identified as important during this phase of the model, as a behavioural intention requires firstly that one believes that the behaviour is within their capacity.

However, once the behavioural intention has been formed, other factors come into play. This marks the transition from the motivational phase to the volitional phase and action-based factors (Schwarzer, 2008) become more relevant for study. At this stage, one must now translate their intention to behave in a healthful way into a concrete behaviour or set of behaviours. Planned instructions for each new behaviour may be helpful to facilitate action, especially in cases where something unfamiliar or novel is being tried. Therefore this is the point, between intention and action, at which the ability to plan starts to become important. Once a new behaviour has been enacted, in order for maintenance to occur, it must then be sustained. This cannot be completed at a single time point, but rather, it requires a complex set of behaviours and skills in order to continue.

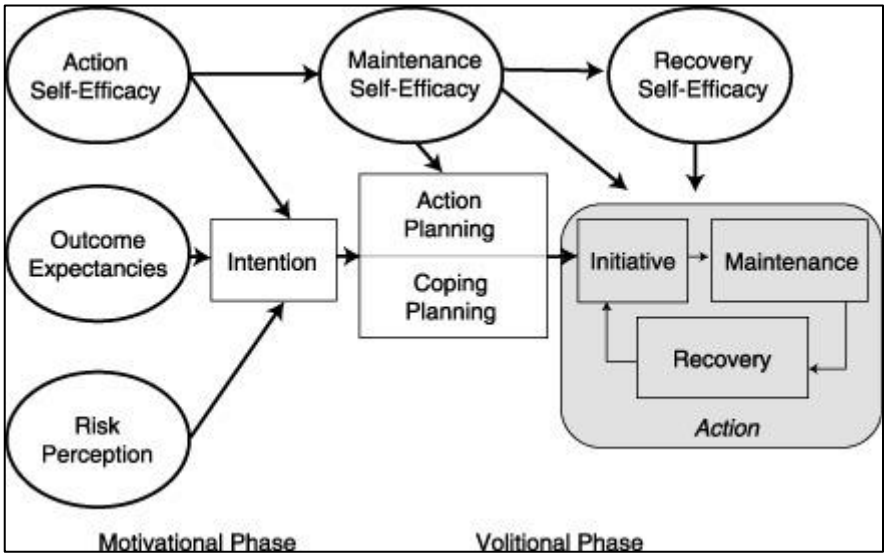

Figure 1: Diagram of the Health Action Process Approach. Reprinted from "Modeling health behavior change: how to predict and modify the adoption and maintenance of health behaviors" by Schwarzer R., 2008, *Applied psychology, 57*(1), p. 6. Copyright 2008 by The International Association of Applied Psychology.

This thesis seeks to investigate factors which occur in the latter half of the health action process approach. Specifically, this thesis aims to examine weight loss maintenance wherein intentions regarding weight and health have already been established, and where initial action (preliminary behaviour related to weight management or weight loss) has already taken place, and where action must now be continued and maintained against relapse. The Health Action Process Approach is useful to review here as it shows firstly the positioning of this research in the latter half of the approach, in the volitional stages of action and maintenance. Secondly, the Health Action Process Approach has been used to reliably predict health action outcomes across a variety of health domains including dietary intake, physical exercise, health monitoring (e.g. breast self-examination), and risk reduction (e.g. seatbelt use and dental flossing) (Schwarzer, 2008). This evidence-based framework is therefore supported by a wide base of rigorous study. As such, an understanding of this framework

provides important evidence-based insights into the nature of a maintenance task; specifically its conceptualisation as being a part of a cycle which includes periods of lapse, recovery and new initiated actions. This makes intuitive sense in the context of weight loss maintenance, which is a lifelong task. Setbacks, disruptions to lifestyle, changes in the environment and naturally occurring mistakes are all eventually inevitable and require some form of recovery effort in order to correct. In this way, inevitable, temporary lapses are kept from becoming more serious relapses. However, this cycle of maintenance, recovery and action is not yet well understood or detailed. This thesis begins by positing that certain psychological skills may be well-suited to assisting with these maintenance-recovery cycle tasks. Specifically, the use of problem solving and planning skills may be useful in order to effectively adjust old plans, forge new intentional-habits, identify and erode counter-intentional ones and to perpetuate the ongoing nature of the weight maintenance task with less effortful deliberation and action.

1.8 Aims and Overview of this Thesis

In light of the research outlined by the thesis so far, it appears that several gaps in the literature remain. Although planning and problem solving have been identified as promising factors with the capacity to increase and sustain intended action, planning remains poorly defined and further research is required to investigate the conditions in which planning and problem solving are most effective (Hagger & Luszczynska, 2014). As planning is an effective facilitator of intentional action, relevant to the formation of new habits and crucial to effective problem-solving, planning has the potential to be greatly beneficial in the context of weight maintenance. This thesis also explores knowledge that is highly relevant in clinical psychology. Given the bidirectional links that have been established between depression and obesity (Luppino et al., 2010), and the high prevalence of

both depression and obesity within Australia, it is likely that these issues will present frequently for treatment by clinical psychologists. Furthermore, the constructs of planning and problem solving are useful in facilitating behaviour change across domains and not solely tied to the health or weight loss/weight loss maintenance arenas. Indeed, several recent meta-analyses have reported on the efficacy of problem solving therapy as a clinical intervention for depression (Kirkham, Choi & Seitz, 2016; Zhang, Park, Sullivan & Jing, 2018) as well as anxiety-related disorders (Zhang et al., 2017). Therefore, understanding the contexts in which good problem solving and planning occur may assist clinical psychologists to support long-term maintenance against relapse of these conditions as well. Finally, despite these constructs being of importance both within the health and clinical psychology arenas, the way in which planning and problem solving skills are perceived by the general population, and by people currently attempting weight maintenance remains largely unknown.

This thesis will contribute towards addressing these gaps in the literature. Specifically, this thesis hopes to contribute to the literature by focussing on three research aims:

1. To investigate perceptions and experiences of weight loss maintenance, planning and problem solving skills from the perspective of those attempting weight loss maintenance;
2. To investigate and contribute to the literature's understanding of contexts in which effective planning and problem solving typically occurs;
3. To construct a set of principles to guide the formation of future maintenance interventions which may incorporate both planning and problem solving skills.

In Chapter 1, a summary of the research has been presented, which highlights weight management as a priority in Australian health research, and which identifies problem solving and planning as helpful component skills for successful weight maintenance. The scope of the thesis and the thesis aims have been outlined, along with a review of the relevant literature.

In Chapter 2, the first study, published in the Journal of Health Psychology, describes the first step of this investigation. Common perceptions of weight loss, maintenance, planning, and problem solving skills which are held by persons engaged in weight maintenance are explored. This exploration is undertaken in the context of a mixed methods study, and convergence between the qualitative and quantitative data are discussed. Links are drawn between the findings in this study and the design and implementation of the second study.

In Chapter 3, the rationale for the second and third studies of the thesis are outlined.

In Chapter 4, the measures and methodology used to capture the data used in the second and third studies are described.

In Chapter 5, the second study, published in the journal Eating Behaviors, describes the second step in this investigation. This study explores the ability of people to break snacking habits using mindful eating in concert with action planning and the impact of a short intervention, delivered online. This study also begins to investigate the finding in Chapter 2 that self-compassion may be relevant to capture alongside planning and problem-solving constructs, given that exploring supportive contexts for planning and problem solving is one of

the thesis aims. Links are drawn between the findings in this study and the design and implementation of the third study.

In Chapter 6, the third and final study undertaken as part of this body of research is presented. This study investigates the predictors of intentions to continue a weight maintenance behaviour after performing this behaviour and receiving feedback. The role of planning, problem solving, coping style and self-compassion in predicting these intentions is investigated and the implications in producing consistent engagement with maintenance-related behaviours is discussed.

In Chapter 7, a discussion of the work within this thesis is presented. This chapter critically appraises the presented studies and interprets the collective findings of all three studies within the broader context of both the weight loss maintenance and the behaviour change maintenance literatures. Recommendations for future interventions are presented, in line with the thesis aims. The clinical implications of these findings and their relevance to clinical practice are also highlighted.

Chapter 2: Study 1. A Mixed-Methods Investigation of Psychological Factors Relevant to Weight Maintenance

This chapter consists of a published paper. The paper is presented in a format that is consistent with the rest of the thesis body within this chapter, and in the format of the journal article in Appendix A. The supplemental materials submitted to the journal along with this paper are presented in Appendix B. This study in this chapter was published as follows:

Dibb-Smith, A. E., Brindal, E., Chapman, J., & Noakes, M: (2016). A mixed-methods investigation of psychological factors relevant to weight maintenance. *Journal of health psychology,* 1359105316678053.

2.1 Statement of Authorship

Statement of Authorship

Title of Paper	A mixed-methods investigation of psychological factors relevant to weight maintenance
Publication Status	☑ Published ☐ Accepted for Publication ☐ Submitted for Publication ☐ Unpublished and Unsubmitted w ork w ritten in manuscript style
Publication Details	Dibb-Smith, A. E., Brindal, E., Chapman, J., & Noakes, M: (2016). A mixed-methods investigation of psychological factors relevant to weight maintenance. *Journal of health psychology,* 1359105316678053.

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Name of Principal Author (Candidate)	Amanda Ellen Dibb-Smith

Contribution to the Paper	Transcribed and analysed both quantitative and qualitative data, interpreted results, wrote manuscript and acted as corresponding author.		
Overall percentage (%)	75%		
Certification:	This paper reports on original research I conducted during the period of my Higher Degree by Research candidature and is not subject to any obligations or contractual agreements with a third party that would constrain its inclusion in this thesis. I am the primary author of this paper.		
Signature		Date	22.11.18

Co-Author Contributions

By signing the Statement of Authorship, each author certifies that:

i. the candidate's stated contribution to the publication is accurate (as detailed above);

ii. permission is granted for the candidate in include the publication in the thesis; and

iii. the sum of all co-author contributions is equal to 100% less the candidate's stated contribution.

Name of Co-Author	Emily Brindal		
Contribution to the Paper	Supervised the development of the work, helped in data interpretation and manuscript editing.		
Signature		Date	23.11.18

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Contribution to the Paper	Co-supervised development of the work, data interpretation and manuscript editing.		
Signature		Date	19.12.18

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Contribution to the Paper	Assisted with manuscript editing		
Signature	Signed by D. Dorstyn (PGC) on behalf of	Date	13.2.20

Abstract

The current study investigated perceptions of and engagement with the concepts of planning and problem solving, within a weight management sample. Fifty three participants (62% female, 20-74 years old) completed a semi-structured interview and quantitative measures after a 16-week weight maintenance period. Preliminary weight maintainers (who had maintained losses of, at least 10% of their original weight) were compared with heavier-than-baseline participants (who had re-gained more weight than was originally lost). Maintainers exhibited stronger problem solving skills ($p < .05$). Heavier-than-baseline participants tended towards non-rational problem solving styles. Qualitatively, maintainers described more planning events and were more accepting of mistakes than heavier-than-baseline participants. Implications are discussed.

Introduction

The health benefits associated with weight loss in obese individuals are considerable. According to the US Institute of Medicine (Thomas, 1995), even modest weight losses can lead to decreased blood pressure (and thus lower risk for hypertension), reduced high blood glucose levels (and thus lower risk for diabetes), lower levels of cholesterol and triglycerides (associated with cardiovascular disease), reduced sleep apnoea, risk of osteoarthritis in weight bearing joints and depression (Stern et al., 1995). As obesity is associated with significantly increased morbidity and mortality, and as the prevalence of obesity is high, cultivating techniques for successful weight maintenance is a priority in health research (Hill et al., 2005). Despite the development of efficacious weight loss treatments, long-term success in weight management is rare (Jeffery et al., 2000; Perri, 1998) and difficult due to a number of common barriers, (e.g. work

commitments, self-motivation and eating habits) (Gupta, 2014). Appropriate criteria for successful weight maintenance have been investigated in previous research and subsequently defined as a weight loss of at least 10% of initial body weight, sustained for a time period of at least one year (Wing & Hill, 2001). According to these criteria, it is estimated that only 20% of people attempting to maintain their weight losses are successful (Wing & Hill, 2001).

Current literature suggests that successful weight maintenance may be associated with good planning and problem solving skills, which facilitate the establishment of healthier habits. Planning strategies such as the formation of action plans or implementation intentions can be used to facilitate intentional action (Gollwitzer & Sheeran, 2006). With repeated action, healthy habits may be built over time and such planning strategies have been successfully used to create intentional healthy habits and to increase healthful eating (Chapman & Armitage, 2012; Sheeran et al., 2005). These strategies have also been used to erode unwanted, unhealthy habits over time (Holland et al., 2006) although it is widely acknowledged that stronger habits require more repetition, time and effort to erode (Webb et al., 2009). According to Gollwitzer et al., (2009) high quality or more detailed plans lead to more successful and less cognitively taxing action.

Problem solving skills may also be useful for weight maintenance. Problem Solving Therapy (PST;Nezu et al., 2013) involves education and skill building in five key processes: (a) developing a definition and understanding of the problem, (b) generation of possible solutions, (c) deciding on a single appropriate solution to trial, (d) planning and implementing that solution and (e) the evaluation of its success or failure to inform subsequent future planning. PST has formed the basis of successful interventions that assist people in both weight loss (Murawski et al., 2009) and maintaining their weight afterwards (Perri et al., 2001).

Interventions using planning and/or problem solving have demonstrated preliminary success in helping people to maintain behaviours related to weight management (e.g. Carels et al., 2010). In addition, qualitative studies have consistently found differences between weight maintainers and re-gainers in the way that they plan and problem solve (Kayman et al., 1990; Kitsantas, 2000; Stuckey et al., 2011), further supporting the importance of these constructs. According to Kayman (1990), maintainers were more likely to approach their problems directly and to develop personalised strategies to help themselves than re-gainers. Similarly, Kitsantas (2000) found that maintainers used more strategies than re-gainers and specifically that they used more goal-setting, self-monitoring and evaluation, time management and environmental structuring than re-gainers. Stuckey et al. (2011) has further noted that maintainers planned meals, tracked calories and their weight loss progress more than re-gainers.

Finally, previous research has suggested that there may be differences between maintainers and re-gainers in terms of their thinking styles and coping strategies (Elfhag & Rosser, 2005). Dichotomous thinking (also known as "black and white" thinking) relates to a thinking style that is characterised by concrete, fast and often extreme dichotomous judgements (Berlin, 1990), and has been linked to an increased incidence of weight re-gain in previous work (Byrne et al., 2003; Byrne et al., 2004; Kayman et al., 1990; Palascha, van Kleef & van Trijp, 2015), as well as poorer mental health outcomes (Dove et al., 2009). According to Byrne (2002) and Kayman et al. (1990) the coping strategies favoured by re-gainers tend to be more emotion-focussed and less direct or problem-focussed than those favoured by maintainers (Byrne, 2002; Kaymen, 1990).

In summary, research suggests strong planning and problem solving skills can facilitate healthful habit development, which assists longer-term weight management. Thinking style (such dichotomous thinking) and coping style (i.e.

utilising primarily problem-focussed, emotion-focussed or avoidance-focussed strategies to cope with difficulty) have also been identified as relevant factors.

However, the meaning and value that people attempting weight maintenance, place on the constructs of planning, problem solving, habit formation, coping and thinking styles remains largely unknown. Similarly, the extent to which would-be weight maintainers effectively understand, engage with and implement the principles behind problem solving, planning and habit-formation without formal education and support also remains largely unknown. As weight losses are rarely sustained over time (Jeffery et al., 2000; Perri, 1998), it may be that planning, problem solving, problem-focussed coping and flexible thinking are undervalued. Indeed, popular opinion often emphasises willpower, avoidance of social eating or other approaches which have been shown to be difficult to sustain in the long-term (Mann, 2015). Those attempting to maintain weight loss may also face as yet unidentified barriers that prevent effective strategies from being implemented. Gaining insight into these matters has important implications for future health interventions.

The aims of the current study were three-fold. The first aim was to undertake a qualitative investigation into perceptions around weight management and the relative importance placed on planning and problem solving. The second aim was to further investigate the previously documented differences between maintainers and re-gainers by quantifying participant skill-levels in planning, problem solving, coping, levels of dichotomous thinking and the strength of existing habits around unplanned eating to investigate any congruence with the qualitative accounts. Finally, the third aim was to determine any additional underlying differences that may exist between preliminary weight maintainers and re-gainers, including an investigation into differences in dichotomous thinking. Specifically, it was hypothesised that participants who maintained their weight

losses over the course of the study would have stronger problem solving and planning skills, would use problem-focussed coping strategies, would have less dichotomously-oriented thinking styles and weaker habits around unplanned eating than those who re-gained weight.

Method

Participants

Ninety four participants were approached for recruitment, all of whom were starting a phase of weight maintenance (Brindal et al., 2016). Participants had just completed the first 12 weeks of a meal-replacement-based weight loss trial, which comprised of a weight loss phase, including face-to-face appointments and electronic support via a mobile phone application, followed by a 12 week free-living (i.e. normal routine, without further appointments, or support) weight maintenance phase. The original trial was a randomised controlled study designed to compare two psycho-educational mobile phone applications (Brindal et al., 2016), however, the core weight loss program was the same for all participants.

Fifty three participants were recruited. On average, participants recruited to this study lost *M* = 7.32kg (*SD* = 6.38kg) throughout the active phase (first 12 weeks) of the weight loss trial. The final sample contained 20 men and 33 women, who ranged in age from 20 to 74 years (*M* = 51.12 years, *SD* = 10.91), and weighed between 58.90 and 151.60 kg (*M* = 94.09, SD = 18.51). This sample was comparable to the wider participant pool of the weight loss trial and did not differ greatly in terms of weight loss or age.

Recruitment

Participation was voluntary and the study was presented as a follow-up appointment for participants to give feedback on their experiences in the weight

loss trial. Participants were approached for recruitment after 12 weeks of active weight loss, and the study appointment took place 16 weeks later (12 weeks free-living within the trial, plus 4 weeks after trial – all weeks were identical with regards to maintenance non-intervention/treatment). In light of this timescale, participants in our study are best thought of as showing only preliminary signs of their future weight management and possible trajectories (e.g. weight maintenance vs. weight regain), rather than being definitive maintainers or re-gainers – especially as the definition of successful weight maintenance requires at least a period of at least one year (Wing & Hill, 2001). Interested parties gave informed consent and made an appointment for the present study after the conclusion of the weight loss trial. Eligibility criteria included being over 18 years of age, English speaking and having participated for the full duration of the 24-week weight loss trial. All participants received a $20 grocery voucher for their time.

Design and procedure

A mixed methods approach was used. All participants took part in both the qualitative and quantitative components. At their appointment, participants were weighed and completed a 40-minute semi-structured interview, which focused on their weight management experiences and included questions about planning, habits and their importance in weight management , as well as feelings of success/failure, current habits, coping, problem solving strategies and plans for future weight management. Participants then completed a survey containing quantitative measures.

Participants were divided into three weight categories for analysis: (1) ‘maintainers’ comprised participants who had lost and maintained a loss of at least 10% of their baseline (beginning of the weight loss trial) weight (n = 10); (2) the ‘heavier-than-baseline’ group comprised participants who weighed more than

their baseline weight (n = 11), and (3) the 'others' group comprised the remainder of participants who had lost and maintained between 0-9% of their baseline weight (n = 32). It should be noted that the "maintainer" category represents participants who were highly successful in losing a clinically significant amount of weight and maintaining this loss. Similarly, the heavier-than-baseline group represents participants who were unsuccessful in their aims to lose weight and by the end of the study period, weighed more than when they started. These stringent criteria were deliberately adopted in light of the relatively short timescale of the maintenance period – as weight maintenance is generally considered successful after a year or more, rather than within months, it was reasoned that stringent criteria for the two comparison groups would maximise the integrity of results based on current weight trajectories.

Measures

The *Social Problem Solving Index-Revised* (SPSI-R) is a 52 item self-report measure of problem solving ability (D'Zurilla et al., 2002). Participants endorse statements on a 0-4 Likert scale (0 = *Not at all true of me*, 4 = *Extremely true of me*). The measure yields an overall ability score as well as scores for three problem-solving subscales: Rational, Avoidant, and Impulsive/Careless (Cronbach α = .96, .77, and .85 respectively). Two subscales also capture the participant's general approach to problems: Positive Problem Orientation and Negative Problem Orientation. Due to skewness, a log transformation was performed on the Avoidance Style and Negative Problem Orientation subscale (Field, 2005). This considerably improved the explanatory power of the variables and therefore their transformed versions were used in the analysis. All other scales were used untransformed.

The *Coping Inventory for Stressful Situations: Situation Specific Coping* (CISS:SSC) is a 21 item self-report measure of coping strategies used by participants in response to a specific situation (Endler & Parker, 1999). The present study asked participants about coping responses to the stresses of their weight loss journey. Participants rate common strategies on a 1-5 Likert scale, indicating the frequency of that strategy's usage (1 = *Not at all*, 5 = *Very much*). The measure yields scores on 3 coping-strategy subscales: Task-oriented, Emotion-oriented and Avoidant-oriented (Cronbach $\alpha \geq .77$)

The *Self-Reported Habit Index* (SRHI) is a self-report 12-item questionnaire (Verplanken & Orbell, 2003) capturing the single construct of habit-strength. The scale requires the nomination of a single behaviour (e.g. unplanned eating) and captures the degree to which this behaviour occurs habitually. This scale has successfully captured habit strength across a wide range of health behaviours in previous studies, including smoking, binge-drinking, physical activity and food and beverage consumption (Chatzisarantis & Hagger, 2014; Orbell & Verplanken, 2010; Lally, Van Jaarsveld, Potts & Wardle, 2010). Participants endorsed statements about unplanned eating habits on a 0-4 point Likert scale (0 = *strongly agree*, 4 = *strongly disagree*) ($\alpha = .87$).

The *Dichotomous Thinking Inventory* (DTI) is a 15-item self-report measure which captures the degree to which a person exhibits a dichotomous thinking style (Oshiro, 2009). This scale captures a single construct, and measures the extent to which a global dichotomous thinking style is present. It does not attempt to capture domain-specific dichotomous cognitions. Participants rate statements on a 1-6 point Likert scale, (1 = *strongly disagree*, 6 = *strongly agree*) ($\alpha = .87$).

The *Goal-Setting Evaluation Tool for Diabetes* (GET-D) is a measure of plan quality, and was designed to assist self-management in diabetes (Teal et al.,

2012).The GET-D is applied by clinicians to a participant plan after it has been written in detail, and assigns points to the plan based on a series of questions. A score of overall plan quality is yielded (0-26), where higher scores indicate a better quality plan. Inter-rater reliability was acceptable (Kappa = 0.66).

Analysis

Qualitative data

Interviews were audio recorded and transcribed for the purpose of thematic analysis (Braun & Clarke, 2013). The data was approached from a positivist, realist perspective and was analysed in two phases. The first phase included transcriptions from all participants and aimed to identify commonalities in weight management experience and constructs of interest. Two cycles of coding were conducted, before a first analysis was produced, as per the recommendations of Saldana (2013).

The second phase of qualitative data analysis involved identifying and comparing the accounts of the maintainer and heavier-than-baseline groups on the theoretical basis that any differences in the constructs of interest would be most pronounced in the accounts of participants with the most extreme maintenance outcomes. This phase of analysis aimed to explore any differences that may exist between the two groups as per the study's aims.

Quantitative data

Using *t*-tests, quantitative analysis investigated corroborating or contradictory trends found in the qualitative data. The two groups compared were the maintainer and heavier-than-baseline groups, and *t*-tests were performed for the overall measures and subscales of the Social Problem Solving Inventory –

Revised, the Coping Inventory for Stressful Situations – Situational Specific Coping, the Self-Reported Habit Index, the Dichotomous Thinking Inventory and the Goal-Setting Evaluation Tool for Diabetes.

Results

Qualitative commonalities across all participants

Participants generally described planning positively and as helpful to their overall ability to manage weight. However, accounts of why or how it was useful tended to be sparse, and further questioning was usually required. Participants had trouble defining planning as a concept and often required time to think before responding, using concrete behavioural examples instead of conceptual terms and appeared to form their opinions as they spoke, rather than from an explicit knowledge base:

",Um, just being organised I guess, yeah it's, um. It's tricky planning, um, I just thought planning was planning, I didn't know I had to elaborate on planning more, but yes, um".-Maintainer Male, participant #50 (see Supplementary Materials[1] (SM), Table 1, "Defining Planning"

Regardless, planning was constructed as increasing chances of success, and the adage, "if you don't plan, you plan to fail" arose in several interviews. This was presented as the evidence that planning was important:

[1] See Appendix B (Tables 1 and 2) for further examples and full versions of all illustrative quotes used.

" it's, a definite, yeah! (laughs) Very, very, very important, 100% important… but if you, if you fail to plan, you plan to fail."-Maintainer, female, #97 (SM Table 1, Planning Importance).

Participants were aware that building new, healthy habits can be an effective maintenance strategy and also described their new routines slipping in times of stress:

"Um, when you have stress, yeah, it's easy to grab a chocolate (laughs)." – Female Heavier-than-baseline, #6 (SM Table 1, Bad habits and mistakes)

Despite this insight, participants consistently under-estimated the impact that future stress could have on their behaviour:

"I don't think there's going to be a problem for me, um, because yeah, I think we've sort of dealt with lots of fairly difficult and sticky situations" – Female, Maintainer, #81 (SM Table 1, Stress coping)

and often espoused confidence that experience (as above) and/or willpower (as below) would be sufficient resources for them to maintain their healthy behaviours in times of stress:

"I think ultimately, you just have to do it. You've just gotta get into that routine, and, just do it, and say no to stuff." –Female, Heavier-than-baseline, #130. (SM Table 1. Stress coping)

Differences between maintainers and heavier-than-baseline groups

When maintainer and heavier-than-baseline accounts were compared, maintainer accounts contained a higher frequency of planning events, giving frequent concrete examples from their everyday lives (eg. "*I'd work out exactly how many calories um, 6 jellybeans are and I'd put them in a, in a snaplock bag*" – Male Maintainer, #50), compared to heavier-than-baseline accounts, suggesting that they may implement more of these behaviours.

Maintainer participants also described reassessing their plans when they encountered problems, frequently identifying and reflecting on their stumbling blocks and adjusting their plans:

"I know that I am, I find it very difficult to restrict myself with nuts… So I sat down and I made bags, little plastic bags of 10 peanuts" – Maintainer Female, #9 (SM Table 2, Problem Solving)

In contrast, heavier-than-baseline participants rarely reflected on or adjusting plans that hadn't worked previously and reiterated their desire to try the same plan again in the future with more willpower.

"I'm motivated now to do it, to continue doing it, I got to... you know, somehow force myself to do it and. I don't know." – Male, Heavier-than-baseline, #126 (SM Table 2, Problem solving)

Both maintainer and heavier-than-baseline participants reported breaking their diets at times, but maintainers described their mistakes differently to the heavier-than-baseline accounts. Maintainer participants tended to express less regret and tended not to think as badly of themselves afterwards as a result. Rather, they seemed to reflect on their past actions with acceptance and resolved quickly to make

better decisions in the present. Maintainers expected to make mistakes in the future and were comfortable talking about this, as is evidenced in the three quotes below:

if you try to be perfect all the time I think you kind of set yourself up for failure. – Female Maintainer, #97 (SM Table 2, Handling mistakes)

You've got to be kind and caring to yourself. That that, that is, it's a difficult and it's really hard to learn... That's what you've got to do. – Female Maintainer, #133 (SM Table 2, Thinking style)

well, you're being kind to yourself really, more than anything. And getting straight back on, not waiting until – 'cause quite often you'd say, "well next week" or "after this important occasion" or- and straight away – Female Maintainer, #133 (SM Table 2, Getting back on track)

Heavier-than-baseline participants tended to express negative viewpoints of themselves when describing a mistake (e.g. "*I'm weak. I think I'm weak*"- Female Heavier-than-baseline, #130, SM Table 2, Handling Mistakes) and evidenced less acceptance of their behaviour. They often attributed their mistakes to internal character flaws rather than considering alternative explanations (such as an unrealistic or unworkable plan, the difficulty of their task, or the inevitability of some mistakes). The sense that heavier-than-baseline participants made of their mistakes tended to include judgements which were often dichotomously oriented around notions of success versus failure:

For me, I'm the kind of thinker that's like "oh well, that's a failure again" and, then it starts to snowball, downhill. – Female, Heavier-than-baseline, #27 (SM Table 2, Thinking style)

Heavier-than-baseline participants also tended to resolve to make better decisions starting from a later point in the future:

I need a kick in the bum and then I'll get back onto the train again. After Christmas. Get over this heat, maybe. – Female, Heavier-than-baseline, #87(SM Table 2, Getting back on track)

Quantitative results

Comparison between maintainers and heavier-than-baseline

Significant differences were detected between the Maintainer and Heavier-than-baseline groups on the Impulsive/Careless Problem Solving Style and Total Problem Solving ability (Table 2). This difference was such that the maintainer group scored significantly higher on Total Problem Solving Ability, and significantly lower on the Impulsive/Careless Problem Solving Style than the heavier-than-baseline group. The difference between the two groups also trended towards significance on the Avoidant Problem Solving Style composite scale and Habit Strength – such that the heavier-than-baseline group tended to score higher on both the Avoidant Problem Solving Style, and Habit Strength scales than the maintainer group.

Table 1.

Means (Standard Deviations) for Maintainers (n = 10), Heavier-than-baseline (n = 11) and Total participants (N = 53) and difference between means of Maintainers (n = 10), and Heavier-than-baseline (n = 11) participants

Construct	**Maintainers M*(SD)***	**Heavier-than-baseline *M(SD)***	**Total *M(SD)***	***t(19)***	***p***	***d***	***95% CI***
SPSI-R: Negative Problem[a] Orientation	6.10(3.81)	9.36(5.18)	10.94(7.59)	*1.96*	.660	0.717	-.600, .0197
SPSI-R: Positive Problem Orientation	13.60(3.53)	11.27(4.58)	11.85(3.97)	*1.29*	.212	0.570	-1.441, 6.095
SPSI-R: Problem Definition and Formulation	12.70(4.87)	10.55(3.37)	11.70(3.84)	*1.19*	.251	0.513	-1.650, 5.959
SPSI-R: Generating Alternative Solutions	12.70(5.44)	11.00(4.78)	11.66(4.45)	*0.75*	.455	0.332	-2.964, 6.364
SPSI-R: Decision Making	12.00(5.16)	9.82(3.87)	11.13(4.12)	*1.10*	.284	0.478	-1.960, 6.323
SPSI-R: Solution Implementation and Verification	10.90(5.49)	9.64(5.12)	10.00(4.63)	*0.55*	.592	0.237	-3.582, 6.109
SPSI-R: Problem Solving Style: Rational	48.30(20.50)	41.00(16.11)	44.49(16.04)	*9.12*	.373	0.396	-9.455, 24.055
SPSI-R: Problem Solving Style: Avoidant[a]	4.90(3.96)	6.91(2.26)	7.43(4.58)	*2.08*	.059	0.623	-0.496, 0.111
SPSI-R: Problem Solving Style: Impulsive/Careless	**6.10(4.70)**	**12.73(5.78)**	**10.83(6.63)**	***2.86***	**.010****	**1.257**	**-11.471, -1.783**
SPSI-R: Total Problem Solving Score	**15.22(2.05)**	**13.11(2.22)**	**13.35(2.60)**	***2.25***	**.036***	**0.988**	**0.149, 4.064**
DTI: Dichotomous Thinking	53.30(5.38)	57.00(12.95)	54.55(10.23)	*0.84*	. 412	0.373	-12.936, 5.536
SRHI: Habit Strength	3.70(2.75)	6.45(3.45)	5.42(3.58)	*2.00*	.060	0.881	-5.638, .128

GET-D: Plan Quality	10.44(3.97)	11.20(3.33)	11.21(3.42)	*0.45*	.658	0.21	-4.289, 2.778
Coping: Task Oriented	28.00(4.52)	26.82(5.44)	26.60(4.19)	0.63	.536	0.24	-3.211, 5.975
Coping: Avoidant Oriented	19.50(6.50)	22.73(4.45)	20.53(5.59)	-1.34	.197	0.58	-8.274, 1.820
Coping: Emotion Oriented	16.20(5.27)	20.27(2.27)	19.23(5.87)	-1.77	.093	1.00	-8.893, 0.749

* indicates significance at the $p = .05$ level
** indicates significance at the $p = .001$ level
[a]Negative Problem Orientation and Avoidant sub-scales of the SPSI-R were transformed due to positive skew, as per the recommendations of Field (2005). Please note that mean and standard deviation data is presented untransformed, for ease of interpretation.

Discussion

The broad aim of this study was to investigate perceptions of planning, problem solving and psychological constructs related to weight maintenance, as well as to investigate underlying differences between preliminary weight maintainers and those who regained more than their originally lost weight. Qualitatively, planning was perceived positively, and was described as a kind of common-sense practice; participants were aware that effective planning was necessary for long-term weight maintenance. However, participants had not thought deeply about what planning was or how to effectively implement it. When comparing maintainer with heavier-than-baseline accounts, maintainers also described a higher frequency of concrete planning activities and reported that they engaged with these activities regularly. Heavier-than-baseline participants espoused the importance of planning but either reported not engaging, disclosed fewer examples or did not disclose examples at all, suggesting that one of the differences between longer term maintainers and re-gainers may be differential engagement with planning strategies.

This notion was not supported by the quantitative data however, as there was no significant difference in plan quality between the maintainer and heavier-than-baseline groups as measured by the GET-D. The GET-D is a new tool designed to measure the quality of plans related to both diet and exercise within diabetic populations. As our participants were taught only diet strategies, and as floor effects were found for some of the criteria (particularly around the question of action "intensity", which is largely inapplicable to diet-based actions) it may be that a modified, more diet-oriented version of the GET-D would be more sensitive to the plans of this population and appropriate for future research. It may also be that plan quality is a less appropriate measure than one of overall engagement with planning, since the main qualitative difference between maintainer and heavier-than-baseline groups was the *amount* of concrete planning strategies described. Participants may have differed more in the extent to which they engaged in planning their strategies, rather than the overall quality of the strategies they employed.

Concurrent evidence across qualitative and quantitative measures was found regarding differential engagement in problem solving across maintainer and heavier-than-baseline participants. Specifically, we found that our maintainer group exhibited stronger overall problem solving skills and that heavier-than-baseline participants tended towards both of the non-rational problem solving styles: Impulsive/Careless and Avoidant. This provides quantitative support for our qualitative findings; that maintainer accounts held more reflective styles of thinking (particularly around mistakes), and developed more individualised coping strategies for their points of difficulty. Difference in weight outcomes may be partially due to underlying differences in problem solving. However, as all data was collected at a single time point, one of the limitations of this study is that it cannot infer causation. More research is needed to understand these differences

and assessing problem solving skills prior to phases of weight maintenance will provide further insight into the relationship between problem solving skills and weight-maintenance trajectories.

Interestingly, one of the emergent findings from the qualitative analysis was that the maintainer group described mistakes differently to those in the heavier-than-baseline group. Mistakes in the maintainer group were described in a manner that appeared to be less dichotomously oriented around success or failure and a subsequent judgement of self. Instead, maintainers tended to describe their mistakes as acceptable, inevitable and/or as necessary for future learning and they were more forgiving of these mistakes when they occurred. The direction of the relationship between weight maintenance and this difference in handling mistakes remains unclear; it is possible that this lack of judgement and acceptance of mistakes may have made it easier for maintainers to troubleshoot their weight management problems more directly, honestly and/or thoroughly. However, it may equally be that stronger problem solving skills somehow foster a lack of judgement and acceptance within the self and future research is needed to understand how these concepts impact on one another.

Quantitative differences in thinking style were not significant, as measured by the DTI. This suggests that the qualitative difference found in how our maintainer and heavier-than-baseline participants handled mistakes, although possibly related to a thinking style, may not be best captured by the dichotomous thinking construct, and future research may wish to investigate alternative thinking styles and constructs. Given that qualitative differences in dichotomous thinking have been repeatedly found in previous research (Byrne, Cooper, & Fairburn, 2003; Byrne, 2002; Byrne, Cooper, & Fairburn, 2004; Kayman, Bruvold, & Stern, 1990), it is worth considering that the current study was powered to detect only large effect sizes due to the sample size (Cohen, 1988).

It should be noted that the data were repeatedly tested via multiple *t*-tests. However, as the measures involved were considered distinct, the alpha level was not amended or made more conservative than $p = .05$, as would be appropriate for repeated testing on highly related constructs. Finally, participants in the current study had attempted weight maintenance for a relatively short period of time (4 months). Nevertheless, our data offers good preliminary evidence that those who are able to maintain weight losses without active intervention or support, over a period of months, are those who are prone to being accepting of their mistakes and who have stronger planning and problem solving skills.

Conclusions

The current study found that participants who initially maintained clinically relevant weight losses showed significantly stronger problem solving skills than participants who re-gained and weighed more than their baseline weight over the same period. Participants who became heavier than their baseline weight also tended towards the two non-rational problem solving styles: Impulsive/Careless and Avoidant styles.

All interviewed participants indicated that planning was important for weight maintenance. Future interventions should emphasise planning and problem solving and should explicitly teach how to implement planning and problem solving, as well as provide opportunities for skill-building in these areas.

Chapter 3: Theoretical Basis for Studies Two and Three

3.0 Introduction

This chapter outlines the rationale for studies 2 (Chapter 5) and 3 (Chapter 6). As described in Chapter 1, the overall aim of this thesis is to examine the context in which good planning occurs, while using a definition of planning as an ongoing cycle, rather than a single linear process. In Chapter 2, study 1 of the thesis was described. Planning was investigated in a sample of people attempting weight maintenance and the importance of continual planning and problem solving was reported. The importance of constructs akin to self-compassion also emerged as being important, especially when responding planfully and constructively to lapses and mistakes.

The aim of the second study was to pilot a short (2-week), email-based, and minimally-resourced intervention, and investigate whether it could produce higher levels of mindful eating and self-compassion, and lower levels of snacking habit strength. The term 'minimally resourced' is used informally here and simply refers to minimising the use of any costly resources or contact time with professionals, for ease of replication and further development. The intervention targeted unwanted snacking habits using a mindful eating exercise, described in further detail below.

The aim of the third study was to explore the predictors of behavioural change following the intervention– including a preliminary investigation into whether self-compassion might also have predictive value, alongside planning and problem solving. In particular, Study 3 aimed to investigate whether degree of self-compassion, action planning, problem solving, and coping style predicted

intentions to continue behavioural change (in this case, the mindful snacking exercise) following the intervention.

3.1 Theoretical Background and Rationale for Study 2 and 3

3.1.1 Summary of the thesis findings so far.

So far, this thesis has established that obesity is a serious health issue and that long-term weight loss maintenance outcomes need improvement. The literature on planning and problem solving has been defined and summarised, identifying important constructs in weight loss-maintenance. Gaps in the literature have been identified and the primary aim of this thesis has been presented – to gain a deeper understanding about the context in which good planning occurs.

The study conducted in Chapter 2 found that amongst participants attempting weight loss-maintenance, planning was perceived as being universally important, and that maintainers evidenced both more frequent use of planning strategies, and stronger, more rational problem-solving styles. The results in Chapter 2 also revealed a surprising difference in the way that maintainer and non-maintainer groups approached their mistakes; maintainers tended to be more accepting of mistakes and described them as being a valuable part of the learning process. Participants who regained all their previous weight losses on the other hand, were frequently judgemental and self-denigrating when describing their mistakes, and reported finding them demotivating. Interestingly, this difference was not quantitatively represented by the Dichotomous Thinking Inventory (Oshio, 2009), suggesting that something other than a globally black-and-white thinking style may be at play.

This differential approach to mistakes has important implications. As weight maintenance is a lifelong task, small-scale mistakes and failures are eventually inevitable. This is very different to the weight loss phase. Weight loss often takes place within a structured, time-limited framework, and has an eventual end-point, making it a temporary way of being. Some practices which are eventually demotivating and detrimental to performance in the long-term may be functional enough to allow for weight loss in the short-term – for example, Thomas, Hyde, Karunaratne, Kausman, and Komesaroff (2008) found in a series of qualitative interviews that self-blame for failures was evident among participants who had originally succeeded in achieving weight loss. Similarly, in an exploration of coping strategies used over a 6 month period by overweight participants, Conradt et al. (2008) found that feelings of guilt predicted engagement in problem-focussed engagement strategies as well as dietary restraint. Weight loss maintenance may be so difficult compared to initial weight loss, in part, because in order to successfully maintain a new lower weight, one may need a healthy, comfortable relationship with inevitable small-scale failures. It may be necessary to use the presence of these failures to honestly recognise and address them, in order to avoid larger ones. Therefore, while weight loss may be attainable without a need for a comfortable relationship with failure, it may be very difficult to sustain without it.

3.1.2 Two new variables: self-compassion and mindfulness.

As this relationship with failure appeared to be qualitatively significant and as the quantitative measure of dichotomous thinking did not capture the underlying construct, further reflection upon participant accounts was required. Two variables of interest began to emerge from both the interview data and from published literature as worthy of investigation. The first of these is self-

compassion. Self-compassion is described as being a non-judgemental awareness of one's own suffering, whilst simultaneously generating the desire to alleviate this suffering with kindness (Neff, 2003b). It consists of three main components: (a) self-kindness, the extension of kindness to one's self, in the place of harsh judgement or criticism, (b) common humanity, the contextualising of one's own experience as part of the larger human experience, rather than seeing it as separating or isolating, and (c) mindfulness, the holding of one's painful thoughts and feelings in balanced awareness, without over identifying with them. This definition appears consistent with our maintainer participant group, who evidenced less self-blame or criticism and who described being "only human" as they recounted their mistakes. In previous research, self-compassion has been linked to greater overall motivation towards self-improvement and persistence in the face of academic failure (Breines & Chen, 2012; Shimizu, Niiya & Shigemasu, 2016; Neff, Hsieh, & Dejitterat, 2005), and appears to be negatively correlated to fear of failure (Neff et al., 2005). Neff et al. theorise that self-compassion facilitates the learning process by freeing individuals from fear of harsh internal consequences (e.g. self-criticism and feelings of isolation) and instead providing them with a sense of self-kindness, common humanity and emotional balance derived from a mindful approach. They further posit that this helps people to focus on mastering tasks at hand rather than worrying about performance evaluations, to retain confidence in their own ability even after negative feedback, and to foster intrinsic motivation. This seems to also match participant accounts in study 1 (see Chapter 2) of learning from mistakes rather than engaging in self-judgement. In short, self-compassion appears to be a strong candidate for further investigation as a positive predictor of continued engagement after setbacks in weight-maintenance.

The mindfulness component of self-compassion is also interesting and deserves further investigation as a variable of interest in and of itself. While Neff (2003b) describes mindfulness as the holding of one's painful thoughts and feelings in balanced awareness, the originator of much of the mindfulness literature, Kabat-Zinn (2003) describes mindfulness as a more general practice which involves "paying attention, on purpose, in the present moment, and non-judgementally" (Kabat-Zinn, 2003, p. 145). This definition of mindfulness can include awareness of one's full experience (not only of painful thoughts and feelings, but of all thoughts feelings, as well as physical sensations). This non-judgemental awareness theoretically facilitates a sense of honest curiosity about one's experience and encourages acceptance of whatever that curiosity reveals. This also allows for physical sensations and internal experiences such as hunger and satiety to be brought more strongly into awareness over time (Vago, 2014). Unsurprisingly, a large body of literature has further investigated mindfulness, and mindful eating. Two recent reviews conclude that there is good supporting evidence that mindfulness as a construct is supportive in decreasing binge eating episodes, emotional eating and external eating in populations engaging with these behaviours (Katterman, Kleinman, Hood, Nackers, & Corsica, 2014; O'Reilly, Cook, Spruijt-Metz, & Black, 2014). This is particularly significant given that binge eating, emotional eating and external eating are also risk factors for the development of obesity and of relapse after weight loss (Burton, Smit & Lightowler, 2007, Karmarli et al., 2013; Koenders & van Strien, 2011). In sum, both the self-compassion and mindfulness constructs appear to be suitable candidates for further investigation. Additionally, mindfulness and action planning have both been cited as helpful tools when engaging with counter intentional habits (common stumbling blocks in weight loss maintenance) (e.g. Bahl, Milne, Ross & Chan, 2013; Webb et al., 2009). Planning interacts with habit

such that in situations of low habit, planning becomes highly effective in initiating action, whereas in situations of high/strong habits that run counter to the plan, planning becomes less effective in initiating action. However, over time, planning can be used to erode the habit's mental link between stimulus and response, by creating a competing, intentional habit (Holland et al., 2006; Brewster, Elliott & Kelly, 2015). Mindfulness training can also be used to erode a habit's strength over time, but instead it does so by creating a habitual deployment of attentional resources. This interrupts the automatic execution of an old habit, allowing for the remembering and execution of an intentional action instead (Vago, 2014). Clearly there is scope for mindfulness and planning strategies to work in concert with each other to change unwanted habits and more broadly, support weight loss maintenance.

However, much of the literature has focussed on producing either a planning intervention (e.g. Veling, Koningsbruggen, Aarts & Wolfgang, 2014) or a mindfulness-based intervention (e.g. Dalen et al., 2010), with few using both strategies in concert. It remains to be seen whether the effect of combining these habit-altering strategies results in larger or more robust effects.

3.1.3 Targeting habitual snacking.

Snacking habits have been linked to overconsumption and health issues such as poorer nutrition, increased BMI (particularly in adulthood), overweight and obesity (Fay, White, Finlayson & King, 2016; Gregori, Foltran, Chidna & Berchialla, 2010; Piernas & Popkin, 2009). Traits commonly ascribed to snacks include their being higher in caloric density, being perceived as tastier and more appealing and being generally eaten in between regular mealtimes (Gregori et al., 2010). A systematic review and Bayesian analysis of 228 studies performed by Gregori et al. (2010) investigated diversity in the operationalisation of the term

'snack'. Their results suggest that although a variety of definitions have been adopted, each reviewed definition of snacking was still relevant (though to differing degrees) to the development of obesity. Snacking is commonly defined by the general populace as referring to non-meal foods eaten between mealtimes (Chaplin & Smith, 2011) and this definition was one more strongly associated with obesity (Gregori et al., 2010). Thusly, it is the definition adopted for the purposes of study 2. Snacking is often unintentional, counter-intentional and habitual (Gore, Foster, DiLilo, Kirk & West., 2003; Ohtomo, 2013); as such intervention strategies are needed to help individuals to weaken their unwanted snacking habits, bringing them more under intentional control.

In light of these findings, combined with the literature-identified need for short, low-cost interventions which can support weight-maintenance, established in Chapter 1, it seemed appropriate to pilot a short email-based intervention combining a brief mindful eating exercise with action-planning, to target counter intentional snacking habits. Study 2 investigated whether this approach could produce measurable differences in (a) mindful eating, (b) habitual snacking, and (c) self-compassion. In addition, study 2 investigated the extent to which the frequency of practicing the mindful eating exercise produced these differences.

3.1.4 Rationale for study 3 – examining the predictors of intentions to continue the mindful snacking exercise.

The overall plan quality scores in study 1, as measured by the GET-D, were low. Upon further inspection, it seemed that floor effects were observed, particularly for criterion 4d ("specify action intensity") and 4e ("specify way that action/goal achievement will be monitored"). Criterion 4d ("specify action intensity") was clearly problematic outside of an exercise-based context – for example, specifying the "intensity" with which one plans to eat strawberries

seems nonsensical. Thus the GET-D in studies 2 and 3 was adapted so that criterion 4d was better suited to the planning task ("specify snack amount"). However the low, mostly zero scores for criterion 4e ("specify way that action/goal achievement will be monitored") has important implications. These results imply that our participants did not engage in (or at least did not plan to engage in) the latter parts of the planning cycle, associated with monitoring and evaluating action. Without these crucial steps, it becomes difficult to conduct the final stage of planning, which relies on these evaluative aspects in order to effectively refine future plans, developing expertise from experience and making future plans more effective (Friedman & Scholnick, 2014). If populations interested in managing their weight consistently neglect to monitor the plan or goal progress, then they may be prone to missing valuable opportunities for learning and adjustment from the implementation phase of their plans. Theoretically, this learning and adjustment should also inform future plans and intentions (Friedman & Scholnick, 2014).

As weight loss maintenance relies not just on a single or even multiple implementations of a behaviour, but rather on ongoing behavioural routines, it is important to understand the process by which a behaviour which is newly learned becomes intentionally adopted on an ongoing basis. The question of whether plan quality (including criterion 4e) would predict participant intentions to continue with the mindful snacking exercise beyond the intervention period is pertinent to this and became the basis of study 3. Furthermore, if plan quality wasn't associated with these intentions, it became important to investigate what else might predict future intentions to continue with the mindful snacking exercise.

The notion of feedback and the impact this has on participants was also considered relevant. Participants in weight and health-related interventions are

often asked to track their own progress, or are given feedback on their performance (Burgess, Hassmen, Welvaert & Pumpa, 2017). Participants in weight-related interventions are also aware of implicit feedback cues, such as clothing size and tightness (Chambers & Swanson, 2012). Feedback has been reported to have an emotional impact on individuals which subsequently impact future intentions and behaviour (Belschak & Den Hartog, 2009). Specifically, positive feedback has been shown to increase pleasurable emotions and to increase commitment, while negative feedback increases negative or uncomfortable emotions, and can inspire withdrawal or less effortful behaviour (Belschak & Den Hartog, 2009). This has important implications for weight maintenance, as in the context of a lifelong task, exposure to some negative feedback cues becomes inevitable. It was considered that this may make self-compassion even more critical to examine further in study 3 as well. This is particularly the case as more recent work had linked it to the continued enactment of health behaviours (Dunne, Sheffield, & Chilcot, 2018; Sirois, Kitner, & Hirsch, 2015) and both persistence and greater achievement among low-income students (Conway, 2007). Furthermore, self-compassion reportedly reduces both distress and associated avoidance (Barnard & Curry, 2011), and it was suspected this may assist participants to openly reflect on mistakes, lapses or plans which had gone awry during the intervention period. It remains to be seen whether negative feedback still induces negative mood states among participants with high self-compassion and whether this moderates the impact of negative feedback on future intentions and behaviour.

Thus study 3 was designed to investigate psychological predictors of participant intentions to continue the mindful snacking exercise beyond the timeframe of the intervention.

Chapter 4: Common Methodology used in Studies Two and Three

The second and third studies presented in this thesis both draw from the same large dataset and as such, they share many aspects of their methodology. As each study addresses a different research question, the variables presented in this chapter may be used in either one or both studies. This chapter presents the methods used to collect the data for studies 2 and 3, and describes both the process of data collection and the participant journey through this process.

4.1 Participants and Recruitment

4.1.1 Recruitment.

Recruitment began two weeks prior to Easter (Friday, 31/03/2017), after attaining appropriate ethical clearance, and when concern about snacking behaviour was likely to be socially prevalent. The study was evaluated by the Human Research Ethics Committee of the University of Adelaide, and given the approval code H-2016-249 on the 10th January, 2017. Ethical approval for the continuation of the study period was given until January, 2020. The CSIRO Human Research Ethics Committee also gave the project reciprocal endorsement under the code: RR/8/2017. The study was advertised using the web-based application 'Facebook', through CSIRO recruiting channels. This means that the study appeared in the newsfeeds of all online users who had 'liked' the page. CSIRO further promoted the study using advertisements which promoted a "Mindful Snacking Study", targeted to the newsfeeds of people meeting broad inclusion criteria and who had liked popular nutrition or weight-based pages. The study advertisement was short (in line with general Facebook promotions) and contained the following message, with a picture of a few snacks:

Learn Mindful Snacking Online!

Looking for some support so you can still enjoy your favourite snacks, but in moderation? Sign up for our free online study and track your progress; see what skills you can learn in two weeks!

Limited places available: Please follow the link below for more details and to sign up:

<Link Inserted Here>

Figure 1: Message used in Online Recruitment

Interested parties were able to access the study information sheet and sign up via a supplied link in the advertisement (see Figure 1). One-hundred and seventy questionnaire licences were obtained from psychological tool supplier Multi-Health Systems, for the Social Problem Solving Inventory – Revised: Short Form (detailed in section 4.2.3). As such, no more than n = 170 participants were able to be accepted into the study. Data collection took place between 16/04/2017 and 04/07/2017.

4.1.2 Inclusion and exclusion criteria.

As the study was not designed in multiple languages, participants were required to possess enough English literacy to read and make sense of the information sheet. The information sheet was deemed to have a reading level requiring the equivalent of year 12 schooling, according to the Flesch-Kincaid Grade Level test. As the study only wished to recruit adults (aged 18 and above), this reading level was considered acceptable. Participants also required access to a personal or work computer in order to access the baseline and follow-up surveys hosted online. Mobile phone compatibility was considered, particularly as newsfeeds are available via the mobile phone Facebook application; however the electronic survey platform (SurveyGizmo) experienced significant compatibility issues with mobile phone access and these were unable to be resolved. Participants were required to be currently living in Australia, and participant access data confirmed their current location. Participants also needed to be able to identify a snack food which they wished to eat more mindfully. In order to capture a representative sample, participants were included irrespective of their current weight and BMI history. Participants were also included irrespective of their specific weight goals, provided that they identified with the desire to manage their weight or change their current snacking behaviour. Participants were screened for this via a drop-down box of options that best described participant goals for participating. Options included “I want to lose weight”, “I want to maintain weight loss” “I want to prevent weight gain”, “I wish to change my snacking behaviour”, or “None of the above”. Participants who selected “None of the above” were automatically excluded on the basis that their lack of any relevant goals would likely lead to non-compliance, or attrition.

Participants were also administered the Performance Failure Appraisal Inventory (detailed in section 4.2.3) as a screening measure to prevent distress to any participants who may exhibit an excessive fear of failure. Participants who scored more than 2 standard deviations above the norm were excluded on the basis that receiving negative feedback about their performance may cause a high level of distress. One participant was excluded on this basis.

4.1.3 Participants.

Two hundred and thirty participants initially expressed interest in the study by clicking on the study link. One hundred and fifty eight eligible participants went on to complete the baseline questionnaires. Of these, $n = 78$ also completed the follow-up measures, resulting in an attrition rate of 49.37%. Although this rate of attrition may seem high, according to Eysenbach (2005) similarly high levels of attrition (above 50%) are commonplace and to be expected when delivering eHealth and online intervention studies. A 50% attrition rate over a two week period is comparable to other eHealth interventions, is in line with Eysenbach's (2005) predictions and can most likely be characterised as a mix of both *drop-out attrition* – that is, participants who wish to withdraw, and *nonuseage dropout* – participants who have used the intervention materials for a short time, have lost interest and who opt not to fill-out their follow-up measures. The final sample consisted of $N = 78$ English-speaking Australians, aged between 20-80 years old ($M = 41.53$, $SD = 13.56$). This sample was predominantly female (12 males, 66 females), and very few participants had practiced mindful eating before ($n = 5$). When describing weight-related goals, a large proportion of the sample expressed wishes to either lose weight (71.8%; $n = 56$), or to avoid weight gain (10.3%; $n = 8$). A minority of participants wanted to maintain previous weight losses (3.8%; *n*

= 3). One person was automatically excluded on the basis that they selected “none of the above”, indicating that they had no relevant motivation for joining the study

4.2 Design and Procedure

4.2.1 Design.

The data-collection for study 2 was for a study with a within-subjects design and had two time points of data collection, as can be seen in Figure 2. However, the data-collection for study 3 required a between-subjects factor (positive/negative feedback), which was administered at follow-up, as can also be seen in Figure 2.

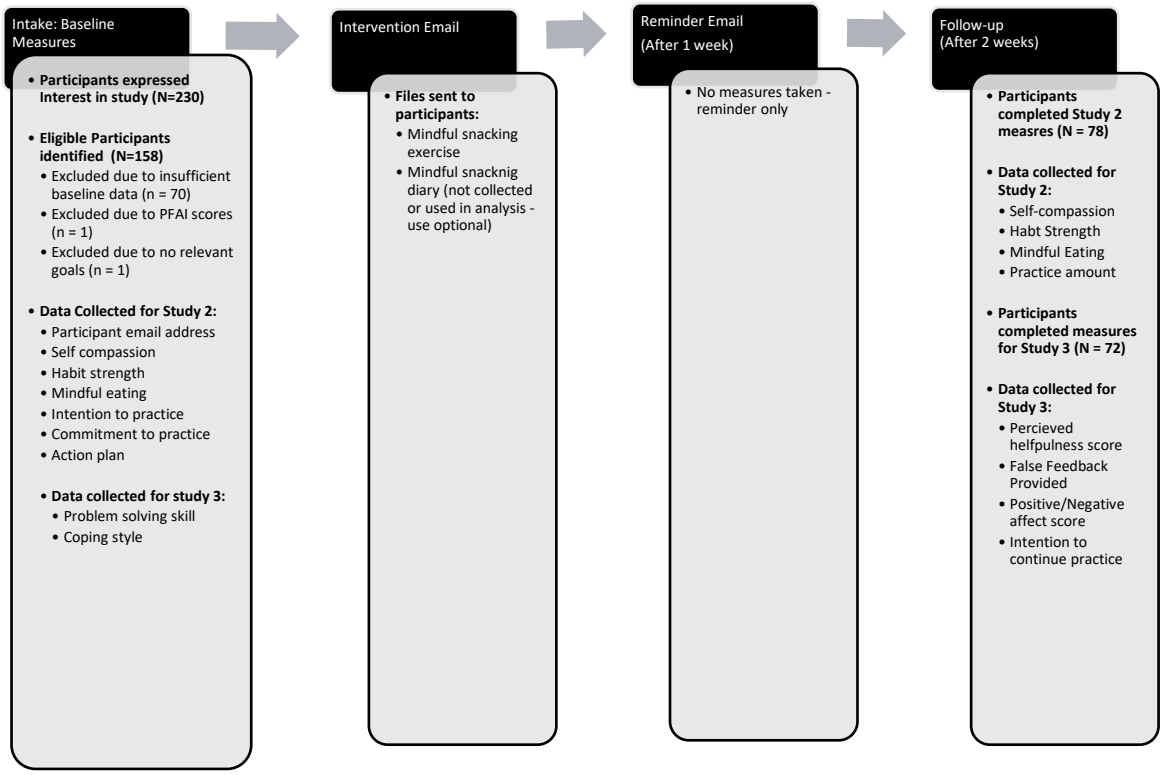


Figure 2. Chart Showing the Intervention Process, Participant Numbers and Data Collected.

Baseline measures were administered prior to participation in the intervention, intervention materials were delivered by email for participants to practice at home, and follow-up measures were administered two weeks later, after completion. Each participant's baseline score acted as their own control.

4.2.2 Procedure.

4.2.2.1 Baseline measures.

From the study link in the advertisement described above, participants accessed the Participant Information Sheet and electronically indicated their informed consent. Participants were screened for eligibility via the question regarding their goals (described above) and their scores on the Performance Failure Appraisal Inventory (Conroy, Willow & Metzler, 2002). Eligible participants were asked to supply a contact email for the study, and then completed the baseline battery of questionnaires. These included the *Social Problem Solving Inventory-Revised (Short Form)* (D'Zurilla et al., 2002), the *Self-Compassion Scale Scale* (Neff, 2003a), the *Mindful Eating Questionnaire* (Framson et al., 2009), the *Self-Report Habit Index* (Verplanken & Orbell, 2003), and the *Coping Style Inventory – Short Form* (Tobin, 2001). As action-planning is known to facilitate intentional action, (Neal et al., 2006), and as exploring the impact of plan-quality alongside self-compassion was part of the aim of study 3, participants were also asked to make an action plan to help them translate their intentions to snack mindfully into action. Participants were not coached on how to make high-quality plans; in order to capture the natural range of plan quality that emerged from participants, they were simply asked to type out, in as much detail as possible, their plan for how they would practice their mindful snacking exercise over the next two weeks. The plan was typed as free text and saved as a part of participant baseline measures. Participants were also asked, two single-item

questions to measure their strength of intention and commitment to practice the mindful eating exercise (both 0-10 response scales, (0 = 'Not very Committed/Do not really Intend', 10 = 'Very Committed/Strongly Intend'). Participants also nominated their target snack and estimated how often they consumed this snack, on average.

Participants were emailed the intervention materials after completing their baseline measures and asked to practice the exercise, unsupervised, throughout their week. As participants were likely to have a variety of differing routines and schedules, the researchers suspected that action planning would not only allow for analysis of plan quality alongside self-compassion later, but that it would help facilitate independent, and self-determined practice of the mindfulness exercise. Specifically, participants were asked to plan where, when and how they would engage in their mindful snacking.

4.2.2.2 Email contact and follow-up.

Within 24 hours of completing baseline measures, participants received identical welcome emails that contained the intervention files as attachments.

One week after completing their baseline measures, participants received identical prompter emails, reminding them that they would be asked to report back on their progress in one weeks' time.

Two weeks after completing their baseline measures, participants received a third email, asking them to report back on their progress, and containing a link to the study website. Participants signed in using the same email address they provided at baseline and completed their follow-up measures on the same SurveyGizmo website. In instances where follow-up measures were not completed, participants received up to three reminder emails, (one per week for three weeks) prompting them to complete their follow-up measures.

4.2.2.3 Follow up measures.

Follow-up measures were collected two weeks after baseline. These were also collected online via SurveyGizmo, and comprised of the *Self-Compassion Scale* (Neff, 2003a), the *Mindful Eating Questionnaire* (Framson et al., 2009), and the *Self-Report Habit Index* (Verplanken & Orbell, 2003). Participants were also asked how many times they had practiced the mindful eating exercise, and how much effort they felt they had expended while engaging in the exercise (0-10 response scale, 0 = 'Did not try to complete', 10 = 'Put in best effort'). Participants were also asked how helpful they perceived the intervention to be (0-10 response scale, 0 = 'Not at all', 10 = 'Very'). Finally, participants were presented with falsified feedback about their mindful snacking performance (see Figure 3) and filled out the *Positive and Negative Affect Scale* (Watson, Clark & Tellegen, 1988) before being asked whether or not they intended to continue practicing the mindful snacking exercise. The question about future intentions to practice mindful snacking was presented as a multiple-choice categorical question with four response options, designed to collapse into two response categories. The final two response categories represented either a clear intention to continue using the mindful snacking exercise ('Yes'), or other intentions to either cease or reconsider using the mindful snacking exercise ('No'). A multiple choice question was posed instead of a forced-choice question, to eliminate response biases associated with forced choice questions towards giving a 'Yes' response, and in line with research suggesting that answers to multiple choice questions are more reliable (Peterson & Grant, 2001). The first response option represented the 'Yes' intention category ('I will continue to address my snacking using mindful snacking to assist me'). Four alternative intentions comprised the 'No' intention category ('I will not continue to address my snacking behaviour', 'I will find another way to address my snacking without using mindful snacking' and 'I have

already thought of a new way to address my snacking and will try this instead of mindful snacking', and 'I am not sure'). The indeterminate response option, 'I am not sure' was included in line with the recommendations of Burns et al. (2008), who report that there is value in allowing participants to acknowledge uncertainty, particularly when binary response options are sought. Participants were asked to select the response category that best represented their intentions going forward.

Negative Feedback Group:

"We hope you enjoyed this exercise!

The change in your mindful eating score is below."

Your Score	22/100 Points
Passing Grade	70%
Your Result	**Did not improve**

Positive Feedback Group:

"We hope you enjoyed this exercise!

The change in your mindful eating score is below."

Your Score	87/100 Points
Passing Grade	70%
Your Result	**Improved**

Figure 3: Fabricated Feedback Presented to Participants

4.2.3 Measures.

4.2.3.1 Self-compassion scale: SCS (Neff, 2003a).

Self-compassion was measured using the *Self-Compassion Scale* (Neff, 2003a). This 26-item questionnaire measures the extent to which a person is self-compassionate, based on three fundamental principles. Firstly, extending kindness and understanding to one's self, rather than criticism or judgement. Secondly, seeing one's experiences as part of the larger human experience, rather than as isolating or separating. And finally, holding one's painful thoughts and feelings in balanced awareness, without over-identifying with them (Neff, 2003a). The scale is accordingly comprised of 6 sub-scales (self-judgement, isolation, over identification, self-kindness, mindfulness and common humanity), which can be combined to create a composite Self-Compassion Score. Participants are asked to endorse statements such as "I'm disapproving and judgmental about my own flaws and inadequacies" on a 1-5 point Likert scale (1 = 'Almost never', 5 = 'Almost always'). Negative scales (self-judgement, isolation and over identification) are reversed during scoring and each subscale yields a final score out of 5 and a total score out of 30 (which can be converted to a directly comparable score out of 5), with higher scores indicating more self-compassion. Although well-established norms and cut-offs are not yet available (Neff, 2016), scores of 1-2.5 out of 5 are generally considered low, 2.5-3.5 is considered moderate and scores of above 3.5 are considered high (Neff, 2018).

Despite the underlying theory of the scale resting on only three principles, confirmatory factor analyses conducted during the scale's construction supported the notion of 6 separate underlying factors (one for each subscale). Neff (2003a) reports that it is not uncommon for scales that contain both negative and positive items to load onto separate factors, and that this makes sense given the nature of

the factors themselves (i.e. they are not mutually exclusive, nor do low scores in one area necessarily mean high scores on the other – for instance, the absence of self-judgement is not the same thing as the presence of self-kindness). The Self-Compassion Scale has demonstrated good test-retest reliability at two weeks (r = .85 - .93 for all scales), and exhibited good scale consistency in the current study (α = .79 - .87. for all scales). It has shown good convergent validity (r = .41., p = .01) with the Social Connectedness Scale (Lee & Robbins, 1995), and the positive subscales of the Meta-Mood Trait Scale (Salovey, Mayer, Goldman, Turvey, & Palfai, 1995), which measures Emotional Intelligence (Attention: r = .43, p < .01; Clarity: r = .43, p < .01; Repair: r = .55, p < .01). It is also negatively correlated with the Depressive Experiences Questionnaire (Blatt, D'Afflitti, & Quinlan, 1976) subscale Self-Criticism (r = -.65, p < .01), consistent with self-compassion theory and expectations. Discriminant validity (r = .08, p = .23) has been established using the Narcissistic Personality Inventory (Raskin & Terry, 1988).

This scale is freely available for use by researchers and is widely used in self-compassion work, making it a strong choice of scale for work that is intended for replication or direct comparison. A recent meta-analysis and systematic review on self-compassion and psychopathology (with no restrictions on the basis of self-compassion measurement) recently identified that all 20 samples included were measured using the Self-Compassion Scale (MacBeth & Gumley, 2012). This same systematic review concluded that self-compassion as measured by this scale is associated (with a large effect size) with lower ratings of psychopathology (specifically depression, anxiety and stress). There is also preliminary evidence that women tend to score significantly worse on this scale than men, specifically on the three negative subscales (Self-Judgement, Over Identification with Emotion and Isolation) as well as the Mindfulness subscale and the Total scale

score (MacBeth & Gumley, 2012; Neff, 2003a; Neff & Dahm, 2015). Further work remains to properly establish this however, as well as to establish evidence-based norms and cut-offs (Neff, 2016).

This scale was selected partially for its strong psychometric properties, and partially due to its free availability and predominantly because it is the most widely used self-compassion scale and appears to have been accepted by researchers as the standard scale for measurement of this construct.

4.2.3.2 Mindful eating questionnaire: MEQ (Framson et al., 2009).

Mindful eating was captured using the *Mindful Eating Questionnaire* (Framson et al., 2009). This 28-item questionnaire measures the extent to which a person exhibits non-judgemental awareness of physical and emotional sensations, associated with eating. The questionnaire was based on two broad theoretical constructs, 1) Observing or noticing perceptions, thoughts and feelings, and 2) Acting with awareness. Participants are asked to respond to questions about the way in which they eat (e.g. "I notice when foods and drinks are too sweet") on a 1-4 point Likert scale (1 = 'Never/Rarely', 4 = 'Always/Usually'). The scale comprises of 5 subscales (awareness, distraction when eating, disinhibition, external eating and emotional eating) which can be combined to create a composite Mindful Eating score. Negative subscales are reversed and once scored, the subscales and the composite score all yield a total score out of 4, with higher scores indicating more mindful eating.

While well-established norms and cut-offs are not yet available, a similar sample of predominantly female (69.6%) South Australian, 18-88 year olds (Beshara, Hutchinson, & Wilson, 2013) yielded total mean scores of 2.92 (*SD* =

0.33), which is comparable to the scores derived from across seven convenience samples (M = 2.92, SD = 0.37), reported in the scale's construction paper (Framson et al., 2009). In a model including sex, race, age education and BMI, only age and BMI were associated with the MEQ summary score, indicating that this mean may be representative across gender, race and education demographics (Framson et al., 2009).

The Mindful Eating Questionnaire is comprised of 5 factors; one for each of the subscales – disinhibition, organoleptic awareness (awareness of food as detected through the senses), external cues, emotional response and distraction (Framson et al., 2009). Good convergent validity (r = .41, p < .01) with general mindfulness has been reported (Beshara et al., 2013) as measured by the Five Factor Mindfulness Questionnaire (Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006) as well as with general mindfulness skills developed through yoga practice (Framson et al., 2009). Good divergent validity has been established from general moderate intensity exercise (Framson et al., 2009).

The overall scale exhibited good reliability in the current study (α = .82), as did three of the subscales. Two of the subscales, External eating (α = .51) and Distraction (α = .68) yielded lower reliability ratings. Lower reliability ratings are more common in shorter subscales (Field, 2005) and it is worth noting that the Distraction subscale is comprised of only 3 items. After examining the individual items from each scale, the reliability ratings of both subscales were improved through the deletion of a single item each (scale items 1 and 8). These items were deleted and the new External eating (α = .63) and Distraction (α = .77) subscales were used in subsequent analyses. The alpha for remaining subscales fell acceptably between .76 and .82.

The Mindful Eating Questionnaire is freely available for use by researchers, and has been used repeatedly to investigate links between mindfulness, eating behaviours and weight (Beshara et al., 2013; Framson et al., 2009), both in cohort studies (Moor, Scott, & McIntosh, 2013) and in intervention randomised controlled trials (Kidd, Graor, & Murrock, 2013; Mason et al., 2016). Higher scores on the MEQ have been linked to eating smaller portion sizes, selection of less dense or less sweet foods and lower BMI (Beshara et al., 2013; Framson et al., 2009; Mason et al., 2016; Moor et al., 2013). A recent systematic review of 21 studies investigating mindfulness based interventions and obesity-related behaviour (O'Reilly et al., 2014) suggests that the Mindful Eating Questionnaire is only rarely used as an outcome measure in intervention studies; 1 of the 21 studies examined used this scale. Use of general mindfulness scales is more common, e.g. the Kentucky Inventory of Mindfulness Skills (Baer, Smith, & Allen, 2004), as used in the MEAL pilot intervention (Dalen et al., 2010), and do not contain items specifically referencing mindful eating. Thus this scale was selected partially for its strong psychometric properties, and partially due to its free availability but predominantly because it measures domain-specific mindfulness in the context of eating, which matches the nature of the intervention task.

4.2.3.3 Self-report habit index: SRHI (Verplanken & Orbell, 2003).

Strength of snacking habit was measured using the *Self-Report Habit Index* (SHRI; Verplanken & Orbell, 2003). This 12-item, questionnaire measures a single construct – the degree to which a particular behaviour is habitual. According to Verplanken and Orbell (2003), theory behind the item construction on this scale attends to several features thought to be associated with habitual behaviour. These are the frequent repetition of habitual behaviour, difficulty

controlling habitual behaviour, a lack of awareness when performing the behaviour, energy efficiency and a sense of identity (e.g. this behaviour is "typically me"). When administering the scale, participants are asked to endorse statements about a specific behaviour (e.g. "(Behaviour x is something…) I do frequently") by responding on a scale that has at least 5 response options (1 = 'Disagree, 5= Agree'). When scored, the scale amounts to a total score out of 60, with higher scores indicating stronger habits.

While norms and cut-off points are not yet available, previous research has identified that scores below 12.6[2] may be a suitable cut-off point, below which a repeated behaviour does not count as a habit (Lally, Van Jaarsveld, Potts, & Wardle, 2010). The SRHI is widely used and a systematic review and meta-analysis of 31 papers recently examined the Self-Report Habit Index as it relates to physical activity and nutritional activities, e.g. eating a candy or chocolate (Gardner, de Bruijn, & Lally, 2011). According to their analysis of 22 studies (all of which used the Self-Report Habit Index) the average score for nutrition-based habits in baseline and control groups (N = 4341) was 25.56[3] (95% CI = 23.706, 27.454). These results were determined using a random effects model in order to permit inferences about effects in the likely population distribution from which the studies were sampled (Gardner et al., 2011).

Factor analyses during the scale's construction supported a one-factor structure (Verplanken & Orbell, 2003). The scale has shown good one-week test-retest reliability (r = .91, p < .01). Convergent validity has been established (r = .58, p < .001) using the response frequency measure of habit (Verplanken, Aarts,

[2] Originally reported as 21, using a 1-7 point scale. Converted in-text to be consistent with a raw score out of 60, for ease of interpretation.
[3] Originally reported in percentages (M = 42.60, 95CI = 39.51, 45.69), converted in-text to a raw score out of 60, for ease of interpretation.

Knippenberg, & Knippenberg, 1994), and it is sensitive to differing habit strengths; it can successfully differentiate between behaviours which are performed on a daily versus weekly basis (Verplanken & Orbell, 2003). Good reliability was demonstrated in the current study (α = .87).

This scale is freely available for use by researchers and is widely used in habit-based literature, making it a strong choice of scale for work that is intended for replication or direct comparison. This scale was originally created in response to an identified gap in the literature; measurement of the habit construct prior to its construction was known to be difficult (Verplanken et al., 1994) and progress in the habit literature was constrained by the absence of reliable, validated measures (Gardner et al., 2011). This measure is freely available to researchers and while alternative scales are now in their infancy, the Self-Reported Habit Index remains the most popular measure of habit used (Gardner, Abraham, Lally, & de Bruijn, 2012). This scale was chosen due to its strong psychometric properties, and its free availability.

4.2.3.4 Coping style inventory (Tobin, 2001).

Coping style was measured using the 32-item *Coping Style Inventory – Short Form* (Tobin, 2001). This scale measures the extent to which a person engages in different cognitive and behavioural responses in order to manage or tolerate stress (e.g. "I spend more time alone"). Participants are asked to respond on a 1-5 point Likert Scale, indicating the degree to which they engage in this behaviour during times of stress (1 = 'Not at all', 5 = 'Very much'). The scale has a hierarchical structure and is comprised of eight subscales representing different domains of coping (problem solving, cognitive restructuring, express emotions, social contact, problem avoidance, wishful thinking, self-criticism and social withdrawal). These are combined into four second-order factors (problem-based

engagement, emotion-based engagement, problem-based disengagement and emotion-based disengagement), and then combined into two composite scores (used in the study 3, Chapter 6), capturing the degree to which a person utilises engagement and disengagement strategies.

The factor structure underlying the scale supports a two-factor structure, with the engagement and disengagement scales each being a different factor (Tobin, Holroyd, Reynolds, & Wigal, 1989). This factor structure makes sense, as in a similar fashion to the SCS, the strategies of engagement and disengagement are not mutually exclusive – e.g. it is possible to both seek social support (emotion-focussed engagement) and to engage in self-criticism (emotion-focussed disengagement). The scale exhibited good overall reliability in the current study for both the overall engagement (α = .82) and disengagement scales (α = .87). Convergent validity has been explored with the long versions of this scale and with the Social Problem Solving Inventory, and as expected, the Coping Style Inventory's Problem Engagement and Problem Disengagement subscales show good convergent validity with the Rational Problem Solving, Negative and Positive Problem Orientation subscales of the Social Problem Solving Inventory – Revised (D'Zurilla & Chang, 1995).

This measure is freely available to researchers, although it appears to be rarely used. Measures such as the Ways of Coping are more commonly used, according to systematic recent review on measurement of coping (Garcia, 2010). This scale was selected partially due to its sound psychometric properties and its free availability. Previous research has been undertaken with the Coping Strategies Inventory alongside the Social Problem Solving Inventory (D'Zurilla & Chang, 1995), also making this a strong choice, as the relationship between the two longer versions of these scales had been established and could be replicated to

provide more confidence in findings. Finally, as funding was limited, use of a non-licenced measure of coping was necessary. The Coping Strategies Inventory is a similar length to the Coping Inventory for Stressful Situations (Endler & Parker, 1999) which was used in study 1, making it an adequate substitute measure.

4.2.3.6 Social problem solving inventory – short form: SPSI-R:SF (D'Zurilla et al., 2002).

Problem solving style was measured using the 25-item *Social Problem Solving Inventory – Revised (Short Form), or SPSI-R:SF* (D'Zurilla et al., 2002). This scale captures the way in which participants respond to and resolve problems in their everyday lives, by asking respondents to endorse statements such as "I feel threatened and afraid when I have an important problem to solve". Participants endorse statements on a 0-4 Likert Scale (0 = 'Not at all true of me', 4 = 'Extremely true of me'). The measures yields an overall problem solving ability score, (used for analysis in studies 2 and 3), comprised of three subscales: Rational, Avoidant and Impulsive/Careless. Two subscales also capture the participant's general approach to problems: Positive Problem Orientation and Negative Problem Orientation. The overall problem solving score is out of 20. Scores on the Social Problem Solving Inventories (both short and long-form) are thought to be sensitive to age, and different published norms are available for young adults (17-21), middle-aged adults (40-55) and older adults (60-80), with middle-aged adults generally scoring slightly higher than other groups (D'Zurilla, et al., 2002).

The short form of the Social Problem Solving Inventory consists of the same five factor structure underlying the longer form of the scale, with one factor for each of the subscales (D'Zurilla et al., 2002), which has been successfully

replicated in recent work (Li, Waid-Ebbs, Velozo, & Heaton, 2016). It has shown good test-retest reliability after three weeks across multiple samples (total *N* = 1291) and adults of all ages (D'Zurilla et al., 2002; Kant, D'Zurilla, & Maydeu-Olivares, 1992) and exhibited good internal consistency among all the inventory's subscales: Rational Problem Solving (α = .75), Impulsive/Careless Problem solving (α = .78), Avoidant Problem Solving (α =.87), Positive Problem Orientation (α = .72) and Negative Problem Orientation (α = .77). The SPSI-R:SF is predictive of depression, anxiety, hopelessness, quality of life and suicidality, similar to the longer version of this scale (D'Zurilla et al., 2002) and is recommended for use by clinicians engaging in Problem-Solving Therapy (Nezu et al., 2013) as well as for use by researchers, particularly to track the progress in applying Problem Solving Therapy (Bell & D'Zurilla, 2009). There is some preliminary evidence that within clinical populations, women tend to score higher on the Negative Problem Orientation scale (D'Zurilla, Chang, Nottingham, & Faccini, 1998), though further replication is required to establish the validity and generalisability of this finding.

The Social Problem Solving Inventories are the intellectual property of Multi-Health Systems and must be purchased prior to use. This measure was included as it has good psychometric properties, and a similar theoretical basis to this thesis exploration of planning as a cyclic process, rather than a linear singular instance.

4.2.3.7 Goal-setting evaluation tool for diabetes: GET-D (Teal et al., 2012).

As participants were asked to record their action plans online, a measure of plan quality was derived from The *Goal-Setting Evaluation Tool for Diabetes* (GET-D). This measure of plan quality was designed to assist self-management in

diabetes (Teal et al., 2012) and is applied by clinicians to a participant's plan after it has been written in detail. The GET-D assigns points to the plan based on a series of questions (e.g. "Does the plan identify how often the action(s) will be taken?"). A score of overall plan quality is yielded (0-19), where higher scores indicate a better quality plan. As one of the criteria "intensity of action" pertains to exercise, this was adapted for our study to a "specify food amount" criteria, to better suit the nature of the task. Raw agreement (98%) and inter-rater reliability were acceptable (Kappa = 0.66).

The GET-D has shown good convergent validity with measures theoretically associated with goal-setting, such as the patient activation subscale (r = .25, p < .05) of the Patient Assessment of Chronic Illness Care (Glasgow et al., 2005), and self-efficacy (r = .38, p < .001), as measured by the Diabetes Self-Efficacy Scale (Lorig et al., 2001) as well as an expected negative relationship with the depression subscale (r = −.38, p < .01) of the Depression Anxiety Stress Scale (Lovibond & Lovibond, 1995). The GET-D has been used primarily in clinical diabetes management where it can successfully discriminate between intervention groups in goal setting interventions (Teal, et al., 2012), and was selected as it is, to the best of the author's knowledge, the only available measure of an action-plan's quality.

4.2.3.8 Performance failure appraisal inventory: PFAI (Conroy, Willow & Metzler, 2003).

The PFAI is a short, 5 item questionnaire that measures the extent to which a person experiences distress during a perceived failure. Scores on this measure are significantly related to scores on longer versions measuring the same construct (containing 25 items), and the short scale has demonstrated good convergent and divergent validity: scores on the PFAI are unrelated to fear of success and sport competence, but positively related to cognitive disruption,

somatic anxiety, worry, and total sport anxiety scores (Conroy, Willow & Metzler, 2003). The measure showed good reliability in the current study (α = .85). This measure is free for researchers to use and was adopted in this thesis to address ethical concerns regarding possible distress that may be caused by the fabrication of negative (failure/did not improve) feedback (see Figure 3). In order to address these concerns, the PFAI was used as a screening measure; participants who scored highly on the PFAI (more than 2 standard deviations above established norms) were excluded electronically from participating in the study.

4.2.3.9 Positive and negative affect scale: PANAS (Watson, Clark, & Tellegen, 1988).

The Positive and Negative Affect Scale measures both positive and negative affect. It is comprised of a list of 20 different feelings (e.g. "Interested" or "Jittery"). Participants are asked to reflect on the extent to which they are currently experiencing each feeling on a 5-point scale (1 = 'Very Slightly', 5 = 'Extremely'). The scale yields two composite scores of both positive and negative affect (each scored out of 50). Good convergent validity has been established with measures of distress and depressed mood; the positive scale is negatively related to both the A-State questionnaire (Spielberger et al., 1970) which measures responses to aversive and stressful states, and the Beck Depression Inventory (Beck et al., 1961) and the negative affect scale is positively related to both (Watson, Clark & Tellegen, 1988). Both the positive (α = .91) and negative (α = .84) composite scales yielded acceptable reliability. This measure is free for researchers to use and was adopted as a manipulation check given that the impact of feedback on future intentions is theoretically mediated by mood states (Belschak & Den Hartog, 2009).

4.2.4 Participant baseline characteristics.

The sample was highly committed to managing their weight over the next month, scoring an average of *M* = 7.55 (*SD* = 2.25) on a 0-10 Likert scale (0 = 'Not very committed', 10 = 'Extremely committed'). The sample also had moderate intentions to practice the mindful snacking techniques on a regular basis, scoring an average of *M* = 6.05 (*SD* = 0.29) on a 0-10 Likert scale (0 = 'Do not really intend', 10 = 'Strongly intend'). According to Neff (2018), self-compassion scores of 2.5-3.5 on the final 1-5 point scale are considered average in non-clinical populations, and participants also exhibited an average level of self-compassion at baseline (*M* = 3.11, *SD* = 0.78). Participants also showed average degrees of mindful eating at baseline, as measured by the Mindful Eating Questionnaire (*M* = 2.48, *SD* = 0.39), in line with the means published in Framson et al., (2009). Initial habit strength scores (*M* = 35.12, *SD* = 10.52) were in line with average estimates of 'unhealthful eating' habits from a recent systematic review (Gardner, de Bruijn & Lally, 2011). The final sample were not significantly different from participants who did not complete the intervention on any baseline measures (Table 1).

Table 1

Table of t-tests Looking for Significant Differences Between Participants who Withdrew (n = 80) and Final Sample (N = 78)

Scale/Subscale name	Mean(SD)		*t*	*p*	*df*	*d*
	Drop-out	**Active**				
Self-Compassion Scale (SCS)						
SCS - Total Self-Compassion	18.227 (4.433)	18.651 (4.719)	0.583	0.561	156	0.093
SCS - Self-Judgement	2.633 (0.891)	2.546 (0.915)	-0.601	0.549	156	0.096
SCS – Isolation	2.809 (0.989)	2.744 (1.003)	-0.415	0.679	156	0.065
SCS - Over Identification (with emotion)	2.831 (0.919)	2.747 (0.922)	-0.577	0.565	156	0.091
SCS – Mindfulness	2.753 (0.779)	2.744 (0.904)	-0.071	0.943	156	0.011
SCS - Common Humanity	2.609 (0.878)	2.747 (0.930)	0.956	0.341	156	0.153
SCS - Self-Kindness	3.138 (0.878)	3.197 (0.952)	0.412	0.681	156	0.064
Mindful Eating Questionnaire (MEQ)						
MEQ – Total Mindful Eating	-	2.484 (0.431)				
MEQ – Awareness	2.432 (0.564)	2.473 (0.540)	0.460	0.646	156	0.074
MEQ - Disinhibition	2.458 (0.582)	2.470 (0.601)	0.125	0.901	156	0.020
MEQ - External Eating	2.663 (0.640)	2.680 (0.580)	0.175	0.862	156	0.028
MEQ - Emotional Eating	2.453 (0.715)	2.436 (0.646)	-0.159	0.874	156	0.025
MEQ – Distraction	2.094 (0.661)	2.180 (0.806)	0.760	0.466	156	0.117
Self-Report Habit Index (SRHI)						
SHRI - Habit Strength	26.64 (9.57)	27.63 (9.33)	-.661	.968	156	.104
Coping Style Inventory (CS)						
CS – Engagement	48.450 (10.475)	48.603 (9.298)	0.097	0.923	156	0.015
CS – Disengagement	41.938 (10.405)	43.308 (11.559)	0.784	0.435	156	0.125
CS - Emotion-focussed Engagement	23.875 (7.416)	23.615 (6.257)	-0.238	0.812	156	0.038
CS - Emotion-focussed Disengagement	22.038 (6.507)	22.782 (7.212)	0.682	0.496	156	0.108
CS - Problem-focussed Engagement	24.575 (5.616)	24.987 (5.977)	0.447	0.656	156	0.071
CS - Problem-focussed Disengagement	19.900 (5.529)	20.526 (6.172)	0.671	0.503	156	0.107

CS – Cognitive Restructuring	11.625 (3.324)	12.308 (3.168)	1.322	0.188	156	0.210
CS – Problem Solving	12.950 (3.031)	12.680 (3.880)	-0.488	0.627	156	0.078
CS – Emotional Expression	11.050 (3.778)	10.410 (3.507)	-1.102	0.272	156	0.176
CS – Seek Social Support	12.825 (4.517)	13.205 (3.995)	0.560	0.576	156	0.089
CS – Avoidance	8.488 (2.658)	9.180 (3.614)	1.374	0.172	156	0.218
CS – Wishful Thinking	11.413 (3.459)	11.346 (3.748)	-0.116	0.908	156	0.019
CS – Self Criticism	11.063 (3.957)	11.372 (3.932)	0.493	0.623	156	0.078
CS – Social Withdrawal	10.975 (3.959)	11.410 (4.335)	0.659	0.511	156	0.105
Social Problem Solving Inventory (SPSI)						
SPSI Total Problem Solving	13.198 (2.511)	13.013 (2.928)	-0.426	0.671	156	0.068
SPSI Positive Problem Orientation	2.533 (0.676)	2.621 (0.724)	0.790	0.431	156	0.126
SPSI Negative Problem Orientation	2.565 (0.716)	2.492 (0.783)	-0.609	0.543	156	0.097
SPSI Rational Problem Solving	2.348 (0.654)	2.380 (0.735)	0.289	0.773	156	0.046
SPSI Avoidant Problem Solving	2.780 (0.828)	2.644 (0.906)	-0.988	0.325	156	0.157
SPSI Impulsive Problem Solving	2.973 (0.658)	2.877 (0.716)	-0.874	0.383	156	0.140

*$p < .05$, **$p < .01$

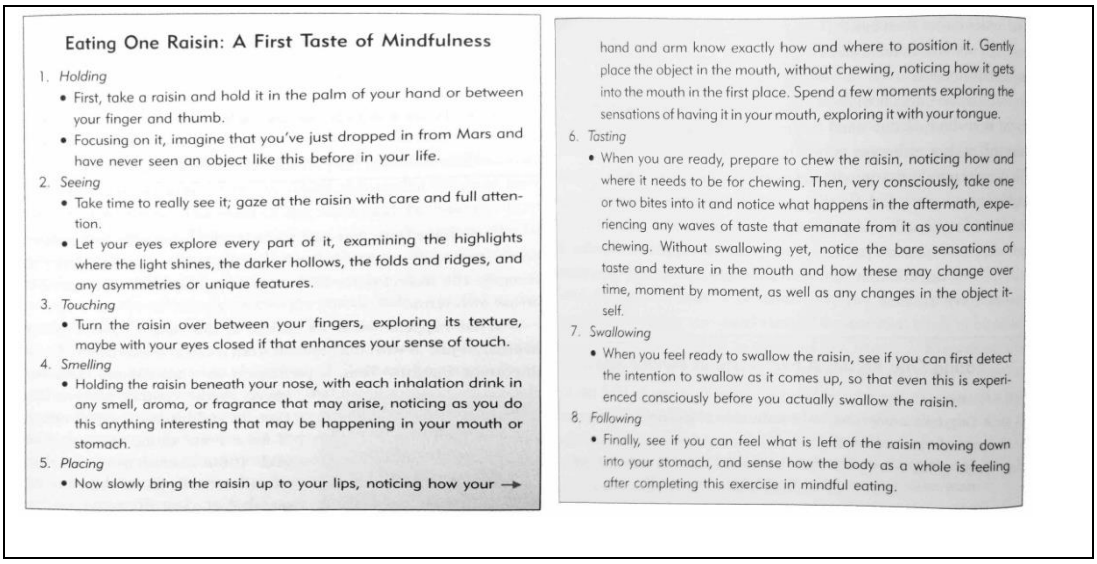
4.4 Intervention Content

4.4.1 The raisin eating task.

The intervention materials emailed to participants was based on a modified version of the "raisin-eating" task used in Williams, Teasdale, Segal, and Kabat-Zinn (2007) (originally used in Kabat-Zinn and Hanh (1990) mindfulness-based stress reduction program). This task requires participants to slowly observe, feel and eat one raisin mindfully over the course of several (five or so) minutes. The aim of this task is to assist participants to become acutely aware of their present lived experience, moment by moment, while suspending judgement and disregarding distractions (Kabat-Zinn, 2003). The task includes written

instructions for participants to look at, smell, touch, taste, swallow and mindfully engage in the experience of eating a raisin (see Figure 4).

Variants of this task have been utilised in several mindfulness-based research studies, and in addition to the general benefits associated with cultivating mindfulness, this specific exercise has been associated with experiencing a greater enjoyment of food (Hong, Lishner, Han, & Huss, 2011), decreased binge eating (Smith, Shelley, Leahigh, & Vanleit, 2006), lower aggression following rejecting feedback (Heppner et al., 2008) and the alleviation of stereotype threat effects (Weger, Hooper, Meier, & Hopthrow, 2012).



Eating One Raisin: A First Taste of Mindfulness

1. *Holding*
   - First, take a raisin and hold it in the palm of your hand or between your finger and thumb.
   - Focusing on it, imagine that you've just dropped in from Mars and have never seen an object like this before in your life.
2. *Seeing*
   - Take time to really see it; gaze at the raisin with care and full attention.
   - Let your eyes explore every part of it, examining the highlights where the light shines, the darker hollows, the folds and ridges, and any asymmetries or unique features.
3. *Touching*
   - Turn the raisin over between your fingers, exploring its texture, maybe with your eyes closed if that enhances your sense of touch.
4. *Smelling*
   - Holding the raisin beneath your nose, with each inhalation drink in any smell, aroma, or fragrance that may arise, noticing as you do this anything interesting that may be happening in your mouth or stomach.
5. *Placing*
   - Now slowly bring the raisin up to your lips, noticing how your hand and arm know exactly how and where to position it. Gently place the object in the mouth, without chewing, noticing how it gets into the mouth in the first place. Spend a few moments exploring the sensations of having it in your mouth, exploring it with your tongue.
6. *Tasting*
   - When you are ready, prepare to chew the raisin, noticing how and where it needs to be for chewing. Then, very consciously, take one or two bites into it and notice what happens in the aftermath, experiencing any waves of taste that emanate from it as you continue chewing. Without swallowing yet, notice the bare sensations of taste and texture in the mouth and how these may change over time, moment by moment, as well as any changes in the object itself.
7. *Swallowing*
   - When you feel ready to swallow the raisin, see if you can first detect the intention to swallow as it comes up, so that even this is experienced consciously before you actually swallow the raisin.
8. *Following*
   - Finally, see if you can feel what is left of the raisin moving down into your stomach, and sense how the body as a whole is feeling after completing this exercise in mindful eating.

Figure 4: Eating One Raisin Task. Reprinted from "The mindful way through depression: freeing yourself with chronic unhappiness" by Williams, M., Teasdale, J., Segal, Z., & Kabat-Zinn, J., 2007, *New York: Guilford*, p. 55-56. Copyright 2007 by The Guilford Press.

This exercise was selected for several reasons. Firstly, according to a recent narrative review on mindfulness and weight control (Mantzios & Wilson, 2015), intervention effects are maximised when mindfulness exercises focus on food and eating experiences, rather than more general mindfulness exercises (e.g. attending to the breath). Secondly, this particular exercise has been associated

with greater enjoyment of food (Hong et al., 2011). As anticipation of greater enjoyment has been linked to the selection of smaller portion sizes (Cornil & Chandon, 2016), and as mindful eating has been linked to decreased instances of later snacking (Higgs & Donohoe, 2011), it was reasoned that deliberate use of mindful snacking using this exercise may assist participants to enjoy their snacks and thus feel more sated by them, assisting them in selecting smaller portions or fewer snacking sessions in the future.

4.4.2 Modifications to the raisin-eating task.

This exercise formed the basis for our intervention. It was adapted in several ways in order to make it suitable for our email-based intervention. These adaptations involved firstly, substitution of a single raisin for a small piece of snack food. This amendment was necessary as the target food needed to be one that participants already snacked on regularly, in order to investigate the effect of the mindful exercise on habit-strength of the snacking behaviour.

Secondly, the intervention was delivered electronically, by email. In line with the study 2 aim of using and requiring minimal resources, both on behalf of the intervention providers and also participants, the entire exercise was delivered in the simple format of a PowerPoint-style PDF file. The PDF file was constructed so that participants could open the file and easily access the next screen of text with a single button press, minimising the need for physical contact with the keyboard to facilitate the handling of and attending to food. It required no audio capabilities and as Adobe Acrobat Reader is freely available to the public, requiring no costly programs to run. The first three pages of the PDF presentation consisted of an introduction, followed by the mindful eating exercise (12 pages), and finally, a completion page congratulated participants on completing the exercise (see Appendix D).

Thirdly, participants did not have access to an instructor throughout the exercise. Therefore the intervention, which is typically presented on a single page or two, (Williams et al., 2007) was spread out so that each element was placed on a separate page (e.g. the "Seeing" element was placed on a separate page to "Holding" – see Figure 4). It was thought that presenting the information in this way would assist participants in slowing down through the exercise.

Fourthly, a short introduction to mindfulness and the premise of mindful snacking, was written specifically for this intervention. This introduction was written by the student investigator (also a registered psychologist, trained in Acceptance and Commitment Therapy theory and delivery), in consultation with research and clinical supervisors. The purpose of this introduction was to (a) introduce the concept of mindfulness to participants who were unfamiliar with the term, (b) to normalise common aspects of the experience and (c) to assist participants in setting realistic expectations for the exercise. In brief summary, the introduction defined the practice of mindfulness using the widely-adopted definition from Kabat-Zinn (1994, p. 145); as the practice of paying attention, "on purpose in the present moment, and non-judgementally" It emphasised the role of attention, thoughts and feelings throughout the exercise, in line with mindfulness literature, and explained, in brief, that the aim of the exercise was to shift attention away from one's thoughts (though these are expected to continue in the background) and instead to focus attention mindfully on what their bodies were perceiving and experiencing, with a sense of genuine curiosity and without judgement. Distractions were normalised as a natural part of all mindful exercises, and the introduction instructed participants to anticipate that they would likely need to return their attention back to their snack food multiple times throughout each exercise. Finally, the introduction also normalised feelings of unfamiliarity

and strangeness for participants new to mindfulness, contextualising these as a part of the learning process (see Appendix D).

Finally, some changes were made to the mindful eating task itself, to make it more suitable for the current study. The original exercise consists of eight core elements as published in Williams et al., (2007) – namely holding, seeing, touching, smelling, placing, tasting, swallowing and following sensations (see Figure 4). However, environmental cues are thought to play a crucial role in the performance of habitual responses. As discussed previously, environmental cues automatically invoke the habitual behavioural response, and are thus linked to the automaticity of the action. Environmental cues can therefore be seen as a maintaining factor in situations where unintentional and counter intentional habits are present; as they continually invoke the unwanted, automatic behaviour. Given this, it was considered that mindful attention to the environmental cues may help to bring these into conscious awareness and allow for more mindful (and less habitual) action in the future. To achieve this, an additional element dedicated to mindfully observing location ('where') was added at the beginning of the exercise. Two further additions ('anticipation') and ('afterwards'), dedicated to mindfully observing any thoughts or feelings that were present during the exercise. These were added as participants were expected to be predominantly naïve to mindfulness entirely. Cultivating some degree of awareness regarding thoughts and feelings is often considered an important first step in mindfulness practice; indeed, Bishop et al. (2004, p. 232) when proposing an operational definition of mindfulness in clinical psychology, wrote: "Mindfulness begins by bringing awareness to current experience – observing and attending to the changing field of thoughts, feelings and sensations from moment to moment". The aims of study 2 also came into play with this amendment decision. The co-

cultivation of self-compassion alongside mindfulness is common, but not inevitable, particularly in instances where the primary focus is on external stimuli (i.e. snack food) (Neff & Dahm, 2015). Thus, if self-compassion was to be successfully cultivated through the administration of this exercise (as per one of the aims in Study 2), it was thought that some attention to thoughts and feelings would be necessary.

In sum, three new elements were added. As the original mindful snacking exercise is short and as participant time was limited, two original elements 'placing' and 'tasting' were combined. This kept the final mindful snacking exercise comparable in length with previous work and in line with estimated participant time burdens.

Chapter 5: Study 2. Breaking Habits with Mindful Snacking? An Email-based Intervention Targeting Unwanted Snacking Habits in an Australian Sample

This chapter consists of a published paper. The paper is presented in a format that is consistent with the rest of the thesis body within this chapter, and again in the format of the journal article in Appendix C. The intervention materials referred to within this article are presented in Appendix D. This study in this chapter was published as follows:

Dibb-Smith, A. E., Chapman, J., & Brindal, E. (2019). Breaking habits with mindful snacking? An email-based intervention targeting unwanted snacking habits in an Australian sample. *Eating Behaviors*, *32*, 37-43.

5.1 Statement of Authorship:

Statement of Authorship

Title of Paper	Breaking Habits with Mindful Snacking? An Email-based Intervention Targeting Unwanted Snacking Habits in an Australian Sample
Publication Status	☑ Published ☐ Accepted for Publication ☐ Submitted for Publication ☐ Unpublished and Unsubmitted w ork w ritten in manuscript style
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Name of Principal Author (Candidate)	Amanda Ellen Dibb-Smith

Contribution to the Paper	Analysed data, interpreted results, wrote manuscript and acted as corresponding author.		
Overall percentage (%)	80%		
Certification:	This paper reports on original research I conducted during the period of my Higher Degree by Research candidature and is not subject to any obligations or contractual agreements with a third party that would constrain its inclusion in this thesis. I am the primary author of this paper.		
Signature		Date	21.11.18

Co-Author Contributions

By signing the Statement of Authorship, each author certifies that:

iv. the candidate's stated contribution to the publication is accurate (as detailed above);

v. permission is granted for the candidate in include the publication in the thesis; and

vi. the sum of all co-author contributions is equal to 100% less the candidate's stated contribution.

Name of Co-Author	Janine Chapman		
Contribution to the Paper	Co-supervised development of work, data interpretation, and manuscript editing.		
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Contribution to the Paper	Supervised development of the work and helped in manuscript editing.		
Signature		Date	23.11.18

Abstract

Objective

To investigate the potential for an email-based, mindful eating exercise to improve unwanted snacking habits.

Method

Australian participants (N = 78, 86% female) with unwanted snacking habits engaged in a mindful eating email-based intervention, over a practice period of two weeks. All measures were completed using an online survey. Habit strength was measured using the Self-Report Habit Index (SHRI). Mindful eating was measured using the Mindful Eating Questionnaire (MEQ) and Self-Compassion was measured using the Self-Compassion Scale (SCS). Participants were emailed a mindful eating exercise and asked to make action plans to practise it. Reminders to perform the task were sent via email after one week. After two weeks, the MEQ, SCS and SHRI were readministered.

Results

Habit strength significantly increased over the two-week period and self-compassion significantly decreased. The amount of practise reported was not associated with these changes, but self-reported effort expended during practice sessions was partially associated.

Discussion

The intervention resulted in increased habit strength; potential mechanisms underlying these changes are discussed. Decreased self-compassion may be linked to both the electronic delivery of the intervention and the nature of the mindful eating task.

Introduction

Snacking between meals has been linked to overconsumption and health issues such as poorer nutrition, increased BMI (particularly in adulthood), overweight and obesity (Fay, White, Finlayson, & King, 2015; Gregori, Foltran, Chidina, & Berchialla, 2010; Piernas & Popkin, 2009). Given the rising prevalence of snacking behaviour (Fayet-Moore, Peters, McConnell, Petocz, & Eldridge, 2017; Piernas & Popkin, 2009) and that snacking is often unintentional, counter-intentional and habitual (Gore, Foster, DiLillo, Kirk, & West, 2003; Ohtomo, 2013), low-cost intervention strategies are needed to help consumers to weaken unwanted snacking habits.

Snacking has been defined by the general populace as meaning the consumption of foods in between mealtimes, with a general consensus that these foods tend to be less healthy than mealtime foods (Chaplin & Smith, 2011). A recent systematic review and Bayesian analysis of 228 studies suggests that behaviour in line with this definition may be associated with the development of obesity (Gregori et al., 2010). Habits, in brief, have been defined as mental links that occur between an environmental cue, and a particular behaviour, which are strengthened with repeated performance over time, and which automatically invoke behaviour, bypassing much of the conscious decision-making process (Neal, Wood, & Quinn, 2006). Thus, a snacking habit in the current study refers to a specific food item, eaten regularly and with a degree of automaticity, in between mealtimes.

Given the automaticity associated with unwanted snacking habits (Gardner, 2015), mindfulness-based strategies may be effective for reducing them. Mindfulness has been broadly defined as “the awareness that emerges through

paying attention on purpose, in the present moment and nonjudgmentally to the unfolding of experience moment by moment" (Kabat-zinn, 2003, p145). It has been described as a *state* that occurs when self-regulation skills are used to deliberately shepherd awareness towards present moment experiences (Lau et al., 2006) and also as a *trait* which remains stable without intervention, denoting one's general tendency to be mindful in daily life (Baer, Smith, & Allen, 2004). According to Kiken, Garland, Bluth, Palsson, and Gaylord (2015), repeated invocation of mindfulness states strengthens trait-based mindfulness in practitioners. Research investigating the utility of mindfulness in the context of interventions targeting weight, food and eating behaviour has grown over the past decade, and the construct of "mindful eating" has become of interest. Mindful eating, which applies the same principles of awareness to food-related contexts, has been defined as the non-judgemental awareness of physical and emotional sensations associated with eating (Framson et al., 2009).

Two recent systematic reviews investigating the efficacy of both mindful eating and broader mindfulness exercises have concluded there is good supporting evidence that these are useful for decreasing binge eating episodes, emotional eating, and external eating (Katterman, Kleinman, Hood, Nackers, & Corsica, 2014; O'Reilly, Cook, Spruijt-Metz, & Black, 2014). Mindful eating in particular has been linked to positive outcomes in body weight, dietary intake, decreased binge-eating behaviour, and decreased snacking behaviour (Higgs & Donohoe, 2011; O'Reilly et al., 2014). A narrative review on mindfulness-based interventions (including mindful eating) adds that they assist with weight control via reductions in automatic eating, improved responses to food cravings and lowered consumption impulsivity (Mantzios & Wilson, 2015). Mindfulness training is thought to be useful for breaking unwanted habits, as it deploys

attentional resources to deliberately interrupt the automatic, habitual response. This allows for the remembering and execution of intentional action instead (Chatzisarantis & Hagger, 2014; Vago, 2014).

Preliminary research has also linked self-compassion with the cultivation of mindfulness. A narrative review by Mantzios and Wilson (2015) reports higher self-compassion is associated with greater effectiveness of mindfulness-based interventions. Neff (2003b) defines three fundamental components of self-compassion as *self-kindness* (cultivating an attitude of kindness and gentleness towards oneself, rather than criticism or judgement); *common humanity* (understanding that suffering and imperfections are all part of a common human experience, rather than seeing them as isolating or separating), and *mindfulness*, (noticing and accepting our inner experiences in balanced awareness, without over-identifying with them). As mindfulness is a core component of self-compassion, it is generally accepted that these two constructs have the capacity to be co-cultivated and work well together (Mantzios & Wilson, 2015; Neff, 2003b). Self-compassion has also been successfully used to alleviate disordered eating, improve body image and foster more adaptive eating styles (Braun, Park, & Gorin, 2016). A recent review by Braun et al. (2016) has reported that self-compassion cultivates more adaptive eating habits via multiple pathways, including the prevention of risk factors for maladaptive eating, mitigating the impact of risk factors which are already present and disrupting the mediational chain through which a risk factor operates.

In light of the research described above, the current pilot study investigated whether a brief, email-based intervention emphasising mindful snacking could help change habitual but unwanted snacking behaviour. Given the high prevalence of weight and snacking issues in society, the value of web-based

interventions to assist with food habits, weight loss and weight maintenance has been well-established. A recent systematic review synthesising the results of twenty previous reviews has confirmed the efficacy of email, online and web-based weight loss/maintenance interventions (Sorgente et al., 2017), reporting greater effects than control or wait-list groups. In line with the subsequent recommendations produced in this review, our intervention was designed using an email-based delivery system, addressing a common limitation of e-interventions as being less accessible to populations with low familiarity with complex web-based technologies. Intervention material was delivered by email, and able to be saved and used offline at a later time, to further address reported limitations associated with access to the internet (Sorgente et al., 2017). The intervention was developed using an adaptation of the 'eating one raisin' exercise, from Williams, Teasdale, Segal, and Kabat-Zinn (2007), originally described in the Kabat-Zinn and Hanh (1990) mindfulness-based stress-reduction program. Though variants of this exercise have been used in mindful eating research previously, mindful eating research is still in its infancy and a need for further study in this area has been identified (Mantzios & Wilson, 2015). It remains to be seen whether mindful eating can be used in the service of breaking consumption-based habits and whether this construct is associated with supportive factors linked to mindfulness, such as self-compassion. We hypothesised (a) mindful eating would increase from baseline to follow-up, and (b) that the habit-strength of participant snacking would decrease from baseline to follow-up. Secondary research aims involved investigating (c) whether self-compassion would increase from baseline to follow-up, and as repeated practice of mindfulness states cultivate a more stable mindfulness-trait (Chatzisarantis & Hagger, 2007), (d) whether our exploratory variables (number of practice sessions, strength of intention, commitment,

perceived effort, plan quality or habit strength) would act as significant explanatory factors in any differences observed between baseline and follow-up.

Materials and Methods

Recruitment and participants

Participants were recruited via the Facebook page of the Commonwealth Scientific and Industrial Research Organisation (CSIRO). Advertisements promoting a "Mindful Snacking Study" targeted the newsfeeds of people meeting broad inclusion criteria and who had liked popular nutrition or weight-based pages. Inclusion criteria were computer access with access to email, English literacy, currently living in Australia, and a desire to eat a particular snack food less habitually.

Participants (n = 158) completed initial questionnaires and of these, 78 completed the follow-up measures. An attrition rate of 50% over two weeks was anticipated and consistent with predictions regarding e-health interventions (Eysenbach, 2005). The final sample (n = 78) was aged between 20-80 years old (M = 42.89, SD = 13.49) and predominantly female (n = 66). Very few participants knew what mindful eating was prior to participation (n = 3).

Participants exhibited average levels of self-compassion at baseline (M = 3.11, SD = 0.78) as per score interpretations published by (Neff, 2018), and average degrees of Mindful eating (M = 2.48, SD = *0*.39), comparable with published means (Framson et al., 2009). Initial habit strength scores (M = 27.63 SD = 9.34) were in line with estimates of 'unhealthful eating' habits from a recent systematic review (Gardner, de Bruijn, & Lally, 2011). Participants who dropped out were not significantly different from those who completed the study on any baseline measures.

Design and Procedure

The study was a within-subjects design with pre- and post-intervention measurement of outcome variables (mindful eating, habit strength and self-compassion). Baseline measures were administered prior to the intervention delivery and follow-up measures were administered two weeks later at completion of the intervention period. All measures were administered online through survey software (Survey Gizmo).

Participants gave informed consent online after reading an information sheet, provided email addresses for future contact and completed baseline questionnaires (Self-compassion Questionnaire, Mindful Eating Questionnaire and the Self-Report Habit Index, described below). Participants then nominated a target snack food. As action-planning is well known to facilitate intentional action (Gollwitzer & Sheeran, 2006) participants were asked to make action plans to help them translate their intentions to practice mindful eating into action. As participants would likely have a variety of routines and schedules, and as practice was unsupervised, action planning was featured to facilitate independent, and self-determined practice of the mindful eating exercise. Participants were asked to record their plans as a part of the online survey, and were asked to consider where, when and how they would practice.

Participants received a standardised welcome email after completing initial measures, which also contained the intervention material as an attachment. One week later, all participants received an email, reminding them that one week of practice remained. Two weeks after the welcome email, participants received a third email, containing a link to the electronic survey and asking them to complete. If follow-up measures were not completed, participants received up to three reminder emails, over the course of three weeks.

Measures

***The mindful eating questionnaire*: MEQ (Framson et al., 2009)**

This 28-item questionnaire measures the extent to which a person exhibits non-judgemental awareness of physical and emotional sensations, associated with eating. Participants are asked to respond to questions about the way in which they eat (e.g. "I notice when foods and drinks are too sweet") on a 1-4 point response scale (1 = 'Never/Rarely', 4 = 'Always/Usually'). The scale comprises of 5 subscales, which can be combined to create a composite Mindful Eating score. Higher scores indicate more mindful eating.

The Mindful Eating Questionnaire has reportedly shown good convergent validity (r = .41, p < .01) with general mindfulness (Beshara, Hutchinson, & Wilson, 2013) and with mindfulness skills developed through yoga practice (Framson et al., 2009). Good divergent validity has been established from moderate intensity exercise (Framson et al., 2009). The questionnaire has been used repeatedly to investigate links between mindfulness, eating behaviours and weight (Beshara et al., 2013; Framson et al., 2009), both in cohort studies (Moor, Scott, & McIntosh, 2013) and in intervention randomised controlled trials (Kidd, Graor, & Murrock, 2013; Mason et al., 2016).

The overall scale exhibited good reliability (α = .82), as did most subscales (awareness α = .83, distraction when eating α = .68, disinhibition α = .76, external eating α = .51 and emotional eating α = .76). Two subscales, external eating and distraction yielded lower reliability ratings. However, this is common among shorter subscales (Field, 2005) and the external eating and distraction subscales are comprised of only 6 and 3 items respectively. After examining the individual items and estimates of the alpha-if-deleted for each scale, both reliability ratings were improved through the deletion of a single item each (item number one from

the distraction subscale and number eight from the external eating subscale). The subsequently improved External eating (α = .63) and Distraction (α = .77) subscales were used in analyses.

Self-report habit index: SRHI (Verplanken & Orbell, 2003)

This 12-item questionnaire measures the degree to which a particular behaviour is habitual. According to Verplanken and Orbell (2003), this scale attends to several features thought to be associated with habitual behaviour, including frequent repetition, difficulty controlling habitual behaviour, a lack of awareness when performing the behaviour, energy efficiency and a sense of identity (e.g. Behaviour x is something that's "typically me"). When administering the scale, participants are asked to endorse statements about a specific behaviour (e.g. "(Behaviour x is something…) I do frequently") by responding on a 5-point response scale (1 = 'Disagree', 5 = 'Agree'). Total scores are out of 60, with higher scores indicating stronger habits.

Factor analyses during the scale's construction supports a one-factor structure (Verplanken & Orbell, 2003). This measure has shown good one-week test-retest reliability (r = .91, p < .01), exhibited good reliability in the current study (α =.87). Convergent validity has been established (r = .58, p < .001) using the response frequency measure of habit (Verplanken, Aarts, Knippenberg, & Knippenberg, 1994), and is sensitive to differing habit strengths; the scale can successfully differentiate between behaviours which are performed on a daily versus weekly basis (Verplanken & Orbell, 2003).

Self-compassion scale: SCS (Neff, 2003a)

This 26-item questionnaire is comprised of 6 sub-scales which are combined to create a composite Self-Compassion Score. Participants are asked to endorse statements such as "I'm disapproving and judgmental about my own

flaws and inadequacies" on a 1-5 point response scale (1 = 'Almost never', 5 = 'Almost always'). Negative scales (self-judgement, isolation and over identification) are reversed during scoring. Each subscale yields a final score out of 5 with the composite score out of 30. Higher scores indicate more self-compassion.

Factor analyses during the scale's construction (Neff, 2003a) supports 6 underlying factors (one for each subscale). This scale is widely used (MacBeth & Gumley, 2012) and according to Neff, (2003a) the Self-Compassion Scale has shown good convergent validity (r = .41. p = .01) with the Social Connectedness Scale (Lee & Robbins, 1995), and the positive subscales of the Meta-Mood Trait Scale (Salovey, Mayer, Goldman, Turvey, & Palfai, 1995), which measures Emotional Intelligence (Attention: r = .43, p < .01; Clarity: r = .43, p < .01; Repair: r = .55, p < .01) as well as negative correlations with the Depressive Experiences Questionnaire (Blatt, D'Afflitti, & Quinlan, 1976) subscale Self-Criticism (r = -.65, p < .01). The composite score exhibited good reliability (α = .94), as did the subscales self-kindness (α = .84), common humanity (α = .82), mindfulness (α = .72), self-judgement (α = .90), isolation (α = .82) and over-identification (α = .80).

Manipulation checks and explanatory factors: practice, effort, commitment, intention and plan quality

At baseline, two single-item questions measured the strength of intention and commitment to practice the mindful eating exercise (both 0-10 response scales, (0 = 'Not very Committed/Do not really Intend', 10 = 'Very Committed/Strongly Intend'). Participants also nominated their target snack and estimated how often they consumed this snack, on average. At follow-up, participants were asked how many times they had practiced the mindful eating

exercise, and how much effort they felt they had expended while engaging in the exercise (0-10 response scale, 0 = 'Did not try to complete', 10 = 'Put in best effort'). Single-item measures were constructed in accordance with the recommendations of Ajzen, Joyce, Sheikh, and Cote (2011). Given these guidelines and the support of previous research for single-item measures to reliably capture goal-intentions (Sheeran, Webb, & Gollwitzer, 2005) and action effort (Maslyn & Uhl-Bien, 2001), it was decided to minimise participant-burden by incorporating these measures as single-items. Participants also reported how often they had eaten their snack during the study fortnight.

A measure of action plan quality was derived from The *Goal-Setting Evaluation Tool for Diabetes* (GET-D). This measure was designed to assist self-management in diabetes (Teal et al., 2012) but has also been used in weight loss intervention programs (Dibb-Smith, Brindal, Chapman, & Noakes, 2016). The GET-D assigns points based on a series of questions (e.g. "Does the plan identify how often the action(s) will be taken?"). A score of plan quality is yielded (0-19); higher scores indicate better quality plans. One of the criteria "intensity of action" pertains to exercise; this was adapted for our study to a "specify food amount" criteria, to better suit the nature of the task. Inter-rater reliability between two coders (ADS, JD) was acceptable (Kappa = 0.81).

Intervention

The intervention file was a power-point presentation-styled PDF and contained an introduction written by a registered psychologist (ADS), explaining the premise of mindful snacking. The 'eating one raisin' exercise (Williams et al., 2007) was the task used in the intervention to cultivate mindful snacking. The task includes written instructions for participants to look at, smell, touch, taste, swallow and mindfully engage in the experience of eating a raisin. This exercise was selected for several reasons. Firstly, according to a recent narrative review on

mindfulness and weight control (Mantzios & Wilson, 2015), intervention effects are maximised when mindfulness exercises focus on food and eating experiences, rather than more general mindfulness exercises (e.g. attending to the breath). Secondly, this particular exercise has been associated with greater enjoyment of food (Hong et al., 2011). As anticipation of greater enjoyment has been linked to the selection of smaller portion sizes (Cornil & Chandon, 2016), and as mindful eating has been linked to both decreased instances of later snacking (Higgs & Donohoe, 2011) and decreased binge eating (Smith et al., 2006), it was reasoned that deliberate use of this mindful snacking using this exercise may assist participants to enjoy their snacks and thus feel more sated by them, assisting them in selecting smaller portions or fewer snacking sessions in the future, without feeling deprived.

For the purposes of the intervention, this exercise was adapted so that participants instead focussed on eating their nominated snack instead of a single raisin. Given the prominent role of environmental cues in habitual behaviour (Neal et al., 2006), an additional element dedicated to observing location ('where') was added at the beginning of the exercise. As emotion is relevant to both snacking and emotional eating (Wilkinson, Rowe, & Heath, 2013), two small elements were also added, to mindfully observe thoughts and feelings ('anticipation' and 'afterwards').

The exercise was delivered via email in a PowerPoint-style PDF file. Participants were able to open the file and easily access the next screen of text with a single button press, minimising keyboard use, to facilitate the handling of food. It required no audio capabilities and Adobe Acrobat Reader is freely available to the public.

Results

Data analysis

Paired *t*-tests investigated significant differences between baseline and follow-up. Effect sizes were calculated using Cohen's *d.* Bonferroni corrections were made where subscales were investigated, adopting a p-value of $p = .007$ for the Self-Compassion scale, and a *p*-value of $p = .008$ for the Mindful Eating Questionnaire. A generalised linear model was constructed in SPSS (IBM, 2016) to examine the effects of intervention practice on outcome variables, controlling for baseline scores. Prior to analysis, the practice variable was transformed using a natural logarithm transformation, due to a positive skew (Field, 2005).

Manipulation checks

The number of intervention practice sessions varied considerably between participants, with the total reported practice sessions ranging from zero to 97 times ($M = 13.30$, $SD = 16.85$) over the intervention fortnight. Based on self-report (0-10 response scale), participants believed they engaged in the exercise with a moderate amount of effort ($M = 6.05$, $SD = 0.29$). Free-text data entered during baseline, revealed that participants had appropriately chosen snacks and not meals as their target; most commonly chosen snacks included chocolate ($n = 24$, 29.1%), and potato chips ($n = 15$, 19.0%). Action plan text revealed that participants planned to practice the mindful eating exercise appropriately with snacks, between mealtimes. Participants reported eating their chosen snacks multiple times each week at baseline ($M = 10.12$, $SD = 21.85$). At completion, participants reported they ate their chosen snack less frequently ($M = 6.61$, $SD = 10.83$). Many participants also practiced mindful eating with other foods ($n = 61$,

79.2%). Practice with alternative foods (*M* = 6.35, *SD* = 10.55) tended to occur just as frequently as practice with selected snacks (*M* = 6.96, *SD* = 12.68).

Testing Hypothesis a: Mindful eating scores at Time 2 will be significantly higher than baseline scores.

Mindful Eating Questionnaire scores significantly improved from time 1 to time 2 when an alpha of p = .05 was adopted (t (77) = -2.64, p = .010, d = .31), with a small effect size (Table 1). The MEQ subscales were further investigated. However the MEQ Total score did not remain significant after a Bonferroni correction was made for multiple analyses, adopting an alpha criterion of p = .008.

Table 1
Paired t-tests Determining Significant Differences Between Scores at Time 1 and Time 2 (N = 78)

Variable name	**Mean(SD)**		***t***	***p***	***df***	***d***
	Time 1	**Time 2**				
Snack food consumed	19.97(43.15)	13.48(21.73)	1.124	.265	77	0.19
Self-Compassion (Total)	18.65(4.72)	17.67(4.28)	3.41	.001*	77	0.21
Self-Judgement	2.55(0.92)	2.81(0.99)	-4.19	<.001**	77	0.27
Isolation	2.74(1.00)	2.97(0.94)	-3.10	.003*	77	0.24
Over Identification (with emotion)	2.75(0.92)	2.99(0.90)	-3.36	.001*	77	0.26
Mindfulness	2.74(0.90)	2.59(0.73)	1.69	.096	77	0.18
Common Humanity	2.75(0.93)	2.77(0.92)	-0.21	.836	77	0.02
Self-Kindness	3.20(0.95)	3.09(0.85)	1.26	.210	77	0.12
Mindful Eating (Total)	2.39(0.46)	2.51(0.29)	-2.64	.010*	77	0.31
Habit Strength	27.63(9.34)	35.12(10.52)	6.48	<.001**	77	0.75
Snack Frequency	10.12(21.42)	6.61(10.76)	1.30	.199	77	0.21

[a] Sub-scale re-named from 'Disinhibition' for ease of interpretation.
*$p < .05$, **$p < .01$

Testing Hypothesis b: Habitual snacking behaviour will significantly decrease from baseline to time 2.

Participants reported eating their snack food less during the study fortnight than they did at baseline, though this difference was not significant (Table 1). Habit Strength increased from baseline to follow-up ($t(77) = 6.48$, $p < .001$, $d = 0.75$), with a large effect size. Practice was not a significant predictor of Habit Strength at follow-up, indicating that the increase Habit Strength between baseline

and follow-up was not significantly related to the amount of times that participants practiced the mindful snacking exercise.

Table 2
Generalised Linear Models, Investigating the Main Effect of Practice in Producing Time 2 Scores, Whilst Controlling for Time 1 (N = 78)

Variable name	[a]*B*	[a]95CI		X^2	*df*	*p*
		Lower	Upper			
Self-Compassion (Total)	0.786	0.455	1.358	.745	1	.388
Self-Judgement	1.039	2.069	2.735	.306	1	.580
Isolation	0.914	0.796	1.048	1.657	1	.198
Over Identification (with emotion)	0.985	0.856	1.135	0.042	1	.838
Habit Strength	0.462	0.067	3.196	.612	1	.434

[a] Shown *B* values and 95% Confidence Interval values are exponentiated (e^x) , as the Practice variable was transformed using a natural logarithm.

Testing Hypothesis c: Self-compassion scores at Time 2 will be significantly higher than baseline scores.

Self-compassion significantly decreased from baseline to follow-up (t (77) = 3.41, p = .001, d = 0.21), with a small effect, meaning that people exhibited worse/less self-compassion after two weeks. The subscales of the SCS were further investigated. There were significant increases in Self-Judgement (t (77) = -4.19, p < .001, d = 0.27), Isolation (t (77) = -3.10, p = .003, d = 0.24) and Over-Identification with emotions (t (77) = -3.36, p = .001, *d = 0.26*), with small effects.

Generalised linear models revealed that Practice was not a significant predictor of any changes in the SCS (Table 2), indicating that these changes between baseline and follow-up were not significantly related to the amount of times that participants practiced the mindful eating exercise.

Testing Hypothesis d: Exploratory Investigation into Practice and factors underlying change.

As Practice was not a significant predictor, alternative explanatory factors for the differences between baseline and follow-up were explored. Factors explored for explanatory value included Effort, Commitment, Intention, and Plan Quality. Habit Strength was also explored as an explanatory factor for Self-Compassion (Table 3).

Table 3
Generalised Linear Models, Investigating the Main Effect of Exploratory Variables in Producing Time 2 scores, Whilst Controlling for Time 1 (N = 78)

Factor	Outcome	*B*	95CI		X^2	*df*	*p*
			Lower	Upper			
Effort							
	Self-Compassion (Total)	-.012	-.216	.191	.014	1	.905
	Self-Judgement	-.031	-.081	.018	1.537	1	.215
	Isolation	-.060	-.110	-.010	5.616	1	.018*
	Over Identification (with emotion)	-.029	-.080	.023	1.194	1	.274
	Habit Strength	-.402	-1.141	.337	1.139	1	.286
Intention							
	Self-Compassion (Total)	-.042	-.270	.186	.130	1	.719
	Self-Judgement	.015	-.042	.071	.259	1	.611
	Isolation	-.018	-.075	.040	.361	1	.548
	Over Identification (with emotion)	-.011	-.069	.048	.131	1	.717
	Habit Strength	-.593	-1.404	.217	2.061	1	.151
Commitment							
	Self-Compassion (Total)	-.112	-.335	.112	.960	1	.327
	Self-Judgement	.031	-.025	.-086	1.180	1	.277
	Isolation	.004	-.053	.061	.021	1	.885
	Over Identification (with emotion)	-.017	-.074	.040	.339	1	.560
	Habit Strength	-.286	-1.104	.532	.470	1	.493
Plan Quality							
	Self-Compassion (Total)	.081	-.080	.242	.969	1	.325
	Self-Judgement	<-.001	-.040	.040	<.001	1	.997

	Isolation	-.006	-.047	.035	.083	1	.774
	Over Identification (with emotion)	.007	-.035	.048	.104	1	.747
	Habit Strength	-.021	-.633	.591	.005	1	.946
Habit							
	Self-Compassion (Total)	.031	-.023	.085	1.260	1	.262
	Self-Judgement	-.015	-.028	-.002	4.804	1	.028*
	Isolation	-.009	-.022	.005	1.565	1	.211
	Over Identification (with emotion)	-.003	-.017	.011	.186	1	.666

*$p < .05$, **$p < .01$

Habit Strength was related to the SCS subscale, Self-Judgement ($p = .028$), such that for every unit of increase in Habit Strength, Self-Judgement increased by .15. Effort was related to the SCS subscale, Isolation ($p = .018$), such that for every unit of increase in Effort, Isolation increased by .60.

Discussion

The aim of this study was to pilot a short mindful eating intervention. We hypothesised that (a) mindful eating would increase, (b) habit strength would decrease, (c) self-compassion may increase, and (d) practice would be significantly associated with these changes.

Participants did not exhibit significantly more mindful eating at follow-up (as per improvements in the MEQ subscales, after correcting for multiple analyses), leaving hypothesis (a) unsupported. Since the overall effect size was small, the authors considered that the study was slightly underpowered to detect small changes in this construct. Interestingly, in another recent mindful eating

intervention Kidd et al. (2013) incorporated a qualitative focus group, and found upon completion, that their participants reported over-estimating their mindful eating scores at baseline. Participants reflected that they had only realised how mindlessly they previously ate *after* practising and engaging in mindful eating tasks. Research on mindful eating is still in its infancy and tendencies for different populations to under or over-report are still largely unknown (Mantzios & Wilson, 2015). As our sample were also new to mindful eating, it is possible that they similarly overestimated their mindful eating at baseline, explaining the lack of statistical significance.

An unexpected finding was that snacking habit-strength increased significantly, leaving hypothesis (b) unsupported. This is particularly surprising as the frequency of snack consumption tended to decrease over the study fortnight. The authors considered two possibilities. Firstly, although trait-based mindfulness is reported as interfering with counter intentional habits (Chatzisarantis & Hagger, 2007), perhaps there is something about mindful eating that strengthens habitual consumption, particularly as it enhances food-enjoyment (Hong et al., 2011). Recent critiques of mindfulness have noted that it is important to establish contraindications for this treatment (Hanley, Abell, Osborn, Roehrig, & Canto, 2016; Van Dam et al., 2018), and perhaps this is one. However, this seems inconsistent with previous research associating greater enjoyment with selection of smaller portion sizes (Cornil & Chandon, 2016), and mindful eating to decreased instances of later snacking (Higgs & Donohoe, 2011). It also appears at odds with the observation of decreased frequency of snack consumption in our sample. An alternative explanation may concern the limitations self-report measures. Both Hagger, Rebar, Mullan, Lipp, and Chatzisarantis (2015) and Sniehotta and Presseau (2012) caution against overreliance on the SHRI and self-report measures; part of the habit construct is thought to operate outside of

awareness. Hagger et al. (2015) theorises that the SHRI likely captures the subjective *experience* of habit, rather than the actual habitual processes per se. As the aim of mindfulness is to enhance awareness of one's own experience, large increases in habit strength may reflect increased awareness of (and thus reported) habitual experiences, rather than increased habit strength itself.

Contrary to prediction, self-compassion also decreased, leaving hypothesis (c) unsupported. The effects were small (d = 0.21-0.27), but this result has important implications. Total self-compassion, as well as subscales Self-Judgement, Isolation and Over-Identification all worsened over the two-week period. A possible explanation may be the email-based nature of our intervention. When not explicitly taught, self-compassion is still often modelled by the leaders in mindfulness programs (Neff & Dahm, 2015). As self-compassion is thought to be based in the mammalian caregiving system (Goetz, Keltner, & Simon-Thomas, 2010; Neff & Dahm, 2015) and as mindfulness is thought to be within a neurologically distinct system (Neff & Dahm, 2015; Siegel, Germer, & Olendzki, 2009), it is possible that the face-to-face learning environment enables this caregiving system to activate for implicit learning (e.g. via perceptions of mentorship between teacher and student) – and this was absent in our study. Use of recorded video instruction may be a closer simulation to face-to-face learning, which could facilitate implicit modelling and learning of self-compassion in future research. Neff additionally suggests that co-cultivation is less likely when mindful tasks focus on external physical sensations (e.g. seeing and hearing), rather than internal states (such as thoughts and feelings). While mindful eating can incorporate internal states (e.g. sensations of hunger and satiety) our mindful eating exercise predominantly focussed on physical sensations (such as asking participants to look at, smell, touch and taste their snacks). Thus, the same guidelines which prompted this study to focus on mindful eating (Mantzios &

Wilson, 2015) may have simultaneously distanced it from the co-cultivation of self-compassion.

However, self-compassion did not only fail to increase; it decreased. Interestingly, the three negative subscales were the ones that exhibited change. The authors considered that public discourse heavily moralises issues of weight and consumption (Cowling, 2016) and snacking can be associated with self-judgement and guilt (Schuster, Painter, Burnas & McKenzie, 2017). Our intervention recruited participants who were interested in eroding a snacking habit; presumably because it was perceived as problematic. Thus, it may be that our sample experienced heightened self-judgement (and lower self-compassion) associated with deliberately approaching (rather than avoiding) snacks perceived as problematic. If this is the case, future research may wish to incorporate measures capturing constructs pertaining to guilt or shame around eating. Our sample was largely new to the practice of mindful eating, and this may have made it more difficult for them to non-judgmentally approach such experiences. Future research should consider that more extensive mindfulness training, emphasising acceptance, or specific self-compassion training may be required before participants are able to cultivate acceptance towards experiences previously perceived as problematic.

Practice of the intervention material was not associated with the observed changes in either Self-Compassion or Habit, prompting further questioning into why scores changed. A significant limitation of this study is that causality cannot be inferred from this design and it is possible that another factor within the intervention, (e.g. the act of enrolling in a study, or devising action plans), acted as a mechanism of change. These mechanisms seem intuitively unlikely to cause changes in habit or self-compassion constructs, but the possibility cannot be excluded. Interestingly, our models for Effort revealed significant associations of

both Effort and Habit strength with self-compassion outcomes, suggesting that these may offer some strength as an explanation. Constructs of habit, effort and engagement may be important for future research to measure alongside change in addition to practice of intervention materials in future studies. Indeed, engagement is considered predictive of success in online weight control interventions (Neve, Morgan, Jones & Collins, 2010) and the impact of habit strength has been widely acknowledged (Gardner et al., 2011).

The lack of available control group was a significant limitation of this study. The aim of this study was to investigate whether exposure to a simple emailed intervention exercise could plausibly assist with snacking behaviour; thus a pilot, no-control exercise was appropriate to our aims. However, while effort has been made to speculate on likely explanatory variables behind changes in outcome variables, future research would benefit greatly from the direct comparison a control group allows. It should also be noted that the reliability of the Mindful Eating Questionnaire was problematic. While an attempt was made to improve the reliability of the subscales, the External Eating subscale continued to exhibit issues with internal consistency ($\alpha = .63$). This is consistent with the subscale's reported performance elsewhere (e.g. (Apolzan et al., 2016; Kidd et al., 2013). Our attempt to modify the scale to increase its reliability may have implications for the generalisability of our findings and they should be interpreted with caution. It should be noted that our sample was predominantly female and entirely drawn from those living inside Australia; replication is required before being reasonably able to generalise these findings to other populations. This includes populations bound by demographics such as BMI or SES, as our participants did not record these details.

Despite these limitations, our study contributes several important findings. We used a well-known mindful eating exercise to target a specific unwanted

eating habit, and found large effects. These effects are worth further investigation; they may reflect greater awareness, facilitating a shift from habitual processes towards more conscious action. If instead this reflects a genuine strengthening of habitual process, this is still an important finding, shedding light on a significant limitation of mindful eating. Finally, although self-compassion is often implicitly taught alongside mindfulness, future research would benefit from considering explicit teaching methods, as well as investigating both how this is translated in mindful eating contexts and when using online tools.

Chapter 6: Predictors of Intention to Continue Using a Mindful Snacking Exercise Following Intervention

The study in this chapter is an unpublished manuscript. It has not yet been submitted to any journal. The manuscript is presented in a manner that is consistent with the rest of the thesis.

6.1 Statement of Authorship

Statement of Authorship

Title of Paper	Predictors of intention to continue to use a mindful snacking exercise following intervention
Publication Status	☐ Published ☐ Accepted for Publication ☐ Submitted for Publication ☑ Unpublished and Unsubmitted w ork w ritten in manuscript style
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Principal Author

Name of Principal Author (Candidate)	Amanda Ellen Dibb-Smith		
Contribution to the Paper	Analysed data, interpreted results and wrote manuscript.		
Overall percentage (%)	80%		
Certification:	This paper reports on original research I conducted during the period of my Higher Degree by Research candidature and is not subject to any obligations or contractual agreements with a third party that would constrain its inclusion in this thesis. I am the primary author of this paper.		
Signature		Date	22.11.18

Co-Author Contributions

By signing the Statement of Authorship, each author certifies that:

i. the candidate's stated contribution to the publication is accurate (as detailed above);
ii. permission is granted for the candidate in include the publication in the thesis; and
iii. the sum of all co-author contributions is equal to 100% less the candidate's stated contribution.

Name of Co-Author	Janine Chapman

Contribution to the Paper	Co-supervised development of work, data analysis, data interpretation, and manuscript editing.		
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Abstract

Objective

To conduct a preliminary exploration into factors that predict intervention participant intentions to continue with a mindful snacking exercise beyond the intervention period.

Method

Australian participants (N = 72, 85% female) who had completed baseline measures and a two week online intervention based on mindful snacking, were asked to give a score regarding their perception of the intervention helpfulness (1-10) and given false feedback (improvement/non-improvement) before being asked whether they intended to continue using the mindful snacking exercise (Y/N). All measures were completed using an online survey. Baseline measures included problem-solving skill, measured using the Social Problem Solving Index (SPSI-R), self-compassion, measured using the Self-Compassion Scale (SCS), coping style, measured using the Coping Strategies Inventory (CSI) and plan quality, measured using a modified version of the Goal Evaluation Tool for Diabetes (GET-D). Objective helpfulness of the intervention was measured by constructing an overall habit-improvement score, using pre and post habit scores, measured using the Self-Report Habit Index (SRHI). Logistic regression models were used to explore factors that were predictive of participant intentions to continue with mindful snacking.

Results

Feedback, plan quality and objective helpfulness did not predict participant intentions to continue with the mindful snacking exercise, however self-compassion, problem solving skill, engagement and disengagement coping and

perceptions of intervention helpfulness were all significant predictors. A backwards entry logistic regression model indicated that factors with the strongest predictive value were perceived helpfulness and disengaged coping.

Discussion

Implications around the impact of feedback are discussed. Future interventions are encouraged to consider participant perceptions of helpfulness and coping tendencies when seeking to identify individuals at risk of disengaging early from newly learned behaviours that are otherwise rated as being generally helpful.

Introduction

It is well known that weight loss is difficult to maintain (Dohle, Diel, & Hofmann, 2018). While reasonably efficacious weight loss interventions have been developed (Burgess, Hassmén, Welvaert, & Pumpa, 2017), long-term outcomes for those who manage to lose weight are considerably less optimistic, and most individuals are likely to regain their lost weight within the first 12-24 months, post-loss (MacLean et al., 2015). According to a recent meta-analysis and systematic review of behavioural interventions and weight outcomes (Burgess et al., 2017), poor adherence to diet, exercise and treatment regimes in the long term is common; individuals do not continue to observe the same behaviours that helped them to lose weight consistently across long periods of time. This predisposes them to weight regain (Burgess et al., 2017; MacLean et al., 2015). It has been suggested that this long-term poor adherence to weight-maintenance behaviours may be the result of reduced positive feedback over time; initial weight loss is perceived as beneficial, experienced as rewarding and worth the

investment in time, energy and adapted behaviours (MacLean et al., 2015). However, weight loss maintenance is perceived as being less rewarding and thus, less worthy of this same investment (MacLean et al., 2015). As small repeated snacking behaviours (such as an increase of x1 fruit serving/day or a few less bites per meal) can have positive long-term effects on weight maintenance (Burgess et al., 2017; Hill, 2009), it is important to be able to predict the contexts in which intentions to either continue or discontinue engaging in these behaviours are formed. Therefore, the primary aim of this study is to investigate the psychological factors that predict and may be relevant to intentions formed about one such behaviour – that is, to predict intentions to either continue or discontinue with the mindful snacking exercise beyond the timeframe of the intervention. The following section gives an overview of likely predictors included in this study.

Helpfulness

Adherence to weight loss maintenance practices has been conceptualised within a value-expectancy framework, where behaviour must have a certain value in order to offset the cost of the behaviour's effort (MacLean et al., 2015). Therefore, it may be that the behaviours are only continued over time if they are effective enough to be considered worth the effort of consistently enacting. Previous research has emphasised the relevance of participants' own perceptions of helpfulness and the need for this to be captured when evaluating weight loss maintenance interventions (Dalcin et al., 2015). However, people are not always accurate judges of their own progress (Knoll, Otani, Skeel, & Van Horn, 2017) and it remains unclear whether the objective helpfulness of an action or the perceived helpfulness of that same action is the stronger predictor of an individual's intention to continue. Furthermore, it remains unclear whether

perceptions of behavioural helpfulness should predict intentions to continue or discontinue. If maintenance is viewed from a value-expectancy framework, then it makes sense that higher perceptions of a behaviour's helpfulness would likely predict intentions to continue that behaviour (as it would be considered more valuable and worth continually enacting). However, people often balance the pursuit of more than a single goal at a time, and these goals are commonly incongruent (Fishbach & Dhar, 2005). For instance, a person may wish to maintain their current weight, but also wish to enjoy foods which promote weight gain. According to Fishbach and Dahr (2005), perceptions of progress in the pursuit of one goal can often have ironic rebound effects, as this liberates people to pursue other, inconsistent goals instead. Thus the perceived helpfulness of a specific behaviour may predict continuance of that behaviour as it becomes considered more worthy of enactment. Or, perceptions of helpfulness may predict intentions to (at least temporarily) disengage from the behaviour, in favour of balancing progress with alternative, incongruent goals.

In short, predictive value of both perceptions of helpfulness and objective measures of helpfulness remains unclear, and these remain fruitful avenues of investigation.

Planning

Various investigations into the psychological predictors of sustained weight loss have identified planning skills as a crucial ingredient in long-term outcomes (Dibb-Smith, Brindal, Chapman, & Noakes, 2016; Reilly et al., 2015). In brief, planning has been defined as a set of mental processes, which prepare someone to enact a behaviour (or set of behaviours), drawing on past expertise (Friedman & Scholnick, 2014). Planning functions also weave new experiences

into future preparations, often as a part of problem solving, proactive coping or goal-striving (D'Zurilla & Chang, 1995; Friedman & Scholnick, 2014; Gollwitzer & Sheeran, 2006). In this sense, planning can be seen as a cycle which starts with the mental preparation for enacting a single behaviour, followed by an attempt at this behaviour, and the development of a set of appraisals and evaluations, which finally are used when preparing for any subsequent attempts. Much research has been conducted on planning as it occurs at the beginning of this cycle, often in the form of implementation intentions and action planning. These strategies have successfully produced successful weight loss (Prestwich et al., 2012), healthier diets (Adriaanse, Vinkers, Ridder, Hox, & Wit, 2011; Chapman & Armitage, 2012), reductions in unhealthy snacking behaviour (Kroese, Adriaanse, Evers, & De Ridder, 2011) and higher levels of exercise (Milne, Orbell, & Sheeran, 2002; Prestwich et al., 2012).

However, the latter stages of planning, particularly post-action evaluations have been under-researched and may be highly relevant to predict longitudinal engagement. According to Friedman and Scholnick (2014) post-action phases which include performance evaluation and interpretation act as important determinants of how experience will shape future beliefs and learning (Friedman & Scholnick, 2014). This means that the later, reflective stages of planning may have an important impact on whether people intend to either continue adhering to or to disengage from key weight maintenance behaviours.

Problem Solving

Planning has been conceptualised as part of the problem-solving process (D'Zurilla, Nezu, & Maydeu-Olivares, 2002). However, whereas planning is thought to occur in preparation for behavioural enactment and can occur outside

of problem solving (e.g. when initiating a new form of action, or throughout goal pursuit), problem-solving occurs in response to a perceived problem. This makes problem solving particularly relevant in situations where behaviours require skill or forethought, or are susceptible to encountering problems. As weight maintenance is a lifelong task, the presence of problems, barriers and small lapses are unavoidable. Given this, problem solving skills are highly relevant and may be predictive of decisions regarding the continuance of behaviours when planned action does not run smoothly. According to D'Zurilla et al., (2002) the problem solving process consists of five main stages:(1) developing a definition and understanding of the problem, (2) generation of possible solutions, (3) deciding on a single appropriate solution to trial, (4) planning and implementing that solution and (5) the evaluation of its success or failure to inform subsequent future planning and problem solving. Problem solving theory has been developed into a clinical therapy (Nezu et al., 2013), known as Problem Solving Therapy. This clinical approach has shown efficacy as an intervention to facilitate both weight loss and treatment adherence (Murawski et al., 2009; Perri et al., 2001), and as problem solving has been identified as a significant predictor of successful weight loss maintenance (Dibb-Smith et al., 2016), it is logical to suggest that problem solving skill may be predictive of intentions to continue enacting specific behaviours.

Coping

Relevant to both planning skills and problem solving is a person's coping style. According to Nezu et al., (2013) the ways in which we cope in the face of adversity will influence whether and how effectively we engage in planning and problem solving. In a seminal work on the hierarchical nature of coping (Tobin,

Holroyd, Reynolds, & Wigal, 1989) two main types of coping were identified: Engagement coping occurs when individuals take active steps to control, manage or change stressful circumstances. Disengagement coping is characterised by individuals seeking to withdraw and avoid transactions with others and their environment (Tobin et al., 1989). Disengaged coping has been found to be associated with higher BMI, experiences of weight-related stigma and feelings of shame (Conradt et al., 2008). Although engaged and disengaged coping have been conceptualised as the superordinate factors, coping is also described in relation to its secondary factors – that is, emotion-focussed coping (engaging with or disengaging from the uncomfortable emotions that naturally arise from adverse situations) or problem-focussed coping (engaging with or disengaging from aspects of the problem one is coping with). Problem-focussed engagement coping includes actions such as planning and problem solving, and has been traditionally reported as being the most efficacious long-term coping style to assist people to navigate adverse situations (D'Zurilla & Chang, 1995) - however, more recent literature has begun to acknowledge that the key to successful coping may be to adapt responses to different situational demands (Stephenson, King, & DeLongis, 2016). Emotion-focussed coping may be particularly appropriate when the problem is outside of one's control, when it is a problem that requires the passage of time to be resolved and when the problem causes high levels of distress (Neff, Hsieh, & Dejitterat, 2005).

Self-Compassion

Self-compassion may be highly relevant to how people make decisions to continue/discontinue behaviours helpful for weight-loss maintenance. Given that self-compassion is an established emotion-focussed and adaptive way of coping,

(Braun, Park & Gorin, 2016) it may be particularly useful in overcoming emotion-related barriers to weight maintenance such as the impact of stigma and emotional eating (Mantzios & Wilson, 2015). Indeed, both coping and self-compassion may be particularly relevant given that they impact on emotional states and motivation (Conradt et al., 2008; Neff & Dahm, 2015). Emotional states and other motivational factors are likely to impact the planning process when the task is difficult, and especially when it requires strategic re-engagement when action steps go awry (Friedman & Scholnick, 2014). Given the difficult and complex nature of weight maintenance, and the inevitability of action steps going awry within the scope of a lifelong task, it seems particularly pertinent to investigate the predictive value of these psychological factors. This makes both coping and self-compassion constructs of interest for this study.

Feedback

Finally, participants in weight loss interventions are often asked to record and monitor their ongoing progress (e.g. through food diaries, daily weigh-ins, etc) (Burgess et al., 2017). This provides participants with consistent feedback about their progress. Even in the absence of active monitoring, feedback cues in the form of clothing size and tightness are regularly noticed by those attempting weight maintenance (Chambers & Swanson, 2012; Dibb-Smith et al., 2016). Performance feedback is also commonly used in weight management interventions, and has been shown to invoke emotional responses, which have a significant impact on behavioural intentions and behaviour (Belschak & Den Hartog, 2009). Specifically, positive feedback has been shown to increase positive or pleasurable emotions, and to increase commitment. On the other hand, negative feedback increases negative or uncomfortable emotions, and can inspire

withdrawal from or less effortful behaviour (Belschak & Den Hartog, 2009). This becomes even more pertinent given the nature of maintenance tasks, which are often longitudinal or lifelong. As negative feedback cues are unavoidable within the scope of a lifelong task, it is important to understand how this impacts those attempting weight maintenance.

In line with the research outlined above, four hypotheses are proposed:

1) That planning quality, the perceived helpfulness of the intervention, the objective helpfulness of the intervention, problem solving ability, coping style and self-compassion would each significantly predict intentions to continue the mindful snacking exercise, such that higher plan quality, perceived and objective helpfulness, problem solving, engaged coping and self-compassion will increase the chances of intentions to continue.
2) That more disengaged coping would decrease the chances of a decision to continue the mindful snacking exercise.
3) That the presence of feedback would significantly predict the decision to continue the mindful snacking exercise, such that positive feedback will increase and negative feedback will decrease the chances of a decision to continue.

Additionally, this research aimed to investigate the predictive validity of each variable.

Method

Recruitment and Participants

Participants were recruited from those who had just completed a two-week intervention, using a mindful-eating exercise with a self-nominated snack to target their snacking behaviour (see Dibb-Smith et al., 2019; Chapter 5). This intervention contained two time points of measurement – baseline, completed before the intervention, and follow-up, completed two-weeks later at the end of the intervention.

Participants were recruited for the intervention via the Facebook page of the Commonwealth Scientific and Industrial Research Organisation (CSIRO). Advertisements promoting a "Mindful Snacking Study" were targeted to the newsfeeds of people meeting the broad inclusion criteria and who had liked popular nutrition or weight-based pages. Inclusion criteria for the current study included computer access with email, English literacy, currently living in Australia, and a desire to eat a particular snack food less habitually. Participants were excluded on ethical grounds if they exhibited a strong fear of failure, as measured by a score of 5 (x2 standard deviations above the norm) on the Performance Failure Appraisal Inventory (Conroy, 2002)

Participants (n = 158) completed baseline questionnaires. An attrition rate of 50% over two weeks was anticipated and consistent with predictions regarding e-health interventions (Eysenbach, 2005). In line with these expectations, 78 participants completed the intervention and logged on to complete the follow-up measures. Six participants completed the intervention, but did not complete the main outcome measure for this study. The final sample (n = 72) was aged between 20 and 80 years old (M = 41.77, SD = 13.08) and predominantly female (n = 61, 84.72%).

Design and Procedure

Design

The study had two conditions. Participants who had already completed the two week mindful snacking intervention described in Dibb-Smith et al. (2019; Chapter 5), were randomly assigned at follow-up to receive either positive or negative feedback about their mindful snacking performance (see Figure 3, Chapter 4). Participants were blind to the nature of this study, having been told only of the aims regarding the mindful snacking study. Most predictor variables (problem-solving skill, action plan quality, coping engagement and disengagement) were captured as part of the enrolment process into the mindful-eating study. Self-compassion was also measured, but as this construct is related to mindfulness, and as it exhibited a small changes over the two-week period (see Dibb-Smith et al., 2019; Chapter 5), participant scores at follow-up were used in analysis. All measures were administered online through survey software (Survey Gizmo). Perceived helpfulness of the intervention was reported by participants after completing the two-week intervention. Feedback was also assigned at this time and positive/negative affect was subsequently measured.

Intervention Task: Mindful Eating for Snacking Habits

For a full description of the intervention, see Dibb-Smith et al. (2019; Chapter 5). In brief, the intervention file was a power-point presentation-styled PDF and contained an introduction written by a registered psychologist (ADS), explaining the premise of mindful snacking. The ‘eating one raisin’ exercise was adapted so that participants instead focussed on eating a snack food of their choosing.

Procedure

As a part of enrolment into the mindful snacking study, all participants gave consent online after reading an information sheet, provided email addresses for future contact and completed baseline questionnaires (including the PFAI screener, Self-Compassion Scale, Self-Report Habit Index, Social Problem Solving Inventory, Coping Strategies Inventory). Participants were also asked to nominate a snack they wished to eat more mindfully, and then devised action plans for when and where they would do so. Eligible participants were welcomed into the mindful snacking study via a standardised email, containing the mindful snacking intervention exercise as an attachment. Two weeks later, participants received a second email, containing the link to the electronic survey and asking them to complete their follow-up measures (Self-Report Habit Index, Self-Compassion Scale). Upon completion participants proceeded to provide data for this study; asked to evaluate the helpfulness of the mindful eating exercise, and presented with falsified feedback stating that they either had or had not improved their mindful eating skills. The feedback manipulation focussed on improvement (or non-improvement) in participant mindfulness skill rather than number of snacks eaten to retain apparent plausibility of the feedback. Participants were asked to record any positive or negative affect, as measured by the Positive and Negative Affect Scale (described below), and to state their intention regarding future practice of the mindful snacking exercise. The question regarding future intentions acted as the outcome measure for this study. This was presented as a multiple choice question, with categories designed to collapse for analysis into a categorical choice (Y / N). Participants were then debriefed.

Measures

Coping Style Inventory – Short Form: CSI (Tobin, 2001)

This 32-item scale measures the extent to which a person engages in different cognitive and behavioural responses in order to manage or tolerate stress (e.g. “I spend more time alone”). Participants are asked to respond on a 5 point Likert Scale, indicating the degree to which they engage in each behaviour during times of stress (1 = ‘Not at all’, 5 = ‘Very much’). The scale yields two composite scores which capture the degree to which a person utilises engagement and disengagement strategies. The scale exhibited good overall reliability in the current study for both engagement (α = .82) and disengagement (α = .87).

Positive and Negative Affect Scale: **PANAS (Watson, Clark, & Tellegen, 1988)**

The Positive and Negative Affect Scale measures both positive and negative affect. It is comprised of a list of 20 different feelings (e.g. “Interested” or “Jittery”). Participants are asked to reflect on the extent to which they are currently experiencing each feeling on a 5-point scale (1 = ‘Very Slightly’, 5 = ‘Extremely’). The scale yields two composite scores of both positive and negative affect (each scored out of 50). Both the positive (α = .91) and negative (α = .84) composite scales yielded acceptable reliability.

Self-Report Habit Index: **SRHI (Verplanken & Orbell, 2003)**

This 12-item index was used to measure the strength of snacking habits. Participants endorsed statements about a behaviour (e.g. “(Behaviour x is something I do frequently”) by responding on a 5-point Likert scale (1 = ‘Disagree’, 5 = ‘Agree’). For the purposes of this study “behaviour x” became “snacking on (participant’s individually chosen snack-food, e.g. chips)”. The scale exhibited excellent reliability (α = .90).

Self-Compassion Scale**: SCS (Neff, 2003a)**

This 26-item scale has 6 sub-scales (self-judgement, isolation, over identification, self-kindness, mindfulness and common humanity), combined to create a Total Self-Compassion Score. Questions (e.g. “I’m disapproving and judgmental about my own flaws and inadequacies”) are presented on a 5-point Likert scale (1 = ‘Almost never’, 5 = ‘Almost always’). The scale and subscales demonstrated good reliability in the current study (α = .72 to .90).

***Social Problem Solving Index (Revised) – Short Form*: SPSI-R (D’Zurilla et al., 2002)**

This 25-item scale captures the way in which participants respond to and resolve problems in their everyday lives, by asking respondents to endorse statements such as “I feel threatened and afraid when I have an important problem to solve”. Participants endorse statements on a 0-4 Likert Scale (0 = ‘Not at all true of me’, 4 = ‘Extremely true of me’). The measure yields a total problem solving score out of 20. The scale exhibited good internal consistency in the current study (α = .79).

***The Goal-Evaluation Tool for Diabetes:* GET-D (Teal et al., 2012)**

A measure of action plan quality was derived from The Goal-Setting Evaluation Tool for Diabetes (GET-D). This measure was designed to assist self-management in diabetes (Teal et al., 2012) but has been used in the context of a weight loss intervention proogram). The GET-D assigns points based on a series of questions (e.g. “Does the plan identify how often the action(s) will be taken?”). A score of plan quality is yielded (0-19); higher scores indicate better quality plans. One of the criteria “intensity of action” pertains to exercise; this was adapted for our study to a “specify food amount” criteria, to better suit the nature

of the task. Inter-rater reliability between two coders was acceptable (Kappa = 0.81).

Helpfulness

Perceived helpfulness: In order to assess whether participants considered the intervention exercise helpful, participants were asked whether they believed the mindful eating exercise was helpful with regards to their snacking goals. Responses were given on a 10-point scale (1 = 'Not at all', 10 = 'Very much'). This question formed the basis of the "perceived helpfulness" variable.

Objective helpfulness: In order to assess how helpful the mindful snacking behaviour was to participants an 'objective helpfulness' measure was derived. Participants had all identified a snack which they wished to eat less habitually as a part of the intervention study, and so an objective helpfulness score was achieved by comparing each individual's snacking habit score at baseline with their follow-up score. Follow-up scores of habit, measured using the SRHI were subtracted from baseline habit scores, with positive integers denoting improvement, and negative scores denoting habits which had gotten stronger rather than weaker (e.g. a participant scoring 30 on the SRHI at baseline and only 20 at follow-up would have an improvement score of 10, indicating that their habitual eating of this snack had weakened by 10 points as measured by the SHRI). This formed the basis of Objective Helpfulness.

Future intentions

Future intentions were captured using a single multiple choice and categorical question with four response options. These response options were designed to collapse into two categories for the purpose of analysis. These two categories represented either a clear intention to continue using the mindful

snacking exercise ("Yes"), or other intentions to either cease or reconsider using the mindful snacking exercise ("No"). A multiple choice question was posed instead of a forced-choice question, to eliminate response biases associated with forced choice questions towards saying "Yes", and in line with research suggesting that answers to multiple choice questions are more reliable (Peterson & Grant, 2001). The first response option represented the 'Yes' intention category ('I will continue to address my snacking using mindful snacking to assist me'). Four alternative intentions comprised the 'No' intention category ('I will not continue to address my snacking behaviour', 'I will find another way to address my snacking without using mindful snacking' and 'I have already thought of a new way to address my snacking and will try this instead of mindful snacking', and 'I am not sure').

Results

Data Analysis

A series of univariate logistic regressions were performed to investigate whether predictor variables were able to significantly predict the likelihood of decisions to continue the mindful snacking behaviour. A backwards stepped regression model was then used to investigate which predictors best explained participant decisions to continue or disengage. All statistical analyses were conducted using SPSS (IBM, 2016). In accordance with the recommendations of Vittinghoff and McCulloch (2007), no more than eight predictor variables were examined in order to preserve statistical power. Backward stepwise entry was selected in line with Field's (2005) recommendations - that stepwise entry be used for preliminary works and analyses where previous research has not yet established a theoretically

based order of importance for the included factors. Backwards entry rather than forward entry was selected in order to avoid suppressor effects (in which a variable may have predictive value, but only when another in the analysis is held constant), minimising the risk of any Type II errors. In order to investigate which were the strongest predictors, all predictor variables were entered simultaneously and removal testing was based on the probability of the Wald statistic.

Sample Characteristics

Participants exhibited average levels of self-compassion at baseline (*M* = 3.08, *SD* = 0.79) as per score interpretations published by (Neff, 2018), and average degrees of social problem solving (*M* = 13.34, *SD* = 2.59), coping: engagement (*M* = 48.87, *SD* = 9.44) and coping: disengagement (*M* = 42.10, *SD* = 10.36). Action plan quality has been rarely measured quantitatively, but average scores in our sample (*M* = 8.73, *SD* = 2.99) were comparable to those published in a different Australian sample (Dibb-Smith et al., 2016; Chapter 2). Initial habit strength scores (*M* = 27.74, *SD* = 9.61) were in line with estimates of 'unhealthful eating' habits from a recent systematic review (Gardner, de Bruijn, & Lally, 2011). Participants who dropped out of the intervention were not significantly different from those who did not on any baseline measures (see Table 1, Chapter 3).

Manipulation Checks and Descriptive Statistics

The mindful snacking exercise was perceived by participants as being moderately helpful in assisting participants to reach their broader snacking behaviour (*M* = 6.72, *SD* = 2.81), and there was considerable variation in how often participants

practiced the exercise over the two week intervention period (*M* = 13.30, *SD* = 16.85). Participants reported that overall they tended to eat their target snacks fewer times throughout the intervention (*M* = 6.61, *SD* = 10.83) than they at baseline (*M* = 10.12, *SD* = 21.85). However, the objective measure of helpfulness indicated that the strength of their snacking habits as measured by the SHRI generally increased rather than decreased (*M* = -7.49, *SD* = 10.22).

In order to assess whether participants in the different feedback conditions experienced different levels of positive and negative emotion after receiving the feedback, an independent samples *t*-test was conducted, comparing the positive feedback group's affect (both positive (*M* = 25.14, *SD* = 7.87) and negative (*M* = 13.06, *SD* = 4.52) with the negative feedback group's affect (positive (*M* = 25.14, *SD* = 8.11) and negative (*M* = 14.97, *SD* = 5.34). Both the t-test for positive affect (*t* (70) = -.004, *p* = .997) and negative affect (*t* (70) = 1.639, *p* = .106) were non-significant, indicating that neither positive nor negative affect was significantly different across the two feedback conditions.

Assumption checks for logistic regression

As observations were independent from one another (i.e. from different participants), the assumption of a binomial distribution is taken to be robust (Peng et al., 2002). Multicollinearity was assessed by constructing a correlation matrix (Table 1). In line with the recommendations of Tabachnick and Fidell (2007), no predictors were highly correlated at or near *r* = .7 .

Table 1
Correlation Matrix of Predictor Variables and Perceived Helpfulness

	Get-D	SCS	Engage	Disengage	SPSI	P. Helpful	O. Helpful
Get-D	-	-.005	.033	.221	-.047	-.147	.182
SCS		-	-.582**	.584**	-.531**	.045	-.061
CSI - Engage			-	-510**	.407**	-.088	.004
CSI-Disengage				-	-.578**	.063	.131
SPSI-R					-	-.015	-.009
P. Helpful						-	-.20
O. Helpful							-

Note. GET-D = The Goal-Evaluation Tool for Diabetes; SCS = Self Compassion Scale; CSI-Engage = Engagement scale of the Coping Strategies Inventory; CSI-Disengage = Disengagement scale of the Coping Strategies Inventory; SPSI-R = Social Problem Solving Inventory; P. Helpful = Perceived helpfulness; O.Helpful = Objective helpfulness.
*$p < .05$, **$p < .001$

Univariate logistic regressions

In order to determine whether the study variables were individually predictive of participant decisions, and in order to investigate the direction of relationships (and so to address hypotheses 1, 2 and 3), a series of univariate logistic regressions were constructed.

Logistic regression models were constructed for each of the predictors, entering participants' dichotomous intentions to either continue or discontinue with mindful snacking as the dependant variable and a single predictor variable as the independent variable. These models revealed that problem solving ability, coping style, perceived helpfulness and self-compassion were all significant predictors of participant decisions, and plan-quality approached significance (Table 2). For each point increase in problem solving skill, as measured by the SPSI, the odds of

deciding to continue with mindful snacking increased by 26%. For each increase in engagement coping, as measured by the CSI, the odds of deciding to continue with mindful snacking increased slightly by 6%. For each increase in disengaged coping, as measured by the CSI, the odds of deciding to continue with mindful snacking decreased by 7.8%. For each increase in self-compassion as measured by the SCS, the odds of deciding to continue with mindful snacking unexpectedly decreased by 11.3% . For each point increase rating of perceived helpfulness, participants were more likely to decide to continue with mindful snacking by almost 60%. Hosmer & Lemishow tests revealed an acceptable fit for each model.

Table 2

Univariate Logistic Regressions Predicting Participant Intentions to Continue

Predictor variable	*p*	*b*(ex) – Odds Ratio	95% CI		Hosmer & Lemistows test
Feedback (+,-)	.144	2.087	.777	5.605	-
Self-Compassion	.032*	.887	.795	.990	.141
SPSI-Total	.011*	1.261	1.054	1.508	.731
GET-D	.073	.866	.740	.1014	.501
Engagement Coping	.038*	1.060	1.003	1.120	.383
Disengagement Coping	.001*	.922	.878	.969	.219
Objective Helpfulness	.137	1.039	.988	1.093	.407
Perceived helpfulness	.000**	1.596	1.243	2.048	.511

*$p < .05$, **$p < .001$

Backwards Prediction Model

In order to explore the strongest predictors, a backwards logistic regression was conducted. As can be seen in Table 3, below, Hosmer & Lemishow tests revealed an acceptable model fit for each stage. Feedback was the first predictor eliminated from the model, followed by self-compassion, objective helpfulness, plan quality, problem solving and engagement coping. The final model comprised of two significant predictors. These results suggest that disengagement coping and perceived helpfulness of the behaviour are the strongest predictors of whether people will intend to continue a behaviour, whilst controlling for the effects of feedback, self-compassion, objective helpfulness, plan quality, problem solving skill and engagement coping. In this model, which controlled for the effect of all eliminated predictors, disengagement coping led to a higher probability of deciding to discontinue with mindful snacking. The perceived helpfulness of the mindful snacking exercise led to a lower probability of intending to discontinue with the exercise. For each increase in disengagement coping as measured by the CSI, the odds of deciding to discontinue with mindful snacking increased by 12.8%. For each increase in perceived helpfulness, the odds of deciding to discontinue decreased by 41.8%.

Table 3.

Backwards Prediction Model Exploring Strongest Predictors

Step	Predictor variable	*p*	*b*(ex) – Odds Ratio	95% CI		Hosmer & Lemishow
0						.991
	Feedback (+,-)	.783	.825	.210	3.241	
	Self-Compassion	.737	.967	.794	1.178	
	SPSI-Total	.552	.917	.688	1.221	
	GET-D	.563	.952	.734	1.183	
	Objective Helpfulness	.564	1.019	.955	1.087	
	Engagement Coping	.452	.965	.880	1.059	
	Disengagement Coping	.038*	1.110	1.006	1.225	
	Perceived Helpfulness	.001*	.555	.390	.789	
1						.855
	Self-Compassion	.743	.968	.794	1.179	
	SPSI-Total	.554	.917	.690	1.220	
	GET-D	.595	.939	.744	1.185	
	Objective Helpfulness	.583	1.018	9.55	1.086	
	Engagement Coping	.481	.968	.884	1.060	
	Disengagement Coping	.038*	1.110	1.006	1.224	
	Perceived Helpfulness	.001*	.561	.561	.399	
2						.901
	SPSI-Total	.585	.925	.698	1.224	

	GET-D	.616	.943	.749	1.187	
	Objective Helpfulness	.555	1.019	.956	1.086	
	Engagement Coping	.528	.973	8.95	1.058	
	Disengagement Coping	.034*	1.103	1.008	1.207	
	Perceived Helpfulness	.001*	.566	.405	.792	
3						.498
	SPSI-Total	.603	.931	.713	1.217	
	Objective Helpfulness	.663	1.014	.953	1.079	
	Engagement Coping	.583	.977	.899	1.062	
	Disengagement Coping	.026*	1.104	1.012	1.204	
	Perceived Helpfulness	.001*	.582	.427	.793	
4						.324
	SPSI-Total	.650	.941	.724	1.223	
	Engagement Coping	.624	.979	.902	1.064	
	Disengagement Coping	.013*	1.111	1.022	1.207	
	Perceived Helpfulness	.000**	.576	.424	.784	
5						.069
	Engagement Coping	.530	.975	.900	1.056	
	Disengagement Coping	.009*	1.115	1.028	1.209	
	Perceived Helpfulness	.000**	.579	.427	.785	
6						.548
	Disengagement Coping	.001*	1.128	1.047	1.214	

Perceived Helpfulness	.000**	.582	.431	.786

*$p < .05$, **$p < .001$

Discussion

Weight loss maintenance is a complex issue (Montesi et al., 2016) and effective interventions are highly heterogeneous, incorporating many different target skills and behaviours (Brauer et al., 2015). Thus, individuals attempting weight loss maintenance are faced with many potentially helpful behaviours and must continuously decide which of these to adhere to and which to discontinue. The mid-high ranking score of the mindful snacking exercise's perceived helpfulness ($M = 6.72$, $SD = 2.81$) therefore provides good face validity for representing one of the many such choices that those attempting weight maintenance are faced with, and for the generalisability of this study's findings to other weight maintenance contexts. However the objective measure of helpfulness indicated that, exposure to the intervention exercise was not associated with decreased habit strength; habit strength increased, on average by approximately 7 points on the SHRI. It is possible that exposure to the mindful snacking exercise had unintended effects and was associated with increased habit strength rather than the habit weakening. Alternatively, as the aim of mindfulness is to increase awareness and as the SHRI measure (as a self-report questionnaire) captures the subjective experience of habit, it is also possible that this score reflects increased awareness of habitual experiences.

Previous research has documented the impact of feedback both on affective states (e.g. positive and negative mood) and on persistence-related decisions (via the mediated impact of changes in affective states) (Belschak & Den Hartog, 2009). The results of the current study were in contrast to these

findings. Interestingly, our positive vs negative feedback manipulation was not a significant predictor of people's intentions to continue using the mindful snacking exercise (Hypothesis 3). Furthermore, participant affect, as measured by the PANAS, did not differ between groups following the feedback manipulation. These findings are significant, as there is considerable value in developing techniques to deliver accurate and sometimes negative performance feedback to intervention participants, while avoiding the consequences associated with negative affect (Kung, Kim, Yang, & Cheng, 2016). Given that feedback manipulations in other studies have induced significant differences in affect (Belschak & Den Hartog, 2009; Fong et al., 2018), and given that our participants did report engaging in the mindful snacking exercise with a moderate amount of effort (M = 6.05, SD = 0.29 – see Dibb-Smith et al., 2019 for details), the results appear at odds with previous research.

One potential explanation is that there must be something different and specific to this study's feedback manipulation that avoided the occurrence of negative affect. It could be that the feedback failed to produce an affective difference because participants were self-aware of their objective progress through their own experiences, and therefore simply chose to disregard the feedback. However, objective helpfulness (as measured by the change in SHRI) was not significantly correlated with perceived helpfulness, nor did it significantly predict the decision to continue. This is consistent with previous research, suggesting that people are not always reliable judges of their own performance (Knoll et al., 2017). Moreover, even when feedback is disregarded, it may still have significant affective impacts (Fong et al., 2018). Thus, a more suitable explanation may lie in the style of feedback used in the current study. While there is a lack of research regarding the impact of feedback on emotion and learning

(Pekrun, Cusack, Murayama, Elliot, & Thomas, 2014), recent work has reported large differences between the emotional responses that arise after self-referential feedback (which emphasises a person's performance relative to their own previous performance) and normative feedback (which makes comparison with the performance of others). Specifically, self-referential feedback has been associated with less anger, hopelessness, anxiety, and shame with medium to large effect sizes (Pekrun et al., 2014). As the feedback manipulation in the current study involved self-referential feedback rather than normative, perhaps this goes some way to explain why negative feedback was not associated with significantly more negative affect. Future interventions may wish to carefully consider the style of feedback provided to participants, in the context of the intervention's affective intent.

Hypothesis 1 predicted that plan quality, perceived helpfulness, objective helpfulness problem solving ability, engaged coping and self-compassion would each significantly predict intentions to continue the mindful snacking exercise, such that higher values would increase the chances of intentions to continue. Hypothesis 2 predicted that higher levels of disengaged coping would significantly predict lower intentions to continue. Both of these hypotheses were mostly supported by the results. With the exception of plan-quality and objective helpfulness, self-compassion, problem solving, perceived helpfulness and engaged and disengaged coping were each significantly predictive of participant intentions. This is an important finding, as decisions to continue with maintenance-related behaviours makes a large impact in long-term maintenance, and these decisions are still poorly understood. Most of our factors predicted either continuance or discontinuance as hypothesised: having stronger problem solving skills and engagement coping increased the odds of a intending to continue with the mindful

snacking exercise, as did perceptions of the exercise's helpfulness. Endorsement of a disengagement-based coping style increased the odds of a decision to discontinue, as predicted in Hypothesis 2.

Interestingly, in contrast to Hypothesis 1, higher levels of self-compassion increased the odds of a decision to *discontinue*. A strong foundation of previous research has reported on the value of self-compassion as an emotion-focussed coping strategy which is negatively related to avoidance (Neff et al., 2005). Previous research has additionally recognized the construct's value as a facilitator of persistence in adverse conditions, including moral, academic and personal failures or lapses (Breines & Chen, 2012). This would appear to make it highly relevant to weight maintenance behaviour decisions, and it was hypothesised that higher self-compassion would predict intentions to continue with the mindful snacking exercise, rather than to cease it. However, some recent work has also found a negative association between self-compassion and task persistence. In an experiment that measured both trait and state (primed) self-compassion, (Landgraf, 2013) found that in situations of high pressure, more self-compassionate individuals persisted for shorter amounts of time than less self-compassionate counterparts. Specifically, self-compassion led to more consistent effort across the different conditions of pressure, such that self-compassionate participants persisted longer in situations of low pressure, but for shorter periods than a comparison control group (not primed with self-compassion) in pressured contexts. The researchers conclude that people who are high in self-compassion, (similar to those high in self-esteem) may more readily resign if they believe the task demands more than they can deliver (Landgraf, 2013). Although our mindful snacking task was not designed to induce feelings of pressure, public discourse heavily moralises issues of weight and consumption (Cowling, 2016) and

previous research has acknowledged that snacking can be associated with both self-judgement and guilt (Schuster, Painter, Bernas, & MacKenzie, 2017).

Furthermore, while mindfulness has been associated with the co-cultivation of self-compassion (Neff & Dahm, 2015), this is not always the case – particularly when the mindfulness exercise focusses on external physical sensations (such as sensory touch, sight and smell) rather than internal states (such as thoughts and feelings) and in the absence of a face-to-face facilitator to model self-compassionate attitudes and behaviours (Neff & Dahm, 2015). As self-compassion was not developed alongside mindful snacking in the current sample (see Dibb-Smith et al., 2019; Chapter 5), the exercise may have inadvertently produced a sense of pressure, resulting in self-compassion leading to intentions to discontinue. Weight loss maintenance is widely acknowledged as being a complex, longitudinal and demanding task, and future research investigating the benefits of self-compassion may wish to measure participant perceptions of pressure and of ability to succeed alongside self-compassion. It remains to be seen whether there are some weight loss maintenance contexts in which self-compassion does not lead to greater behavioural persistence, and whether decisions to discontinue behaviours in this context may be beneficial in the long term for those attempting weight maintenance.

While one aim of this research was to investigate whether theoretically identified constructs were predictive of participant intentions, a further research question was to investigate which of these predictors were most relevant. It was found that perceptions of the behaviour's helpfulness and a disengaged style of coping were the strongest predictors of a participant's decision to continue or otherwise, whilst controlling for all other factors (feedback, self-compassion, problem solving, plan quality engagement-coping and objective helpfulness).

Coping style has long been established as an important framework for describing the ways in which people react to stress and difficulty. Consistent with this, the results suggest that people who identify with a coping style that emphasises disengagement strategies may be most at risk for deciding to discontinue with behaviours taught in weight management interventions. Although not tested directly, the current study suggests that individuals who cope by disengaging could be considered to be at higher risk of relapse in the long-term through non-adherence (Lillis & Kendra, 2014). Future work may benefit by considering the identification and appropriate early support of these individuals. Notably, the intervention was only two weeks in length, and was able to capture people who already self-reported disengaging in a behaviour after this short period. As weight regain typically occurs over months or years post-weight loss, it may be useful to identify and target those at risk of disengagement from the beginning of intervention, to assist them as they encounter challenges and problems.

It is also interesting that perceptions of the mindful snacking exercise's helpfulness were more relevant in predicting participant intentions to continue than the objective helpfulness measure. The predictive value of perceived helpfulness was not only significant, but also substantial; participants were almost half as likely to disengage with each single point increase in perceived helpfulness, as measured on a 1-10 point scale, even when controlling for the effects of feedback, self-compassion, objective helpfulness, planning and problem solving ability. Indeed, this was the case even when objective measures of helpfulness were at odds with participant perceptions of helpfulness; participants rated the intervention as being moderately helpful despite the objective measure of helpfulness indicating that participant habit-scores on average tended to worsen rather than improve. This may indicate that the objective measure of helpfulness

did not capture the full extent of intervention benefits as perceived by participants and lends credence to the notion that the mindfulness-based exercise may have increased participant awareness of their habitual snacking experiences, rather than increasing habit strength per se. Alternatively, this may indicate that participant perceptions of intervention helpfulness do not accurately reflect their progress, and further research is needed to better understand the relationship between participant perceptions of helpfulness and their objectively measured progress. Despite existing recommendations, the perceived helpfulness of intervention components is often overlooked in the evaluation of intervention delivery (VanWormer, Martinez, Consentino & Pronk, 2010). However, previous research has established that those who are more successful in weight management tend to be more satisfied with intervention delivery (Dalcin et al., 2015) and consistent with this research, the current results suggest that those who perceive intervention components to be helpful are less likely to express intentions to disengage. Future interventions may benefit from capturing perceptions of helpfulness with regards to intervention components, particularly as these often differ across demographics (Dalcin et al., 2015). Targeted interventions that take into account the target community's specific perceptions of what intervention types and components are helpful seem more likely to result in favourable intentions to continue and thus to foster better adherence.

As weight management is not comprised of a single repeated action, but rather of many disparate actions which all have a cumulative impact, the mindful snacking exercise reported here has good face validity in representing the kinds of behaviours that participants decide to incorporate or drop from their weekly routines. However, it is worth acknowledging that this study has examined only one such behaviour. Decisions to continue or cease such behaviours must

logically happen at multiple time points throughout the weight maintenance journey, and while this study yields interesting results and insight into the predictors of one such decision, it was only designed to capture decisions at a single time point, (two weeks after initial uptake). It remains to be seen whether, among those who persist, the predictors of ongoing decisions remain the same across longer timescales. Weight maintenance has been acknowledged as difficult to study due to the multifaceted and longitudinal nature of the task (Dohle et al., 2017), and while the current findings identify relevant predictors for future study, more research is needed to investigate the longitudinal relevance of these predictors, as well as any causal relationship.

This research has presented a first step into investigating the ongoing problem of adherence in weight maintenance. The study was able to capture participants intending to disengage from a newly learned weight management behaviour, which was generally rated as being moderately helpful. Both perceptions of helpfulness and the presence of disengagement coping were predictive of participant intentions to either continue or discontinue with this behaviour after a two-week practice period. Future research may fruitfully explore the use of these predictors, by assessing the perceived helpfulness of intervention components in order to effectively target and engage demographics of interest, and to target individuals with a disengaged coping style who may be more at-risk of relapse than their peers. Constructs of pressure and/or guilt within weight-related interventions may also be worth monitoring. Finally, the use of self-referential feedback may be useful in delivering accurate reports of progress without invoking the negative affect and risk of disengagement which is generally otherwise associated with negative feedback.

Chapter 7: Discussion

The research aims of this thesis were to investigate planning and problem solving skills within the context of weight loss maintenance. Specifically, the thesis aimed to investigate conceptions of planning and problem-solving from the perspective of those attempting weight loss maintenance, and to investigate the context in which effective planning and problem-solving typically occurs. The thesis also set out to construct a set of recommendations useful for future work pertaining to the development of interventions assisting with weight maintenance outcomes. This final chapter reviews the findings of the studies and considers the impact of their combined findings within the wider context of the literature. Attention is given to the clinical implications of these findings. Finally, this chapter makes comment on directions for future research and critiques the presented works to acknowledge both their methodological strengths and limitations.

7.1 Summary of the Thesis Findings

7.1.1 Perceptions of planning and problem-solving among those attempting weight maintenance.

The mixed method study presented in Chapter 2 had three aims. Firstly, to investigate how conceptions of planning and problem-solving were perceived by those actively involved in weight maintenance tasks. Secondly, to investigate previous qualitative findings with appropriate quantitative measures. Thirdly, to examine any differences between preliminary weight maintainers and weight re-gainers, after 4 months of attempted weight maintenance.

A mixed methods approach was used and participants completed semi-

structured interviews in addition to a computer-based survey. Qualitative results showed that participants generally regarded planning to be an important concept, and that they related it to both weight loss and weight maintenance. However while planning was generally endorsed as being important, it was also poorly defined and understood. Furthermore, planning events (e.g. forethought about preparing meals) were more frequently described by participants who successfully maintained their weight losses, and less frequently described by participants who regained weight. It was considered that this may mean that more successful weight maintainers differentially engaged in more planning.

The quantitative measure of plan quality, as measured by the GET-D was not significantly different between participants who maintained vs regained their weight losses. It was noted that plan-quality in this sample was relatively low overall and that floor effects for some criteria of the GET-D were observed. These likely contributed to the overall low plan quality ratings. It was also considered that overall engagement in planning (i.e. plan quantity) rather than quality may be more important in differentiating weight maintenance success.

Maintainers had significantly stronger rational problem-solving styles and were less Avoidant/Careless in their problem-solving, and these results were consistent with qualitative findings. Qualitative analysis showed that maintainers more frequently reflected on their mistakes and on problems in a practical, problem-oriented way.

Finally, the way in which maintainers and re-gainers approached mistakes and lapses differed. Maintainers appeared qualitatively to adopt more forgiving, accepting and self-reflective stances, whereas re-gainers were frequently self-punitive and evidenced less reflection and learning from these times. This qualitative finding was not reflected in the quantitative Dichotomous Thinking Inventory, which showed no significant differences between maintainers and re-

gainers, suggesting that some other factor may be at play.

7.1.2 Planning and problem-solving in mindful snacking.

The aim of the second study was to pilot a brief online email-based intervention and explore whether mindful snacking could be used to weaken unwanted snacking habits. A secondary aim involved an exploration of self-compassion alongside mindful snacking with the hypothesis that it may be developed through the intervention.

Results showed that participants ate more mindfully with a small effect ($d = 0.31$), however this was not statistically significant. It was considered that the study was slightly under powered to detect small effects. It was also considered that participants may have a tendency to underestimate how mindlessly they ate at baseline, presumably as they are naïve to what mindful eating was at this stage, minimising detectable effects using self-report measures.

Contrary to prediction, the snacking habit strength significantly increased, despite participants reporting that they ate their snacks *less* frequently than they usually would have. This may be a side effect of using a self-report measure of habit. Furthermore, awareness of the habit may have increased with mindful training. Alternatively, exposure to the materials may have had unintended effects and increased the strength of participant's habits, and further study is required to understand this contraindication.

Self-compassion also significantly decreased (with a small effect), leading to the conclusion that development of self-compassion may be most likely when it is taught either implicitly via modelling or explicitly as an adjunct in mindfulness training. It was also considered that as the sample were novices, and as the experiences they were being mindful of were likely perceived as problematic, a more graded structure of mindfulness training with extra training resources and support may be appropriate in order to better support novices in developing the

acceptance and mindfulness skills needed to approach these experiences with self-compassion.

Interestingly, the frequency with which participants practised the mindful snacking exercise was not associated with these changes. This is consistent with previous research suggesting that number of practice sessions does not necessarily translate into direct changes with associated outcomes (Kiken et al., 2015).

7.1.3 Predicting intentions to continue behaviour.

The aim of the third study was to explore which factors predicted intentions to continue engaging with the mindful snacking exercise following the intervention.

Results indicated that self-compassion, perceived helpfulness, problem-solving style and coping style all significantly predicted future intentions regarding continuance. A backwards entry model revealed that the two strongest predictors were disengagement coping and perceived helpfulness of the behaviour, whilst controlling for all other factors.

The correlations between variables showed that, consistent with previous literature (D'Zurilla & Chang, 1995; D'Zurilla et al., 2002), problem-solving and engagement coping were positively and significantly correlated, and that problem-solving and disengagement coping were significantly and negatively related to each other. However, self-compassion showed an unexpected negative and significant correlation with both problem-solving and engagement coping, and a significant and positive correlation with disengagement coping (see Table 1, Chapter 6).

7.2 Implications

7.2.1 Using problem solving and planning skills to improve weight maintenance outcomes.

Collectively, the thesis found strong support for the inclusion of problem solving. The first and third studies (Chapters 2 and 6) indicate that problem solving is associated with better weight maintenance outcomes. This held true using both physical outcomes (i.e. weight status in study 1), and psychological outcomes (i.e. the intention to continue an intervention exercise in study 3). This was also found using both qualitative and quantitative measures in study 1, and found quantitatively using both the long (study 1) and short (study 3) versions of the Social Problem Solving Inventory.

However, the importance of plan quality remains considerably less clear. Different components of an action plan have been theorised to correspond with different outcomes. For example the quality (detail and specificity) of the part of a plan which specifies the situational cue is, in theory, linked with the activation of the action plan, when this situational cue is encountered (Gollwitzer & Sheeran, 2006; Hagger & Luszczynska, 2014). The quality of the plan's goal-directed action is theoretically associated with the automaticity of the intended action, and the quality of both of these components is thought to be associated with the strength of the mental link between these two elements (Gollwitzer & Sheeran, 2006; Hagger & Luszczynska, 2014). Moreover, when planning is considered cyclic, the quality of any intended monitoring or evaluation during and after implementation is linked to a variety of longer-term outcomes. These include specific attributions of efficacy, the effectiveness with which future plans will be adapted in the face of difficulties, motivation and notions of performance success or failure, as well as more general notions such as expertise developed from the

experience, beliefs about the usefulness of planning in general, and the likelihood with which planning will be invoked as a conscious strategy during future goal pursuit (Friedman & Scholnick, 2014). Given the distinct importance of each of these planning components, the newly developed GET-D measure, which gives attention to each component individually, seemed ideally suited to this body of work. However, despite attempts to measure the quality of action-plans alongside problem solving, the GET-D was not related to weight management outcomes in study 1 (where its use was unmodified), nor intentions regarding the continuance of the mindful snacking exercise in study 3 (where an attempt was made to modify the tool to make it more suitable for non-exercise plans). It was not significantly different across weight outcomes (study 1), nor associated with psychological changes in habit strength or behavioural practice undertaken (study 2). It did not significantly predict intentions to continue using the mindful snacking exercise after implementing an action plan pertaining to when, where and how that exercise would be applied (study 3). It may be that the quality of people's action plans are not as closely associated with weight maintenance outcomes as other plan-related variables. This seems like a viable possibility given the qualitative results in study 1 – where the number of planning events (rather than the quality of plans) differed across preliminary weight maintainers and re-gainers.

Alternatively, the qualitative analysis in study 1 lends itself to an alternative interpretation. The study suggests that planning as a concept, while widely endorsed, was not well-defined or understood and participants struggled to give in-depth definitions or descriptions of how/why it was beneficial. Given this, and that overall plan quality was low across both study 1 and study 3, it may be that teaching participants to make high quality action plans *would* be beneficial,

and that the benefits associated with plan quality were masked, either by floor effects observed in our studies, measurement issues associated with free-text self-reporting measures delivered online (detailed in section 7.3.2) or by the need for a more sensitive measure. The GET-D is a relatively new tool and despite attempts in this thesis to contribute to the validation of this measure, the sensitivity of the GET-D in being able to differentiate weight-related outcomes has not yet been established. Overall, it seems that the GET-D would benefit from further development, including the establishing of population-based norms. It is worth noting that the GET-D also only measures one aspect of planning (aka quality) and future research would also benefit from the development of a tool which captures not only plan quality, but also the frequency with which planning is valued, endorsed as and engaged as a strategy (i.e. decisions to plan, or plan quantity).

7.2.2 The undervalued end of the cycle.

When interviewing the participants from study 1 (Chapter 2), it became evident that one of the implications of a poorly defined conception of planning was that the latter part of both the planning and problem-solving cycles were overlooked. Specifically, the post-action evaluations and interpretations of either successes or failures as well as their associated attributions were largely ignored in conscious thought. This is also consistent with the quantitative measure of plan-quality derived from the study's participants using the GET-D. As mentioned previously, plan quality scores were generally low, and a major contributing factor to this was the lack of intention to engage in monitoring and the associated post-action evaluation of the plan's suitability and efficacy. This also converges with quantitative evidence of plan-quality collected in study 2 (Chapter 5), when plan quality was also generally low – once again, partially due to the GET-D's criterion

regarding monitoring and post-action evaluation.

These findings have far-reaching implications for weight maintenance. According to Friedman & Scholnick, (2014), the implementation phase of planning is the central location of experience and where expertise is built. The post-action phase of planning is where the implementation is evaluated and future planning and actions become more or less likely as a result of the interpretations that are made. These interpretations also partially determine future beliefs about self-efficacy and the efficaciousness of making future plans. Indeed, the monitoring of behaviour has been repeatedly associated with goal attainment (Harkin et al., 2016) and weight maintenance outcomes (e.g. Zheng et al., 2015) – and this is theoretically explained by the reflective learning space that behaviour monitoring creates, enabling people to adjust effort and energy expenditure when there is a discrepancy between their desired state and actual state (Harkin et al., 2016).

Thus if populations interested in managing their weight consistently undervalue or neglect the end of the planning cycle it seems likely that they are less prone to monitoring and thus become likely to miss valuable opportunities for conscious learning and adjustment from the implementation phase of their plans. Progress monitoring is commonly incorporated into weight management interventions, with a recent review reporting that as many as 38% of interventions promoting healthy eating and physical activity included mechanisms for monitoring (Michie, Abraham, Whittington, McAteer, & Gupta, 2009). However, there is more embedded in this notion of 'monitoring' than simply the task of logging behaviour and progress. For example, when describing the theoretical process of goal striving, Harkin et al. (2016) state:

"The crucial activity of goal striving, however, is monitoring goal progress – that

is, evaluating one's ongoing performance relative to the standard – and responding accordingly." (p. 4).

This description clearly refers to monitoring, but also to a process of reflection, where progress is considered, and appropriate adjustments are devised when plans go awry – in short, a planning cycle which includes evaluation and interpretation, and which (when needed) incorporates a problem solving process.

Furthermore, in the absence of conscious consideration and reflection, unconscious and habitual mental processes may dominate (Wood, Quinn & Kashy, 2002). Given that the success of weight management and weight loss maintenance relies heavily on people choosing to favour newer (often weaker) habits over more established ones, under-engagement with the end of the planning cycle may be particularly problematic when goals are weight-related. Future research is needed to quantify the benefits of not just monitoring, but of the conscious, deliberate reflection and interpretation of experiences, which is necessary for the completion of the planning cycle as well as for effective, rational problem solving processes.

7.2.3 The role of self-compassion in weight loss maintenance.

Part of the aim of this thesis was to explore the context in which good planning and problem solving occurs - and to investigate other constructs which may work well in conjunction with planning interventions. A construct seemingly akin to mindfulness and self-compassion arose in the qualitative data of study 1, prompting further study into these constructs in studies 2 and 3.

The results of study 1 appear to support the use of self-compassion as being positively associated with weight loss maintenance. Qualitatively, it differentiated maintainer and re-gainers accounts after 4-months of weight loss maintenance. Moreover, the maintainer accounts in study 1 often used self-

compassionate accounting when interpreting mistakes and lapses, or after plans had gone awry. This presumably made it easier for them to reflect and contemplate openly on such mistakes. Previous research supports this interpretation: self-compassionate individuals have reported experiencing less distress after failure experiences (Allen & Leary, 2010). As weight and weight-management are often stigmatised and associated with complicated cultural notions of individual responsibility and shame (Duarte et al., 2017; Malterud & Ulriksen, 2011), it makes sense that lapses and mistakes in weight loss journeys have the potential to be distressing. Indeed, the distress associated with weight-stigma has been well-documented (e.g. O'Brian et al., 2016). Emotion-focussed coping using self-compassion may assist in alleviating this distress, reducing avoidance and facilitating more rational problem solving and the adjustment of future plans. This is consistent with previous work which supports self-compassion as a facilitator of action persistence in academia (Neff et al., 2005). Future work applying these principles to weight loss maintenance may be beneficial.

However, the relationships between planning, problem solving and self-compassion remain unclear. Interestingly, self-compassion significantly predicted intentions regarding mindful snacking continuance in study 3 (Chapter 6), however higher self-compassion was associated with participants being more likely to intend to discontinue practicing the exercise. Self-compassion was also negatively associated with problem solving and engagement coping, and positively associated with disengagement coping in study 3, suggesting that higher self-compassion was associated with *less* problem-solving, less engagement coping and more disengaged coping. This seems surprising when compared with previous research, which has generally identified self-compassion as an adaptive, emotion-focussed strategy, which promotes psychological

wellbeing (Braun, Park & Gorin, 2016). People who are self-compassionate have been found to show less anxiety after experiencing a stressor (Allen & Leary, 2010; Neff, Kirkpatrick et al., 2007), and according to Neff, and Dahm (2015) self-compassion is positively associated with variables such as optimism and curiosity, which predict action-oriented coping (Allen & Leary, 2010). People who are self-compassionate have been found to be more likely to accept responsibility for their mistakes and failures (Allen & Leary, 2010) and self-compassion has been identified as a factor which should in theory result in more motivation to learn after receiving negative feedback, when pursuing mastery goals (Neff, Hsieh & Dejitterat, 2005).

However, the evidence on self-compassion, problem-solving and coping has been somewhat mixed. After reviewing several studies investigating the relationship between self-compassion and different forms of coping, Allen and Leary (2010) concluded that self-compassion did not appear to relate strongly to the use of problem-solving techniques and that people who are self-compassionate are not necessarily more likely to try and change their situation than those who are low in self-compassion. Despite studies having linked self-compassion to task persistence, even after failures (e.g. Breines & Chen, 2012), more recent work by Landgraf (2013) appears to have qualified this relationship; self-compassion produced more consistent effort across instances of high and low pressure. The results of Landgraf (2013) suggest that in contexts of high pressure, individuals experiencing less self-compassion will continue to persist for longer than individuals who have been primed to feel more self-compassionately. However, those primed with self-compassion will persist more consistently overall, regardless of pressure. This means that they persist significantly longer than controls in situations of no-pressure, but significantly less than controls in situations where pressure is high (Landgraf, 2013). It may be that our intervention

produced an inadvertent sense of pressure in our participants, explaining the inverse association between self-compassion and intentions of task persistence.

The relationships between self-compassion, coping and problem-solving.

Understanding the unexpectedly negative relationship between self-compassion and coping style requires further consideration. While engaged forms of coping, including problem solving, have traditionally been seen as more adaptive than emotion-focussed coping strategies, research has distinguished between two-types of emotion-focussed strategies – one which involves avoidance and disengagement, and another that involves effort to explore and understand one's own reactions and emotions (Allen & Leary, 2010). Avoidance based (or disengagement) coping strategies are generally viewed as maladaptive, as they are associated with poorer wellbeing; however, understanding one's own reactions and emotions is actually related positively to psychological functioning (Allan & Leary, 2010). The coping literature and resultant inventories do not yet have a solid foundation of agreement regarding the best categorisation of coping strategies; a review of the coping literature examining over 400 different coping strategies has indeed concluded that little consensus exists on the best way to categorise these strategies (Skinner, Edge, Altman & Sherwood, 2003). Allen and Leary (2010) similarly acknowledge difficulties among coping measures stemming from interpretation; the same coping action can be used to both regulate emotion and to problem-solve, and similarly while some actions may clearly approach or avoid the stressor, others are more ambiguous. Thus, it is worth commenting on the structure of the coping measurement used. The CSI-SF (Tobin, 2001), categorises some strategies as disengagement (e.g. wishful thinking), which could arguably be incorporated into part of an emotion-focussed component of self-compassionate cognitive restructuring instead (e.g. acknowledging and accepting that you wish things were different and are

struggling with the way things are). This may have nudged self-compassion towards being seen as more related to disengagement coping than engagement coping. Future work remains to bring the coping literature and inventories together more cohesively so that a general consensus can be reached as to which specific behaviours fall into which category or categories. Furthermore, if self-compassion is to be considered an adaptive and emotion-focussed coping strategy, then future work also remains to establish how and if this should be captured on coping inventories in the future and it may be appropriate to redefine some coping components traditionally thought of as representing disengagement.

Overall, it seems most likely that the relationships found in our third study between self-compassion, problem solving and coping are consistent with the notion that self-compassion is an adaptive, emotion-focussed coping strategy which may facilitate engagement and problem solving in some contexts – but which preserves wellbeing in situations of high pressure by facilitating earlier disengagement (and hence less problem solving). Self-compassion remains a construct of interest in weight loss maintenance; the heavily moralised discourses around weight, health risks and the psychological impacts of weight stigma (both internalized and externally encountered) have been well-documented (Cowling, 2016; O'Brien et al., 2016; Papadopoulos & Brennan, 2015). Populations interested in weight management and weight loss maintenance may therefore be vulnerable to emotional distress invoked by these topics, and the inevitably encountered contexts of small-scale failures or lapses may be particularly threatening (Solomon, 2001). Given emerging evidence and the theoretical attributes of the self-compassion construct, it seems likely that self-compassion has the capacity to act as a protective factor against this distress, mitigating the need for avoidance and facilitating engagement with, and effective reflection within the planning and problem-solving space. However, more research is needed

to pair the cultivation of planning and problem-solving skills with self-compassion and to determine the conditions under which there may be quantitative benefits for weight loss maintenance.

A word on mindfulness and self-compassion in weight-related contexts.

In study 2 self-compassion significantly decreased after exposure to the intervention materials. The translation of clinical skills such as mindfulness into online interventions is becoming more commonplace as the benefits of reaching a wider audience with minimal resources has the potential to reach wider audiences and thus to be a powerful tool to assist with public health and wellbeing. However, the value of instructors to actively guide and teach mindfulness in interpersonal settings has been described by Kabat-Zinn (2003), who notes that mindfulness practitioners and particularly novices will inevitably fall into streams of conceptual thought and into challenging emotions throughout their practice. Furthermore, when attending to stimuli that is challenging, Kabat-Zinn (2003) reports that both practice and perseverance is required in order to develop the competencies necessary to both successfully retain a mindful, non-judgemental stance, and to experience the significant benefits generally associated with mindfulness practice. The mechanism by which these benefits arise has been documented by other researchers (e.g. Vago, 2014) who have described mindfulness as a kind of extinction learning in which mental biases (which often incorporate challenging or aversive feeling states) are gradually corrected through consistent and repeated deployment of attention to the present moment. The drop in self-compassion found in study 2 may be related the challenges associated with mindfully approaching (rather than avoiding) experiences which are viewed as problematic. As the study population were new to mindfulness and received minimal guidance (i.e. only a single emailed file on Mindful Snacking), it is important to consider that novice populations may require extra levels of support

to adequately prepare them for approaching these experiences. Instructors (either in face-to-face settings, through internet video channels, or even recorded video) may be useful in anticipating commonly experienced difficulties associated with mindfully attending to challenging objects, and may provide benefits in modelling how to appropriately navigate these difficulties while maintaining the non-judgemental attitude that is vital to effective mindfulness practice (Kabat-Zinn, 2003). In this way, additional instructor supports may assist against participants falling prey to self-judgement and less self-compassion. Minimalist e-health interventions have received much attention in the literature and continue to be both cost-effective and viable options for health prevention and treatment (Ball & Lillis, 2001). However, the translation of these tools into online mediums may change critical elements of delivery and the findings of this research suggest that it may be beneficial for online interventions to incorporate supports that either include (through channels such as video chat) or simulate (through video or other contact) instructors and group learning environments that are more usually present in a clinical setting. This may be particularly the case when working with (a) novice populations, who are still developing their skills and (b) weight loss maintenance populations, who may by the nature of their goals and common intervention targets, be required to attend to challenging stimuli. In line with these findings, it is recommended that future work be undertaken in the service of investigating and quantifying the benefits of differing levels of support for mindfulness-learning with these populations, with particular regard for the cultivation of non-judgemental attitudes and self-compassion.

7.2.4 Recommendations for future interventions.

The final aim of this thesis was to produce a set of recommendations on which the development of future interventions could be based. In light of the findings and discussion above, the following guidelines for future intervention

development are outlined:

1. Interventions involving planning and problem-solving should define these terms explicitly. Definitions of both planning and problem solving, are important to present to ensure that participants are operationalising these constructs in the same manner as professionals involved in intervention delivery. In particular, a broad definition of planning beyond simple action-planning may be helpful in teaching participants to value the end of the planning cycle – i.e. to build-in and attend to monitoring and evaluation processes after attempting to implement a plan. This will arm people with tools that allow continual engagement with shifting routines across the lifespan. Problem-solving skills, as defined by the Social Problem Solving Inventory (D'Zurilla et al, 2002) and frequently taught through Problem Solving Therapy techniques (Nezu et al., 2013) has been demonstrated to be predictive of positive weight management outcomes, both within this body of work, and elsewhere; as such, a definition of problem solving processes and skills consistent with this is recommended.
2. Furthermore, the benefits of both planning and (when obstacles are encountered) problem solving should be explicitly taught. This is important in light of the findings presented in Chapter 2, wherein participants were unable to articulate tangible benefits of these processes, despite these being well-established in the literature and even despite participants endorsing these notions as being generally understood and valued. Taking time to emphasise the value of planning and problem solving becomes even more important when the findings presented in Chapter 6 are considered; perceptions of helpfulness are likely to inform participant intentions to continue. Perceptions of helpfulness may also be beneficial to measure for the purposes of intervention evaluation and refinement. The need for interventions to

incorporate measures of perceived helpfulness for each of their intervention components has been written about previously, but is still often overlooked (Dalcin et al., 2015; VanWormer et al., 2010). Our results suggest that capturing perceptions of intervention helpfulness would (a) allow for identification of intervention components which participants may be more likely to intend to persist with, and (b) allow the components favoured by different populations to be identified, so that future interventions may be more effectively targeted towards demographics whom researchers wish to engage. In short, interventions should not assume that behaviours will be seen as helpful, but would benefit from taking time to investigate perceptions of helpfulness within target populations, and to emphasise and explain the helpfulness of skills involved in interventions.

3. Participants should explicitly be taught *how* to construct good quality plans – that is, plans which incorporate elements used in implementation intentions (if context *x* occurs, then I will enact action(s) *y*) with enough detail to be clear (e.g. specifying not just the action and where/when it will occur, but also how it will occur; specifying intensity, duration or in the case of diet, amounts of food or where the focus of attention will be), and which incorporate some kind of post-action evaluation. This is especially the case given that plan quality was consistently low across samples throughout this body of work, as well as how to problem solve. In future work aiming to quantify plan quality, giving participants alternative ways of recording their plans (e.g. voice recording or discussion with an intervention facilitator) in addition to writing, is likely to ensure a higher degree of accuracy than asking participants only to write down their plans.
4. Self-compassion has been well-established as an adaptive emotion-focussed coping strategy which is associated with positive wellbeing. It has been

associated with good persistence and engagement, even in the face of failures or negative feedback in the context of mastery goals, and self-compassionate individuals show lower levels of distress in the face of such failures. Thus, it seems that self-compassion could be fruitfully used to emotionally regulate and facilitate both problem-solving and planning skills in situations where distress, shame or guilt might otherwise act as barriers to engagement. However, more research is needed to more clearly elucidate the conditions under which self-compassion is quantitatively beneficial in weight management. Future interventions incorporating planning and problem-solving in the service of weight loss maintenance would be well-served by including measures of distress, pressure and self-compassion components to both assist with emotional regulation and to investigate the relationship between these variables. Self-compassion seems an adaptive way for participants to soothe the reported distress which arises around mistakes, lapses or other barriers. This distress may otherwise tempt people to avoid or impulsively engage with issues that require careful attention – acting as a barrier to effective planning and problem-solving.

Interventions utilising mindfulness to facilitate weight loss maintenance may be well served by retaining some of the elements traditionally used in clinical therapy including the presence (real or virtual) of an experienced instructor who is able to model appropriate responses to challenging stimuli. This is important because weight is a highly stigmatised issue, often associated with difficult thoughts and feelings, as well as longitudinally practiced and often habitual thought and behavioural patterns. Therefore, as previously mentioned, participants in weight-based interventions may be more subjected to more challenging stimuli in their mindfulness practice and may benefit from additional support in navigating these challenges. Interventions recruiting mindfulness novices should likewise be aware

that additional support may be required as these participants are still developing their mindfulness skills.

7.2.5 Clinical implications.

Obesity and overweight are prevalent and significant health risks, experienced both in Australia and overseas. These conditions are acknowledged in the International Statistical Classification of Diseases and Related Health Problems (World Health Organisation, 1992) and though they are not diagnoses within the purview of the Diagnostic and Statistical Manual, Version 5 (DSM5; American Psychiatric Association, 2013), research has established several pathways through which weight impacts on mental health and wellbeing. Excessive weight is often targeted for treatment by medical professionals including General Practitioners, who act as the gatekeeper to much of the Mental Health Service in Australia, through the government supported Mental Health Care Plans (Department of Health, 2012). Overweight and obesity are not only associated with higher health risks, but bidirectional links have been established between depression and obesity (Luppino et al., 2010) as have the indirect effects of weight-status on mental health have been established through mediators such as weight stigma (O'Brien et al., 2016). A recent systematic review of 23 studies investigating the impact of weight stigma alone reports that weight stigma is consistently associated with anxiety, stress and substance use, and that consequences of weight stigma include symptoms of anxiety and depression, poor self-esteem and suicidal thoughts and behaviours (Papadopoulos & Brennan, 2015). Furthermore, psychological distress has been found to mediate the relationship between weight stigma and disordered eating (O'Brien et al., 2016), which is recognised by the DSM-5 and which is commonly treated by clinical psychologists (American Psychiatric Association, 2013). In short, although clinical psychologists are not traditionally involved in the direct treatment of

excessive weight, the mental health outcomes associated with weight issues and weight management, combined with the prevalence of overweight and obesity in Australia, make it likely that clinical psychologists practicing within an Australian context will work with clients for whom weight is a relevant factor in their presentation.

Furthermore, the constructs investigated in this thesis, although highly salient to weight and weight loss maintenance, have also been reported as having value as transdiagnostic approaches. The term transdiagnostic refers to conceptualising pathology outside of a disorder-focussed, diagnostic perspective, and instead considering the underlying psychological mechanisms which maintain pathology (Watkins, 2015). A transdiagnostic approach to treatment may be particularly appropriate in cases where co-morbidity exists, as treating one underlying mechanism is more efficient than otherwise attempting to implement two diagnosis-based treatments (Dawson et al., 2015). Interventions based on problem-solving have been associated with better outcomes across a variety of diagnostic and personal issues, including depression, anxiety, stress, grief, unemployment and interpersonal conflict (Dawson et al., 2015). Similarly, self-compassion has been identified as effective in treating both shame and self-criticism, which are salient underlying factors across a range of diagnoses, including many weight-related disorders, (Duarte et al., 2017; Steindl, Buchanan, Goss & Allan, 2017) and the practice of mindfulness has been reported as having substantial effects on several processes relevant across a range of psychological disorders (Baer, 2007). In short, the constructs examined in this thesis underpin clinical treatments for a wide variety of clinical issues and understanding how these same constructs may apply in presentations where weight and weight-related concerns are a salient issue has much value for clinical psychologists. This is particularly the case as one of the key competencies outlined for clinical

psychologists in Australia is the ability to deliver interventions, and to have specialist knowledge and skills in "behaviour change methods" (Psychology Board of Australia, 2015, p. 14). As this thesis examines psychological constructs pertinent to eroding counter-intentional habits (aka persistent and unwanted behaviour), and maintaining wanted behaviours, these findings are relevant to core competencies in clinical psychology. Therefore this thesis makes three main contributions to clinical psychology. Firstly, it acts as a resource for clinical psychologists to understand the perceptions and challenges that their clients may face when presentations are weight-related. Secondly, it gives insight to the application and value of constructs commonly used by clinical psychologists to these weight-related presentations. Finally, it lends some insight regarding the constructs themselves. Specifically, this thesis contributes the knowledge that clients are likely to already believe that planning is important and to believe that they understand how to do this. However, it is worth clinicians taking the time to explain both planning and problem solving processes in detail, and to emphasise the latter half of the planning cycle which was often missed by the participants in this research. Reducing avoidance and increasing distress tolerance are well-known and often-adopted goals in clinical psychology practice (e.g. Beckers & Craske, 2017; Borges, Dahne, Lim & MacPherson, 2017). This makes clinical psychologists well-suited to recognising when clients may be exhibiting signs of avoidance in planning due to distress, or when they are exhibiting less effective planning and problem solving styles. Appropriate emotional support to manage this distress may be required before effective planning can once again take place, and self-compassion techniques or other emotion-focussed coping strategies may be useful in these instances.

7.3 Limitations, Strengths and Directions for Future Research

The studies presented in this body of work have both strengths and limitations which impact on the implications, generalisbility and conclusions that can be drawn from the results. These have been discussed throughout the thesis and are summarised here:

7.3.1 Study design.

Weight loss maintenance is achieved over a long period of time, typically measured in months or more commonly years (Wing & Hill, 2001). However, the timeframe for all three studies presented in this thesis were relatively short. The first study (Chapter 2) was cross-sectional, limiting the discussion of results to psychological factors that were associated with different weight outcomes, rather than factors that were predictive of, or demonstrably causal in these outcomes. The third study (Chapter 6) utilised data collected before an action-plan to predict persistence-related intentions to continue using a mindful snacking exercise made 2 weeks later. While this study design was useful in fulfilling the research aims and allowed the predictive value of planning and problem-solving to be quantified, this research also took place over a relatively short period of time. The second study, which piloted a short intervention (Chapter 5) incorporated both pre and post measures with the aim of capturing change over time. However, the longitudinal follow-up period was conducted over two weeks. Given that the health benefits of sustained weight loss take time to accrue, a longer-term follow-up would be preferable. While this was an appropriate timeframe for an initial intervention pilot, future research attempting to replicate these results would benefit from investigating the longer-term outcomes so that the impact of these factors on long-term weight loss maintenance can be more fully understood.

The sample sizes in the studies were also relatively small, and designed to find only large or medium effects. It is worth noting, however, that the sample sizes presented here are comparable with other studies in the field; a recent systematic review of weight management interventions reports that 48% of the 49 reviewed studies utilised similar sample sizes (Williams, Wood, Collins & Callister, 2015). As with much of the weight management literature, the majority of participants contributing to this research were women, and as such the thesis findings may not generalise as confidently to male samples. However, this is also comparable to the common overrepresentation of women found in other weight loss trials and weight-based research (Williams et al., 2015); as such the current sample is also arguably representative of those who are most likely to self-select into the kinds of interventions which this thesis has sought to inform.

Furthermore, the recruitment strategies used throughout this thesis and the resultant participant pools must be considered a significant strength. Student samples are commonly used in psychology research; indeed a review of over 1000 articles published in the Journal of Applied Psychology reports that approximately 40% of all published articles utilized student samples (Shen et al., 2011). However, this work has instead taken care to recruit participants either directly engaged in weight loss maintenance, or with active weight-management goals (and who engaged in weight management techniques) from the general populace. In this way, the studies presented here are likely to be more representative of individuals within the general populace who are either attempting weight loss maintenance or who are directly engaged with weight management. In this way the thesis has fulfilled its aim to investigate the experiences of those who have already formed intentions to take action and has captured their experiences of either actively taking or maintaining that action more accurately than would have

been possible using convenience sampling or student populations. Future work should identify recruitment strategies to target samples that are typically underrepresented in this domain.

7.3.2 Issues of measurement.

The research presented here encountered similar issues of measurement to those commonly found throughout the literature. Notably, the use of self-report measures inherently comes with limitations, from which this work was not immune.

One potential issue may relate to the use of the Self-Report Habit Index. The Self-Report Habit Index remains the most widely-used measurement; a meta-analysis of 22 studies on habit and behaviour change recently noted that the SHRI was the measure of choice utilised to capture the habit construct in all 22 studies included, as well as being the most-used measure of habit more widely throughout the literature (Gardner, et al., 2011). In this sense, the use of the measure must be considered a strength, as it is currently used as the gold standard in the measurement of the psychological construct of habit. However, this measure has also attracted criticism recently, as it has been argued that any self-report measure of habit is, by default, unable capture the components of habitual action that fall outside of conscious control (Sniehotta & Presseau, 2012). As the studies presented here were predominantly delivered online (with the exception of the interviews described in Chapter 2), self-report measures were clearly the only measurement option available. However it is worth noting that the thesis may have missed more nuanced components of the habit construct. Future research would greatly benefit from capturing behavioural measures of habit alongside self-report measures of habit until such time as a more comprehensive battery of tests to capture the habit-construct can be developed. In addition to objective

measures of behaviour-frequency, response time in lab-monitored sorting-tasks has been linked to habit strength, as has the unconscious nature of habit initiation. Where practical, and where such resources are available, future researchers in weight management may wish to supplement self-report measures of habit with objective measures of behavioural frequency, or laboratory food-sorting tasks.

This body of work was one of the first to use a new measurement of plan quality derived from clinical nursing practice – namely, the GET-D. As discussed above, the different components of an action plan have been theorised to correspond with different outcomes. Given the distinct importance of each component, the use of a measure which captures them separately, and the investigation of a plan-quality construct using a novel quantitative measure, must be considered a strength of this work. However, despite this strength, the measure itself is new, and observations regarding its sensitivity, limitations, and ways in which these constrained the work of the thesis are appropriate. As previously detailed, the GET-D exhibited some signs of floor effects, particularly around the final two criterion. Some of these may reflect genuine paucity of plan-quality. For example, the tendency for participants to omit details pertaining to criterion 4e about monitoring or evaluating their actions has been discussed in detail. However, criterion 4d ("specify action intensity") may be particularly problematic when action plans concern diet-related actions, or actions that are not exercise-related; e.g. specifying the intensity with which one will pack lunch seems unintuitive and nonsensical. In addition, the GET-D requires that participants write down their goals and plans in detail. This requires both literacy and (when delivered online) that participants be comfortable typing often-lengthy responses. This predisposes those who are better at typing to write more detail and as such, to receive a potentially better score for plan-quality. This is a significant limitation,

as some participants may have detailed plans but neglect to write them, and this may inflate issues of error in measurement. In summary, the accurate measurement of plan quality is important for future research in the area of weight maintenance, and further adaptations to the GET-D are required to assist the tool to flexibly assess eating-related plans so that the measure is more sensitive to both the eating and weight maintenance domain, as well as the development or population-specific norms. Further work is also required to establish the boundaries of its sensitivity as a measure (e.g. what cut-offs might be appropriate to discriminate a 'good enough' quality plan from one associated with poorer outcomes).

Online administration of questionnaires was necessitated as a practical and cost-effective means of intervention delivery in the current studies, and these same advantages are no doubt part of the reason that online surveys have increased drastically over the past two decades (Wright, 2005). However, there are limitations associated with their use. The use of open questions in web-based surveys, for example, has been associated with more missing data due to non-responses and invalid entries (Reja, Manfreda, Hlebec & Vehovar, 2003). According to Reja et al. (2003), those that are less familiar with the internet, women, the youngest, eldest and less educated participants – tend to give more invalid responses. Nevertheless, the information gleaned through this thesis, particularly regarding the translation of clinical skills to effective online delivery provides a number of valuable insights for future research to build upon. There are a number of advantages to developing online interventions, and a need for research in these areas has been identified (Clarke & Yarborough, 2013). The Australian Bureau of Statistics estimates that in 2017 approximately 86% of Australians had access to the internet at home (Australian Bureau of Statistics,

2018) and previous research has found that this has shifted the way in which people access information related to health and wellbeing; the majority of internet users will go online for health information before consulting a general practitioner (Hesse, et al., 2005). Well-crafted online interventions have the potential to reduce overall costs associated with health care, for both governments and consumers, to reduce the waiting times otherwise associated with care, and to effectively deliver services to populations that are commonly underserviced – for example, those of lower socioeconomic status for whom cost may be a barrier, or those who prefer to remain anonymous while receiving care (Clarke & Yarborough, 2013). The potential for online interventions to assist with public health and wellbeing is even greater in Australia, where distance serves as an additional and significant barrier to accessing services in rural areas (Smith, Bensink, Armfield, Stillman & Caffery, 2005). In short, online administration of questionnaires is associated with some unavoidable limitations. However, further research is required despite these limitations in order to gain insight into more effective intervention delivery, particularly in an online context. This thesis contributes to the growing body of knowledge, aiming to refine online intervention delivery service.

7.4 Final Comments

Overall, the findings of this thesis suggest that populations attempting weight management are likely to benefit from support that incorporates a focus on both planning and problem-solving. Benefit is likely to be gained if interventions explicitly define, and teach the benefits and skills associated with these processes, particularly as this population is likely to have difficulties defining and expressing detailed knowledge of these concepts, despite generally endorsing them as

valuable in a weight-management context. Furthermore, perceptions of an intervention's helpfulness are likely to be predictive of intentions to continue behaviours taught in interventions beyond just the intervention period, and they may be more predictive of intentions to continue than measures of objective helpfulness – making explicit consultation on the benefits of intervention components more valuable. Self-compassion appears to have the potential to work well in concert with both planning and problem-solving intervention components, but further research is needed to clarify the relationship between these constructs. Finally, interventions wishing to translate traditionally clinical tools into online delivery should be mindful of the way in which the benefits conferred through face-to-face contact may be reconstructed online. Specifically when using mindfulness with weight-management populations and novices, extra supports may be required.

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Appendices

Appendix A: Journal Article of Paper from Study One

JHP

Article

Journal of Health Psychology
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A mixed-methods investigation of psychological factors relevant to weight maintenance

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Abstract

This study investigated perceptions of and engagement with the concepts of planning and problem-solving, within a weight management sample. A total of 53 participants (62% female, 20–74 years old) completed a semi-structured interview and quantitative measures after a 16-week weight maintenance period. Preliminary weight maintainers (who had maintained losses of, at least 10% of their original weight) were compared with heavier-than-baseline participants (who had re-gained more weight than was originally lost). The maintainers exhibited stronger problem-solving skills ($p < .05$). The heavier-than-baseline participants tended towards non-rational problem-solving styles. Qualitatively, the maintainers described more planning events and were more accepting of mistakes than the heavier-than-baseline participants. Implications are discussed.

Keywords

dichotomous thinking, planning, problem-solving skills, weight maintenance, weight re-gain

Introduction

The health benefits associated with weight loss in obese individuals are considerable. According to the US Institute of Medicine (IOM, 1995), even modest weight losses can lead to decreased blood pressure (and thus lower risk for hypertension), reduced high blood glucose levels (and thus lower risk for diabetes), lower levels of cholesterol and triglycerides (associated with cardiovascular disease), reduced sleep apnoea, risk of osteoarthritis in weight bearing joints and depression (Stern et al., 1995). As obesity is associated with significantly increased morbidity and mortality, and as the prevalence of obesity is high, cultivating techniques for successful weight maintenance is a priority in health research (Hill et al., 2005). Despite the development of efficacious weight loss treatments, long-term success in weight management is rare (Jeffery et al., 2000; Perri, 1998) and difficult due to a number of common barriers (e.g. work commitments, self-motivation and eating habits; Gupta, 2014). Appropriate criteria for successful weight maintenance have been investigated in previous research and subsequently defined as a weight loss of at least 10 per cent of initial body

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weight, sustained for a time period of at least 1 year (Wing and Hill, 2001). According to these criteria, it is estimated that only 20 per cent of people attempting to maintain their weight losses are successful (Wing and Hill, 2001).

The current literature suggests that successful weight maintenance may be associated with good planning and problem-solving skills, which facilitate the establishment of healthier habits. Planning strategies such as the formation of action plans or implementation intentions can be used to facilitate intentional action (Gollwitzer and Sheeran, 2006). With repeated action, healthy habits may be built over time and such planning strategies have been successfully used to create intentional healthy habits and to increase healthful eating (Chapman and Armitage, 2012; Sheeran et al., 2005). These strategies have also been used to erode unwanted, unhealthy habits over time (Holland et al., 2006) although it is widely acknowledged that stronger habits require more repetition, time and effort to erode (Webb et al., 2009). According to Gollwitzer et al. (2009), high-quality or more detailed plans lead to more successful and less cognitively taxing action.

Problem-solving skills may also be useful for weight maintenance. Problem-solving therapy (PST; Nezu et al., 2013) involves education and skill-building in five key processes: (1) developing a definition and understanding of the problem, (2) generation of possible solutions, (3) deciding on a single appropriate solution to trial, (4) planning and implementing that solution and (5) the evaluation of its success or failure to inform subsequent future planning. PST has formed the basis of successful interventions that assist people in both weight loss (Murawski et al., 2009) and maintaining their weight afterwards (Perri et al., 2001).

Interventions using planning and/or problem-solving have demonstrated preliminary success in helping people to maintain behaviours related to weight management (e.g. Carels et al., 2010). In addition, qualitative studies have consistently found differences between the weight maintainers and re-gainers in the way that they plan and solve problem (Kayman et al., 1990; Kitsantas, 2000; Stuckey et al., 2011), further supporting the importance of these constructs. According to Kayman (1990), the maintainers were more likely to approach their problems directly and to develop personalised strategies to help themselves than the re-gainers. Similarly, Kitsantas (2000) found that the maintainers used more strategies than the re-gainers and specifically that they used more goal-setting, self-monitoring and evaluation, time management and environmental structuring than the re-gainers. Stuckey et al. (2011) have further noted that the maintainers planned meals, tracked calories and their weight loss progress more than the re-gainers.

Finally, previous research has suggested that there may be differences between the maintainers and the re-gainers in terms of their thinking styles and coping strategies (Elfhag and Rossner, 2005). Dichotomous thinking (also known as 'black and white' thinking) relates to a thinking style that is characterised by concrete, fast and often extreme dichotomous judgements (Berlin, 1990) and has been linked to an increased incidence of weight re-gain in previous works (Byrne et al., 2003, 2004; Kayman et al., 1990; Palascha et al., 2015), as well as poorer mental health outcomes (Dove et al., 2009). According to Byrne (2002) and Kayman et al. (1990), the coping strategies favoured by the re-gainers tend to be more emotion-focussed and less direct- or problem-focussed than those favoured by the maintainers (Byrne, 2002; Kayman, 1990).

In summary, research suggests that strong planning and problem-solving skills can facilitate healthful habit development, which assists longer term weight management. Thinking style (such dichotomous thinking) and coping style (i.e. utilising primarily problem-focussed, emotion-focussed or avoidance-focussed strategies to cope with difficulty) have also been identified as relevant factors.

However, the meaning and value that people attempting weight maintenance place on the constructs of planning, problem-solving, habit formation, coping and thinking styles remain largely unknown. Similarly, the extent to which would-be weight maintainers effectively understand, engage with and implement the principles

behind problem-solving, planning and habit formation without formal education and support also remains largely unknown. As weight losses are rarely sustained over time (Jeffery et al., 2000; Perri, 1998), it may be that planning, problem-solving, problem-focussed coping and flexible thinking are undervalued. Indeed, popular opinion often emphasises willpower, avoidance of social eating or other approaches which have been shown to be difficult to sustain in the long-term (Mann, 2015). Those attempting to maintain weight loss may also face as yet unidentified barriers that prevent effective strategies from being implemented. Gaining insight into these matters has important implications for future health interventions.

The aims of this study were threefold. The first aim was to undertake a qualitative investigation into perceptions around weight management and the relative importance placed on planning and problem-solving. The second aim was to further investigate the previously documented differences between the maintainers and the re-gainers by quantifying participant skill levels in planning, problem-solving, coping, levels of dichotomous thinking and the strength of existing habits around unplanned eating to investigate any congruence with the qualitative accounts. Finally, the third aim was to determine any additional underlying differences that may exist between the preliminary weight maintainers and the re-gainers, including an investigation into differences in dichotomous thinking. Specifically, it was hypothesised that participants who maintained their weight losses over the course of the study would have stronger problem-solving and planning skills, would use problem-focussed coping strategies and would have less dichotomously oriented thinking styles and weaker habits around unplanned eating than those who re-gained weight.

Method

Participants

In all, 94 participants were approached for recruitment, all of whom were starting a phase of weight maintenance (Brindal et al., 2016). Participants had just completed the first 12 weeks of a meal-replacement-based weight loss trial, which comprised a weight loss phase, including face-to-face appointments and electronic support via a mobile phone application, followed by a 12-week free-living (i.e. normal routine, without further appointments or support) weight maintenance phase. The original trial was a randomised controlled study designed to compare two psycho-educational mobile phone applications (Brindal et al., 2016); however, the core weight loss programme was the same for all participants.

Totally, 53 participants were recruited. On average, the participants recruited to this study lost $M = 7.32$ kg (standard deviation (SD) = 6.38 kg) throughout the active phase (first 12 weeks) of the weight loss trial. The final sample contained 20 men and 33 women, who ranged in age from 20 to 74 years ($M = 51.12$ years, $SD = 10.91$ years) and weighed between 58.90 and 151.60 kg ($M = 94.09$ kg, $SD = 18.51$ kg). This sample was comparable to the wider participant pool of the weight loss trial and did not differ greatly in terms of weight loss or age.

Recruitment

Participation was voluntary and the study was presented as a follow-up appointment for participants to give feedback on their experiences in the weight loss trial. Participants were approached for recruitment after 12 weeks of active weight loss, and the study appointment took place 16 weeks later (12 weeks free-living within the trial, plus 4 weeks after trial – all weeks were identical with regards to maintenance non-intervention/treatment). In light of this timescale, participants in our study are best thought of as showing only preliminary signs of their future weight management and possible trajectories (e.g. weight maintenance vs weight re-gain), rather than being definitive maintainers or re-gainers – especially as the definition of successful weight maintenance requires at least a period of 1 year (Wing and Hill, 2001).

Interested parties gave informed consent and made an appointment for this study after the conclusion of the weight loss trial. Eligibility criteria included being over 18 years of age, English speaking and having participated for the full duration of the 24-week weight loss trial. All participants received a AU$20 grocery voucher for their time.

Design and procedure

A mixed-methods approach was used. All participants took part in both the qualitative and quantitative components. At their appointment, participants were weighed and completed a 40-minute semi-structured interview, which focused on their weight management experiences and included questions about planning, habits and their importance in weight management, as well as feelings of success/failure, current habits, coping, problem-solving strategies and plans for future weight management. Participants then completed a survey containing quantitative measures.

Participants were divided into three weight categories for analysis: (1) 'maintainers' comprised participants who had lost and maintained a loss of at least 10 per cent of their baseline (beginning of the weight loss trial) weight (n=10), (2) the 'heavier-than-baseline' group comprised participants who weighed more than their baseline weight (n=11) and (3) the 'others' group comprised the remainder of the participants who had lost and maintained between 0 and 9 per cent of their baseline weight (n=32). It should be noted that the 'maintainer' category represents participants who were highly successful in losing a clinically significant amount of weight and maintaining this loss. Similarly, the heavier-than-baseline group represents participants who were unsuccessful in their aims to lose weight, and by the end of the study period weighed more than when they started. These stringent criteria were deliberately adopted in light of the relatively short timescale of the maintenance period – as weight maintenance is generally considered successful after a year or more, rather than within months, it was reasoned that stringent criteria for the two comparison groups would maximise the integrity of the results based on the current weight trajectories.

Measures

The *Social Problem Solving Inventory–Revised* (SPSI-R) is a 52-item self-report measure of problem-solving ability (D'Zurilla et al., 2002). Participants endorse statements on a 0–4 Likert scale (0=*Not at all true of me*, 4=*Extremely true of me*). The measure yields an overall ability score as well as scores for three problem-solving subscales: Rational, Avoidant and Impulsive/Careless (Cronbach α=.96, .77 and .85, respectively). Two subscales also capture the participant's general approach to problems: Positive Problem Orientation and Negative Problem Orientation. Due to skewness, a log transformation was performed on the Avoidance Style and Negative Problem Orientation subscale (Field, 2005). This considerably improved the explanatory power of the variables, and therefore their transformed versions were used in the analysis. All other scales were used untransformed.

The *Coping Inventory for Stressful Situations: Situation Specific Coping* (CISS: SSC) is a 21-item self-report measure of coping strategies used by participants in response to a specific situation (Endler and Parker, 1999). This study asked participants about coping responses to the stresses of their weight loss journey. Participants rate common strategies on a 1–5 Likert scale, indicating the frequency of that strategy's usage (1=*Not at all*, 5=*Very much*). The measure yields scores on three coping-strategy subscales: Task-oriented, Emotion-oriented and Avoidant-oriented (Cronbach $\alpha \geq .77$)

The *Self-Reported Habit Index* (SRHI) is a self-report 12-item questionnaire (Verplanken, 2003) capturing the single construct of habit strength. The scale requires the nomination of a single behaviour (e.g. unplanned eating) and captures the degree to which this behaviour occurs habitually. This scale has successfully captured habit strength across a wide range of health behaviours in previous studies, including smoking, binge-drinking, physical activity and

food and beverage consumption (Chatzisarantis and Hagger, 2014; Lally et al., 2010; Orbell and Verplanken, 2010). Participants endorsed statements about unplanned eating habits on a 0–4 point Likert scale (0=*strongly agree*, 4=*strongly disagree*; α=.87).

The *Dichotomous Thinking Inventory* (DTI) is a 15-item self-report measure which captures the degree to which a person exhibits a dichotomous thinking style (Oshiro, 2009). This scale captures a single construct and measures the extent to which a global dichotomous thinking style is present. It does not attempt to capture domain-specific dichotomous cognitions. Participants rate statements on a 1–6 point Likert scale (1=*strongly disagree*, 6=*strongly agree*; α=.87).

The *Goal-Setting Evaluation Tool for Diabetes* (GET-D) is a measure of plan quality and was designed to assist self-management in diabetes (Teal et al., 2012).The GET-D is applied by clinicians to a participant plan after it has been written in detail and assigns points to the plan based on a series of questions. A score of overall plan quality is yielded (0–26), where higher scores indicate a better quality plan. Inter-rater reliability was acceptable (Kappa=.66).

Analysis

Qualitative data. Interviews were audio recorded and transcribed for the purpose of thematic analysis (Braun and Clarke, 2013). The data were approached from a positivist, realist perspective and were analysed in two phases. The first phase included transcriptions from all participants and aimed to identify commonalities in weight management experience and constructs of interest. Two cycles of coding were conducted, before a first analysis was produced, as per the recommendations of Saldana (2013).

The second phase of qualitative data analysis involved identifying and comparing the accounts of the maintainer and heavier-than-baseline groups on the theoretical basis that any differences in the constructs of interest would be most pronounced in the accounts of participants with the most extreme maintenance outcomes. This phase of analysis aimed to explore any differences that may exist between the two groups as per the study's aims.

Quantitative data. Using *t*-tests, quantitative analysis investigated corroborating or contradictory trends found in the qualitative data. The two groups compared were the maintainer and the heavier-than-baseline groups, and *t*-tests were performed for the overall measures and subscales of the SPSI-R, the CISS: SSC, the SRHI, the DTI and the GET-D.

Results

Qualitative commonalities across all participants

Participants generally described planning positively and as helpful to their overall ability to manage weight. However, accounts of why or how it was useful tended to be sparse, and further questioning was usually required. Participants had trouble defining planning as a concept and often required time to think before responding, using concrete behavioural examples instead of conceptual terms and appeared to form their opinions as they spoke, rather than from an explicit knowledge base:

> … Um, just being organised I guess, yeah it's, um. It's tricky planning, um, I just thought planning was planning, I didn't know I had to elaborate on planning more, but yes, um. (Maintainer, Male, participant #50; see Supplementary material,[1] Table 1, 'Defining Planning')

Regardless, planning was constructed as increasing chances of success, and the adage 'if you don't plan, you plan to fail' arose in several interviews. This was presented as the evidence that planning was important:

> it's, a definite, yeah! (laughs) Very, very, very important, 100% important … but if you, if you fail to plan, you plan to fail. (Maintainer, Female, #97; Supplementary material, Table 1, 'Planning importance')

Table 1. Means (standard deviations) for maintainers ($n = 10$), heavier-than-baseline ($n = 11$) and total participants ($N = 53$) and difference between means of maintainers ($n = 10$) and heavier-than-baseline ($n = 11$) participants.

Construct	Maintainers, *M* (*SD*)	Heavier-than-baseline, *M* (*SD*)	Total, *M* (*SD*)	*t*(19)	*p*	*d*	95% CI
SPSI-R: Negative Problem[a] Orientation	6.10 (3.81)	9.36 (5.18)	10.94 (7.59)	*1.96*	.660	0.717	−0.600, 0.0197
SPSI-R: Positive Problem Orientation	13.60 (3.53)	11.27 (4.58)	11.85 (3.97)	*1.29*	.212	0.570	−1.441, 6.095
SPSI-R: Problem Definition and Formulation	12.70 (4.87)	10.55 (3.37)	11.70 (3.84)	*1.19*	.251	0.513	−1.650, 5.959
SPSI-R: Generating Alternative Solutions	12.70 (5.44)	11.00 (4.78)	11.66 (4.45)	*0.75*	.455	0.332	−2.964, 6.364
SPSI-R: Decision Making	12.00 (5.16)	9.82 (3.87)	11.13 (4.12)	*1.10*	.284	0.478	−1.960, 6.323
SPSI-R: Solution Implementation and Verification	10.90 (5.49)	9.64 (5.12)	10.00 (4.63)	*0.55*	.592	0.237	−3.582, 6.109
SPSI-R: Problem Solving Style: Rational	48.30 (20.50)	41.00 (16.11)	44.49 (16.04)	*9.12*	.373	0.396	−9.455, 24.055
SPSI-R: Problem Solving Style: Avoidant[a]	4.90 (3.96)	6.91 (2.26)	7.43 (4.58)	*2.08*	.059	0.623	−0.496, 0.111
SPSI-R: Problem Solving Style: Impulsive/Careless	6.10 (4.70)	12.73 (5.78)	10.83 (6.63)	*2.86*	.010**	1.257	−11.471, −1.783
SPSI-R: Total Problem Solving Score	15.22 (2.05)	13.11 (2.22)	13.35 (2.60)	*2.25*	.036*	0.988	0.149, 4.064
DTI: Dichotomous Thinking	53.30 (5.38)	57.00 (12.95)	54.55 (10.23)	*0.84*	.412	0.373	−12.936, 5.536
SRHI: Habit Strength	3.70 (2.75)	6.45 (3.45)	5.42 (3.58)	*2.00*	.060	0.881	−5.638, .128
GET-D: Plan Quality	10.44 (3.97)	11.20 (3.33)	11.21 (3.42)	*0.45*	.658	0.21	−4.289, 2.778
Coping: Task Oriented	28.00 (4.52)	26.82 (5.44)	26.60 (4.19)	*0.63*	.536	0.24	−3.211, 5.975
Coping: Avoidant Oriented	19.50 (6.50)	22.73 (4.45)	20.53 (5.59)	−1.34	.197	0.58	−8.274, 1.820
Coping: Emotion Oriented	16.20 (5.27)	20.27 (2.27)	19.23 (5.87)	−1.77	.093	1.00	−8.893, 0.749

SD: standard deviation; CI: confidence interval; SPSI-R: Social Problem Solving Inventory–Revised; DTI: Dichotomous Thinking Inventory; SRHI: Self-Reported Habit Index; GET-D: Goal-Setting Evaluation Tool for Diabetes.

[a]Negative Problem Orientation and Avoidant subscales of the SPSI-R were transformed due to positive skew, as per the recommendations of Field (2005). Please note that mean and standard deviation data are presented untransformed, for ease of interpretation.

*Significance at the $p = .05$ level.

**Significance at the $p = .001$ level.

Participants were aware that building new, healthy habits can be an effective maintenance strategy and also described their new routines slipping in times of stress:

> Um, when you have stress, yeah, it's easy to grab a chocolate (laughs). (Heavier-than-baseline, Female, #6; Supplementary material, Table 1, 'Bad habits and mistakes')

Despite this insight, participants consistently under-estimated the impact that future stress could have on their behaviour:

> I don't think there's going to be a problem for me, um, because yeah, I think we've sort of dealt with lots of fairly difficult and sticky situations. (Maintainer, Female, #81; Supplementary material, Table 1, 'Stress coping')

and often espoused confidence that experience (as above) and/or willpower (as below) would be sufficient resources for them to maintain their healthy behaviours in times of stress:

> I think ultimately, you just have to do it. You've just gotta get into that routine, and, just do it, and say no to stuff. (Heavier-than-baseline, Female, #130; Supplementary material, Table 1, 'Stress coping')

Differences between maintainers and heavier-than-baseline groups

When the maintainer and heavier-than-baseline accounts were compared, the maintainer accounts contained a higher frequency of planning events, giving frequent concrete examples from their everyday lives (e.g. 'I'd work out exactly how many calories um, 6 jellybeans are and I'd put them in a, in a snaplock bag' – Maintainer, Male, #50), compared to the heavier-than-baseline accounts, suggesting that they may implement more of these behaviours.

Maintainer participants also described reassessing their plans when they encountered problems, frequently identifying and reflecting on their stumbling blocks and adjusting their plans:

> I know that I am, I find it very difficult to restrict myself with nuts … So I sat down and I made bags, little plastic bags of 10 peanuts. (Maintainer, Female, #9; Supplementary material, Table 2, Problem-solving)

In contrast, heavier-than-baseline participants rarely reflected on or adjusting plans that had not worked previously and reiterated their desire to try the same plan again in the future with more willpower:

> I'm motivated now to do it, to continue doing it, I got to … you know, somehow force myself to do it and. I don't know. (Heavier-than-baseline, Male, #126; Supplementary material, Table 2, Problem-solving)

Both maintainer and heavier-than-baseline participants reported breaking their diets at times, but the maintainers described their mistakes differently to the heavier-than-baseline accounts. Maintainer participants tended to express less regret and tended not to think as badly of themselves afterwards as a result. Rather, they seemed to reflect on their past actions with acceptance and resolved quickly to make better decisions in the present. The maintainers expected to make mistakes in the future and were comfortable talking about this, as is evidenced in the three quotes below:

> if you try to be perfect all the time I think you kind of set yourself up for failure. (Maintainer, Female, #97; Supplementary material, Table 2, Handling mistakes)

> You've got to be kind and caring to yourself. That that, that is, it's a difficult and it's really hard to learn … That's what you've got to do. (Maintainer, Female, #133; Supplementary material, Table 2, Thinking style)

> well, you're being kind to yourself really, more than anything. And getting straight back on, not waiting until – 'cause quite often you'd say, 'well next week' or 'after this important occasion' or- and straight away. (Maintainer, Female, #133; Supplementary material, Table 2, Getting back on track)

Table 2. Differences between maintainers and heavier-than-baseline groups: qualitative extract examples, arranged by theme and participant group.

Theme	Rule for inclusion	Maintainer example	Heavier-than-baseline example
Specific planning event	Describes putting or attempting to put a pre-planned action into practice	*And also I say things like, 'on the weekend, I'm going to have toast and vegemite on Sunday morning for brunch', we go out, and that fits within my um, understanding of what I know I can eat, you, you know, won't go overboard, I'm not going to have 5 slices, I'm not going to have it with honey and cream or whatever else, I'll have a toast with vegemite, which is what I like, and multigrain toast which is what I like.* (Female, #140, 3, 97–101) *I'd work out exactly how many calories um, 6 jellybeans are and I'd put them in a, in a snaplock bag.* (Male, #50, 7, 253–254) *Like, I'm working this afternoon but I've got my little chicken salad in the car and, (laughs). So yeah, it's just a matter of being organised instead of going into a cafe or just, yeah.* (Female, #124, 5, 149–151)	*Trying to put them (strategies) into my life. So um, you know when you're out and about and, um, you know, I'm working as well, so trying to make meals late at night, I do tend to go for an easier option, for quick, yeah, and that is always probably not the best choice. So, like an easy pasta because that's what the kids will eat it and then I'll eat it, and that's probably not a good thing, is it? So um, once again, have that structure say, 'this is what we're having for dinner' and then being prepared and yeah. I'm not very good at that, so (laughs).* (Female, #29, 4, 99–104). *It's, it's really tricky because you, don't have milk [at work]. You don't have anything. Yeah, because you're, you might grab something as you're walking out of the door, um, and, that, you know, let's say it's a bag of lollies, at work we have, you know, little dollar bags of lollies.* (Male, #22, 7, 229–236).
Problem-solving	Reaction to a problem or a plan gone awry	*I know that I am, I find it very difficult to restrict myself with nuts, peanuts in particular, and if I see a peanut, I've got to have it. And in the past, I would sit down with a bag and I would just eat until I'd finished the bag. And I knew I was like that, so, I knew I couldn't do without them. And one of that snacks was, I think it was 10 peanuts. So I sat down and I made bags, little plastic bags of 10 peanuts. So when, I really had to have nuts, I would go and get one bag and I'd make a big point of getting one bag, shutting the container and then walking away with my one bag, and I found that was quite, I could finish with the 10 and that was it! (laughs).* (Female, #9, 6, 17–23)	*The most difficult for me is to, um, is to stick to it. Is to be, vigilant and if … you know, you've got a procedure to follow, then you must rigidly follow it, each day. I think my problem's been,,, I uh, I've got good intentions, I mean to do this, I'm yeah, it's really important to me, I've got to do it, and then I get to work and, there's pressures and,,, you just get on with the pressures at work and, well, you're busy and it's lunch time, oh and you haven't taken the milkshakes to work or,,, you know, uh, I'll just uh, I'll just go and grab a sandwich or and then so you, you know, you're off track. You need to be vigilant and stick to it. And although I'm, motivated initially or, I'm a, I'm motivated now to do it, to continue doing it, I got to,,, you know, somehow force myself to do it and. I don't know.* (Male, #126, 5, 177–184)
Handling mistakes	Describes reaction to breaking their diet	*… just try to make a better decision? Because we're not perfect. Like I probably could have, could have lost a lot of- lot more weight a lot quicker, but I'm not perfect. And if you try to be perfect all the time I think you kind of set yourself up for failure. Whereas admitting that you're a human being and food's bloody awesome (laughs) and how can I stop the food controlling me, I, having the sense that 'yeah, I'll eat you cake. But I'm not letting you slap yourself all over my thighs!'* (Female, #097, 9, 316–321)	*So I get the chips, and what happens then? You know either my husband or I eat them! But at home you don't have to have those sorta things put in front of you. And I'm weak. I think I'm weak.* (Female, #130, 9, 317–318) *So, I said, 'oh, stuff it, I'll just have a beer!' (laughs), So I was weak and failed and,,, ended up just going back.* (Male, #126, 8, 297–298)

Table 2. (Continued)

Theme	Rule for inclusion	Maintainer example	Heavier-than-baseline example
Thinking style	Describes a general thinking style or 'mindset' that the participant says they approach dieting with	*[Successful dieting is] not having to, be miserable about what you're eating out all the time, successful is about being able to live a normal life, go out to a café or go out to dinner with your friends or go to [festival name] and eat whatever the hell is going because you're hungry and not thinking 'oh my god, that's a disaster!', going 'I can make that fit, right?'. It's about being normal and socialising and, the whole interaction of, to not lose sight of the fact that, you know, food is an interactive thing that you do with family and friends and to be able to enjoy the good part of it.* (Male, #96, 4, 142–148)	*For me, I'm the kind of thinker that's like 'oh well, that's a failure again' and, then it starts to snowball, downhill. Or even 'I can't do it', it just goes down from there.* (Female, #027, 3, 102–104) *It's probably, it's only cos, it's probably my own fault. If I chose to, to just do it? And not talk about it? I could probably get back in the, you know, the swing of things. And you know, probably because I know I'll always fail, I never, I always start these diets and I always fail them.* (Female, #130, 12, 415–420)
		you can't rely on other people. You've got to be kind and caring to yourself. That that, that is, it's a difficult and it's really hard to learn, nut you know. That's what you've got to do. (Female, #133, 6, 217–219)	
Getting back on track	Describes resolutions to take up the diet again after a mistake or period of relapse	*If you do make a mistake, just you know, forgive yourself and get back on and do the right thing. So that is a age thing I think, I've learned over the years as well. Many years of dieting and it, it's all, a lot if it's got to do with your mind as well. Being, making, well, you're being kind to yourself really, more than anything … and getting straight back on, not waiting until – 'cause quite often you'd say, 'well next week' or 'after this important occasion' or, and straight away, the next day. You have a hiccup and um, I think that's how I'm going to be looking at um, how I am now. Like, after I've finished all the shakes or whatever, um, and just if I mess up, well I'll just get back and, you know.* (Female, #133, 4, 132–144)	*Yep, and I just lost the motivation at the moment. And I need a kick in the bum and then I'll get back onto the train again. After Christmas. Get over this heat, maybe.* (Female, #87, 5, 154–157) *a big fright would be the only thing that would really stupendously motivate me without me going, 'I'm going to get around to that after I come back from that holiday, you know, I'll start then'.* (Female, #55, 5, 153–156)

Heavier-than-baseline participants tended to express negative view points of themselves when describing a mistake (e.g. 'I'm weak. I think I'm weak' – Heavier-than-baseline, Female, #130; Supplementary material, Table 2, Handling mistakes) and evidenced less acceptance of their behaviour. They often attributed their mistakes to internal character flaws rather than considering alternative explanations (such as an unrealistic or unworkable plan, the difficulty of their task or the inevitability of some mistakes). The sense that heavier-than-baseline participants made of their mistakes tended to include judgements which were often dichotomously oriented around notions of success versus failure:

> For me, I'm the kind of thinker that's like 'oh well, that's a failure again' and, then it starts to snowball, downhill. (Heavier-than-baseline, Female, #27; Supplementary material, Table 2, Thinking style)

Heavier-than-baseline participants also tended to resolve to make better decisions starting from a later point in the future:

> I need a kick in the bum and then I'll get back onto the train again. After Christmas. Get over this heat, maybe. (Heavier-than-baseline, Female, #87; Supplementary material, Table 2, Getting back on track)

Quantitative results

Comparison between maintainers and heavier-than-baseline. Significant differences were detected between the maintainer and heavier-than-baseline groups on the Impulsive/Careless Problem Solving Style and Total Problem Solving ability (Table 1). This difference was such that the maintainer group scored significantly higher on Total Problem Solving Ability and significantly lower on the Impulsive/Careless Problem Solving Style than the heavier-than-baseline group. The difference between the two groups also trended towards significance on the Avoidant Problem Solving Style composite scale and Habit Strength – such that the heavier-than-baseline group tended to score higher on both the Avoidant Problem Solving Style and Habit Strength scales than the maintainer group.

Discussion

The broad aim of this study was to investigate perceptions of planning, problem-solving and psychological constructs related to weight maintenance, as well as to investigate underlying differences between the preliminary weight maintainers and those who re-gained more than their originally lost weight. Qualitatively, planning was perceived positively and was described as a kind of common-sense practice; participants were aware that effective planning was necessary for long-term weight maintenance. However, participants had not thought deeply about what planning was or how to effectively implement it. When comparing the maintainer with the heavier-than-baseline accounts, the maintainers also described a higher frequency of concrete planning activities and reported that they engaged with these activities regularly. Heavier-than-baseline participants espoused the importance of planning but reported not engaging, disclosed fewer examples or did not disclose examples at all, suggesting that one of the differences between the longer term maintainers and re-gainers may be differential engagement with planning strategies.

This notion was not supported by the quantitative data; however, as there was no significant difference in plan quality between the maintainer and heavier-than-baseline groups as measured by the GET-D. The GET-D is a new tool designed to measure the quality of plans related to both diet and exercise within diabetic populations. As our participants were taught only diet strategies, and as floor effects were found for some of the criteria (particularly around the question of action 'intensity', which is largely inapplicable to diet-based actions), it may be that a modified, more diet-oriented version of the GET-D would be more sensitive to the plans of this population and appropriate for future research. It may also be that plan quality is a less appropriate measure than one of overall engagement with planning, since the main qualitative difference between the

maintainer and heavier-than-baseline groups was the *amount* of concrete planning strategies described. Participants may have differed more in the extent to which they engaged in planning their strategies, rather than the overall quality of the strategies they employed.

Concurrent evidence across qualitative and quantitative measures was found regarding differential engagement in problem-solving across the maintainer and heavier-than-baseline participants. Specifically, we found that our maintainer group exhibited stronger overall problem-solving skills and that heavier-than-baseline participants tended towards both the non-rational problem-solving styles: Impulsive/Careless and Avoidant. This provides quantitative support for our qualitative findings that maintainer accounts held more reflective styles of thinking (particularly around mistakes) and developed more individualised coping strategies for their points of difficulty. Difference in weight outcomes may be partially due to underlying differences in problem-solving. However, as all data were collected at a single time point, one of the limitations of this study is that it cannot infer causation. More research is needed to understand these differences, and assessing problem-solving skills prior to phases of weight maintenance will provide further insight into the relationship between problem-solving skills and weight maintenance trajectories.

Interestingly, one of the emergent findings from the qualitative analysis was that the maintainer group described mistakes differently to those in the heavier-than-baseline group. Mistakes in the maintainer group were described in a manner that appeared to be less dichotomously oriented around success or failure and a subsequent judgement of self. Instead, the maintainers tended to describe their mistakes as acceptable, inevitable and/or as necessary for future learning and they were more forgiving of these mistakes when they occurred. The direction of the relationship between weight maintenance and this difference in handling mistakes remains unclear; it is possible that this lack of judgement and acceptance of mistakes may have made it easier for the maintainers to troubleshoot their weight management problems more directly, honestly and/or thoroughly. However, it may equally be that stronger problem-solving skills somehow foster a lack of judgement and acceptance within the self, and future research is needed to understand how these concepts impact on one another.

Quantitative differences in thinking style were not significant, as measured by the DTI. This suggests that the qualitative difference found in how our maintainer and heavier-than-baseline participants handled mistakes, although possibly related to a thinking style, may not be best captured by the dichotomous thinking construct, and future research may wish to investigate alternative thinking styles and constructs. Given that qualitative differences in dichotomous thinking have been repeatedly found in previous research (Byrne, 2002; Byrne et al., 2003, 2004; Kayman et al., 1990), it is worth considering that this study was powered to detect only large effect sizes due to the sample size (Cohen, 1988).

It should be noted that the data were repeatedly tested via multiple *t*-tests. However, as the measures involved were considered distinct, the alpha level was not amended or made more conservative than $p = .05$, as would be appropriate for repeated testing on highly related constructs. Finally, participants in this study had attempted weight maintenance for a relatively short period of time (4 months). Nevertheless, our data offer good preliminary evidence that those who are able to maintain weight losses without active intervention or support, over a period of months, are those who are prone to being accepting of their mistakes and who have stronger planning and problem-solving skills.

Conclusion

This study found that participants who initially maintained clinically relevant weight losses showed significantly stronger problem-solving skills than participants who re-gained and weighed more than their baseline weight over the same period. Participants who became

heavier than their baseline weight also tended towards the two non-rational problem-solving styles: Impulsive/Careless and Avoidant styles.

All interviewed participants indicated that planning was important for weight maintenance. Future interventions should emphasise planning and problem-solving and should explicitly teach how to implement planning and problem-solving, as well as provide opportunities for skill-building in these areas.

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Note

1. See Supplementary material, Tables 1 and 2 for further examples and full versions of all illustrative quotes used.

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Appendix B: Supplementary Table Submitted Alongside Study One

Supplementary Material (1) Qualitative Extracts

Table 1
Commonalities: Qualitative Extract Examples, Arranged by Theme and Participant Group

Theme	Rule for inclusion	Maintainer example	Heavier-than-baseline example
Defining Planning	Participant attempts to describe planning as a concept	*,Um,just being organised I guess, yeah it's um.It's tricky planning, um, I just thought planning was planning, I didn't know I had to elaborate on planning more, but yes, um. Mmm, yeah it's just even when you're shopping for the week, you sort of are planning long term I guess, like you know, 'cause you buy snacks and you know, you buy all those things for you, so it's always there at home so um... yeah. Male, #50, 12,404-408*	*Um, [planning is] basically everything you do. So, planning the timetable, the, the actual organisational part of, getting what you need together, maybe the milkshake and the bottle, uh, planning your time at work, saying "well okay, on that break or, I'm, I'm going to (Location) next week so I won't be able to do this" that's a plan, to take 5 sachets or 10, even take 2 a day or whatever and organise to take it with you. Um, nut the planning is, it's a part of everything. It's, you can have, you can organise things afterwards if you've put a plan into place. But, you do need to plan in advance. So*

			you can, stick to it, basically. – Male, PM126, 10, 360-366.
Planning importance	Endorsement of planning as being important	*Uh, it's, it's… a definite, yeah! (laughs) Very, very, very important, 100% important. Um… planning in, in, it's like anything in life, like I've got my, you know, I've had a few little sayings, but if you, if you fail to plan, you plan to fail. – Female, #97, 13, 487-489.*	*I think planning your food's just the – is just paramount. You know, you can't – well if you're working it's paramount. You've got to work out what are you going to take for lunch. Can you heat it up when you get there… - Female, #55, 10,352-354.*
Bad habits and mistakes	Describes circumstances or contexts in which unwanted habitual actions tended to occur	Um, and I suppose I comfort eat too. So if things are going really bad, mmm, chocolate beckons. So yeah, the temptation of chocolate. Perhaps is the other thing that gets in the way. – Female, #81, 4, 145-147.	Um, when you have stress, yeah, it's easy to grab a chocolate (laughs). Yep, when you get stressed out, or, um, have money problems and things like that. yeah. – Female, #6, 4 121-122. [continued] that's why I've failed! (laughs) That's why I've failed, 'cause I just grab [the chocolate bar] and then think after, "oh, I shouldn't

			have had that". Yeah. –*Female, #6, 5, 144-145.*
Stress coping	Participant describes what they think they will need to cope with stress in the future	*Going through heaps of stressful situations at the moment with (family)… we're well practiced at that, yes! I don't, I don't think there's going to be a problem for me, um, because yeah, I think we've sort of dealt with lots of fairly difficult and sticky situations, particularly in the last 6 months.* – Female, #81, 8, 260-267.	*I think ultimately, you just have to do it. You've just gotta get into that routine, and… just do it, and say no to stuff. And… whereas I don't. I just don't do that. I just think I've… it doesn't… situations don't make me want to eat, like if there's a funeral or… it doesn't make me want to eat. I just eat because I want to eat, sorta thing. – Female, #130, 11, 377-380*

Table 2

Differences between Maintainers and Heavier-than-baseline groups: Qualitative Extract Examples, Arranged by Theme and Participant Group

Theme	Rule for inclusion	Maintainer example	Heavier-than-baseline example
Specific planning event	Describes putting or attempting to put a pre-planned action into practice	*And also I say things like, "on the weekend, I'm going to have toast and vegemite on Sunday morning for brunch", we go out, and that fits within my um, understanding of what I know I can eat, you, you know, won't go overboard, I'm not going to have 5 slices, I'm not going to have it with honey and cream or whatever else, I'll have a toast with vegemite, which is what I like, and multigrain*	*Trying to put them* (strategies) *into my life. So um, you know when you're out and about and, um, you know, I'm working as well, so trying to make meals late at night, I do tend to go for an easier option, for quick, yeah, and that is always probably not the best choice. So, like an easy pasta because that's what the kids will eat it and then I'll eat it, and that's probably not a good thing, is it? ...So um, once again, have that structure say, "this is what we're having for*

		toast which is what I like. – Female, #140, 3, 97-101. *I'd work out exactly how many calories um, 6 jellybeans are and I'd put them in a, in a snaplock bag- Male, #050, 7,253-254* *Like, I'm working this afternoon but I've got my little chicken salad in the car and...(laughs). So yeah, it's just a matter of being organised instead of going into a cafe or just... yeah. – Female, #124, 5, 149-151.*	*dinner" and then being prepared and yeah. I'm not very good at that, so.(laughs).- Female, #29, 4, 99-104.* *It's... it's really tricky because you... don't have milk* [at work]. *You don't have anything. Yeah, because you're... you might grab something as you're walking out of the door, um... and... that, you know, let's say it's a bag of lollies, at work we have, you know, little dollar bags of lollies... –Male, #22, 7, 229-236.*
Problem solving	Reaction to a problem or a plan gone awry	*I know that I am, I find it very difficult to restrict myself with nuts, peanuts in particular, and if I see a peanut, I've got to have it. And in the past, I would sit down with a bag and I would just eat until I'd finished the bag. And I knew I*	*The most difficult for me is to, um, is to stick to it. Is to be... vigilant and if... you know, you've got a procedure to follow, then you must rigidly follow it, each day. I think my problem's been... I uh, I've got good intentions, I mean to do*

		was like that, so, I knew I couldn't do without them. And one of that snacks was, I think it was 10 peanuts. So I sat down and I made bags, little plastic bags of 10 peanuts. So when, I really had to have nuts, I would go and get one bag and I'd make a big point of getting one bag, shutting the container and then walking away with my one bag, and I found that was quite, I could finish with the 10 and that was it! (laughs) – Female, #9, 6, 17-23.	*this, I'm yeah, it's really important to me, I've got to do it, and then I get to work and, there's pressures and... you just get on with the pressures at work and, well, you're busy and it's lunch time, oh and you haven't taken the milkshakes to work or... you know, uh, I'll just uh, I'll just go and grab a sandwich or and then so you, you know, you're off track. You need to be vigilant and stick to it. And although I'm... motivated initially or, I'm a, I'm motivated now to do it, to continue doing it, I got to... you know, somehow force myself to do it and. I don't know. –Male, #126, 5, 177-184.*
Handling mistakes	Describes reaction to breaking their diet	*...just try to make a better decision? Because we're not perfect. Like I probably could have... could have lost a lot of- lot more weight a lot quicker, but I'm not perfect. And if you*	*So I get the chips, and what happens then? You know either my husband or I eat them! But at home you don't have to have those sorta things put in front of you. And I'm weak. I think I'm*

		try to be perfect all the time I think you kind of set yourself up for failure. Whereas admitting that you're a human being and food's bloody awesome (laughs) and how can I stop the food controlling me, I, having the sense that "yeah, I'll eat you cake. But I'm not letting you slap yourself all over my thighs!" – Female, #097, 9, 316-321.	*weak.-Female, #130, 9, 317-318.* *So... I said, "oh, stuff it, I'll just have a beer!" (laughs) ...So I was weak and failed and... ended up just going back. – Male, #126, 8, 297-298.*
Thinking style	Describes a general thinking style or "mindset" that the participant says they approach dieting with	*[Successful dieting is] not having to… be miserable about what you're eating out all the time, successful is about being able to live a normal life, go out to a café or go out to dinner with your friends or go to [festival name] and eat whatever the hell is going because you're hungry and not thinking "oh my god, that's a disaster!", going "I can make that fit, right?". It's about being normal and socialising*	*For me, I'm the kind of thinker that's like "oh well, that's a failure again" and, then it starts to snowball, downhill. Or even "I can't do it", it just goes down from there. – Female, #027, 3, 102-104* *It's probably, It's only cos, it's probably my own fault. If I chose to, to just do it? And not talk about it? I could probably get back in the, you know, the swing of things. And you know,*

		and, the whole interaction of, to not lose sight of the fact that, you know, food is an interactive thing that you do with family and friends and to be able to enjoy the good part of it. – Male, #96, 4, 142-148.	*probably because I know I'll always fail, I never, I always start these diets and I always fail them –Female, #130, 12 415-420.*
		you can't rely on other people. You've got to be kind and caring to yourself. That that, that is, it's a difficult and it's really hard to learn, nut you know. That's what you've got to do. –Female, #133, 6, 217-219.	
Getting back on track	Describes resolutions to take up the diet again after a mistake or period of relapse	*if you do make a mistake, just you know, forgive yourself and get back on and do the right thing. So that is a age thing I think, I've learned over the years as well. Many years of dieting and it, it's all, a lot if it's got to do with your mind as well. Being... making... well, you're being kind to yourself*	*Yep, and I just lost the motivation at the moment. And I need a kick in the bum and then I'll get back onto the train again. After Christmas. Get over this heat, maybe. –Female, #087, 5, 154-157.* *a big fright would be the onl- probably the only thing that would really stupendously*

really, more than anything....and getting straight back on, not waiting until – 'cause quite often you'd say, "well next week" or "after this important occasion" or, and straight away, the next day. You have a hiccup and um, I think that's how I'm going to be looking at um, how I am now. Like, after I've finished all the shakes or whatever, um, and just if I mess up, well I'll just get back and, you know. – Female, #133, 4, 132-144.

motivate me without me going, "I'm going to get around to that after I come back from that holiday... you know, I'll start then". – Female, #055, 5, 153-156.

Appendix C: Journal Article of Paper from Study Two

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Breaking habits with mindful snacking? An email-based intervention targeting unwanted snacking habits in an Australian sample

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ABSTRACT

Objective: To investigate the potential for an email-based, mindful eating exercise to improve unwanted snacking habits.

Method: Australian participants (N = 78, 86% female) with unwanted snacking habits engaged in a mindful eating email-based intervention, over a practice period of two weeks. All measures were completed using an online survey. Habit strength was measured using the Self-Report Habit Index (SHRI). Mindful eating was measured using the Mindful Eating Questionnaire (MEQ) and self-compassion was measured using the Self-Compassion Scale (SCS). Participants were emailed a mindful eating exercise and asked to make action plans to practice it. Reminders to perform the task were sent via email after one week. After two weeks, the MEQ, SCS and SHRI were readministered.

Results: Habit strength significantly increased over the two-week period and self-compassion significantly decreased. The amount of practice reported was not associated with these changes, but self-reported effort expended during practice sessions was partially associated.

Discussion: The intervention resulted in increased habit strength; potential mechanisms underlying these changes are discussed. Decreased self-compassion may be linked to both the electronic delivery of the intervention and the nature of the mindful eating task.

1. Introduction

Snacking between meals has been linked to overconsumption and health issues such as poorer nutrition, increased BMI (particularly in adulthood), overweight and obesity (Fay, White, Finlayson, & King, 2015; Gregori, Foltran, Chidina, & Berchialla, 2010; Piernas & Popkin, 2009). Given the rising prevalence of snacking behaviour (Fayet-Moore, Peters, McConnell, Petocz, & Eldridge, 2017; Piernas & Popkin, 2009) and that snacking is often unintentional, counter-intentional and habitual (Gore, Foster, DiLillo, Kirk, & West, 2003; Ohtomo, 2013), low-cost intervention strategies are needed to help consumers to weaken unwanted snacking habits.

Snacking has been defined by the general populace as meaning the consumption of foods in between mealtimes, with a general consensus that these foods tend to be less healthy than mealtime foods (Chaplin & Smith, 2011). A recent systematic review and Bayesian analysis of 228 studies suggests that behaviour in line with this definition may be associated with the development of obesity (Gregori et al., 2010). Habits, in brief, have been defined as mental links that occur between an environmental cue, and a particular behaviour, which are strengthened with repeated performance over time, and which automatically invoke behaviour, bypassing much of the conscious decision-making process (Neal, Wood, & Quinn, 2006). Thus, a snacking habit in the current study refers to a specific food item, eaten regularly and with a degree of automaticity, in between mealtimes.

Given the automaticity associated with unwanted snacking habits (Gardner, 2015), mindfulness-based strategies may be effective for reducing them. Mindfulness has been broadly defined as "the awareness that emerges through paying attention on purpose, in the present moment and nonjudgmentally to the unfolding of experience moment by moment" (Kabat-Zinn, 2003, p. 145). It has been described as a *state* that occurs when self-regulation skills are used to deliberately shepherd awareness towards present moment experiences (Lau et al., 2006) and also as a *trait* which remains stable without intervention, denoting one's

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general tendency to be mindful in daily life (Baer, Smith, & Allen, 2004). According to Kiken, Garland, Bluth, Palsson, and Gaylord (2015), repeated invocation of mindfulness states strengthens trait-based mindfulness in practitioners. Research investigating the utility of mindfulness in the context of interventions targeting weight, food and eating behaviour has grown over the past decade, and the construct of "mindful eating" has become of interest. Mindful eating, which applies the same principles of awareness to food-related contexts, has been defined as the non-judgemental awareness of physical and emotional sensations associated with eating (Framson et al., 2009).

Two recent systematic reviews investigating the efficacy of both mindful eating and broader mindfulness exercises have concluded there is good supporting evidence that these are useful for decreasing binge eating episodes, emotional eating, and external eating (Katterman, Kleinman, Hood, Nackers, & Corsica, 2014; O'Reilly, Cook, Spruijt-Metz, & Black, 2014). Mindful eating in particular has been linked to positive outcomes in body weight, dietary intake, decreased binge-eating behaviour, and decreased snacking behaviour (Higgs & Donohoe, 2011; O'Reilly et al., 2014). A narrative review on mindfulness-based interventions (including mindful eating) adds that they assist with weight control via reductions in automatic eating, improved responses to food cravings and lowered consumption impulsivity (Mantzios & Wilson, 2015). Mindfulness training is thought to be useful for breaking unwanted habits, as it deploys attentional resources to deliberately interrupt the automatic, habitual response. This allows for the re-membering and execution of intentional action instead (Chatzisarantis & Hagger, 2007; Vago, 2014).

Preliminary research has also linked self-compassion with the cultivation of mindfulness. A narrative review by Mantzios and Wilson (2015) reports higher self-compassion is associated with greater effectiveness of mindfulness-based interventions. Neff (2003b) defines three fundamental components of self-compassion as *self-kindness* (cultivating an attitude of kindness and gentleness towards oneself, rather than criticism or judgement); *common humanity* (understanding that suffering and imperfections are all part of a common human experience, rather than seeing them as isolating or separating), and *mindfulness*, (noticing and accepting our inner experiences in balanced awareness, without over-identifying with them). As mindfulness is a core component of self-compassion, it is generally accepted that these two constructs have the capacity to be co-cultivated and work well together (Mantzios & Wilson, 2015; Neff, 2003b). Self-compassion has also been successfully used to alleviate disordered eating, improve body image and foster more adaptive eating styles (Braun, Park, & Gorin, 2016). A recent review by Braun et al. (2016) has reported that self-compassion cultivates more adaptive eating habits via multiple pathways, including the prevention of risk factors for maladaptive eating, mitigating the impact of risk factors which are already present and disrupting the mediational chain through which a risk factor operates.

In light of the research described above, the current pilot study investigated whether a brief, email-based intervention emphasising mindful snacking could help change habitual but unwanted snacking behaviour. Given the high prevalence of weight and snacking issues in society, the value of web-based interventions to assist with food habits, weight loss and weight maintenance has been well-established. A recent systematic review synthesising the results of twenty previous reviews has confirmed the efficacy of email, online and web-based weight loss/maintenance interventions (Sorgente et al., 2017), reporting greater effects than control or wait-list groups. In line with the subsequent recommendations produced in this review, our intervention was designed using an email-based delivery system, addressing a common limitation of e-interventions as being less accessible to populations with low familiarity with complex web-based technologies. Intervention material was delivered by email, and able to be saved and used offline at a later time, to further address reported limitations associated with access to the internet (Sorgente et al., 2017). The intervention was developed using an adaptation of the 'eating one raisin' exercise, from Williams, Teasdale, Segal, and Kabat-Zinn (2007), originally described in the Kabat-Zinn and Hanh (1990) mindfulness-based stress-reduction program (see Section 2.4). Though variants of this exercise have been used in mindful eating research previously, mindful eating research is still in its infancy and a need for further study in this area has been identified (Mantzios & Wilson, 2015). It remains to be seen whether mindful eating can be used in the service of breaking consumption-based habits and whether this construct is associated with supportive factors linked to mindfulness, such as self-compassion. We hypothesised (a) mindful eating would increase from baseline to follow-up, and (b) that the habit-strength of participant snacking would decrease from baseline to follow-up. Secondary research aims involved investigating (c) whether self-compassion would increase from baseline to follow-up, and as repeated practice of mindfulness states cultivate a more stable mindfulness-trait (Chatzisarantis & Hagger, 2007), (d) whether our exploratory variables (number of practice sessions, strength of intention, commitment, perceived effort, plan quality or habit strength) would act as significant explanatory factors in any differences observed between baseline and follow-up.

2. Materials and methods

2.1. Recruitment and participants

Participants were recruited via the Facebook page of the Commonwealth Scientific and Industrial Research Organisation (CSIRO). Advertisements promoting a "Mindful Snacking Study" targeted the newsfeeds of people meeting broad inclusion criteria and who had liked popular nutrition or weight-based pages. Inclusion criteria were computer access with access to email, English literacy, currently living in Australia, and a desire to eat a particular snack food less habitually.

Participants (n = 158) completed initial questionnaires and of these, 78 completed the follow-up measures. An attrition rate of 50% over two weeks was anticipated and consistent with predictions regarding e-health interventions (Eysenbach, 2005). The final sample (n = 78) was aged between 20 and 80 years old ($M = 42.89$, $SD = 13.49$) and predominantly female (n = 66). Very few participants knew what mindful eating was prior to participation (n = 3).

Participants exhibited average levels of self-compassion at baseline ($M = 3.11$, $SD = 0.78$) as per score interpretations published by (Neff, 2018), and average degrees of mindful eating ($M = 2.48$, $SD = 0.39$), comparable with published means (Framson et al., 2009). Initial habit strength scores ($M = 27.63$ $SD = 9.34$) were in line with estimates of 'unhealthful eating' habits from a recent systematic review (Gardner, de Bruijn, & Lally, 2011). Participants who dropped out were not significantly different from those who completed the study on any baseline measures.

2.2. Design and procedure

The study was a within-subjects design with pre- and post-intervention measurement of outcome variables (mindful eating, habit strength and self-compassion). Baseline measures were administered prior to the intervention delivery and follow-up measures were administered two weeks later at completion of the intervention period. All measures were administered online through survey software (Survey Gizmo).

Participants gave informed consent online after reading an information sheet, provided email addresses for future contact and completed baseline questionnaires (Self-Compassion Questionnaire, Mindful Eating Questionnaire and the Self-Report Habit Index, described below). Participants then nominated a target snack food. As action-planning is well known to facilitate intentional action (Gollwitzer & Sheeran, 2006) participants were asked to make action plans to help them translate their intentions to practice mindful eating

into action. As participants would likely have a variety of routines and schedules, and as practice was unsupervised, action planning was featured to facilitate independent, and self-determined practice of the mindful eating exercise. Participants were asked to record their plans as a part of the online survey, and were asked to consider where, when and how they would practice.

Participants received a standardised welcome email after completing initial measures, which also contained the intervention material as an attachment. One week later, all participants received an email, reminding them that one week of practice remained. Two weeks after the welcome email, participants received a third email, containing a link to the electronic survey and asking them to complete. If follow-up measures were not completed, participants received up to three reminder emails, over the course of three weeks.

2.3. Measures

2.3.1. The Mindful Eating Questionnaire: MEQ (Framson et al., 2009)

This 28-item questionnaire measures the extent to which a person exhibits non-judgemental awareness of physical and emotional sensations, associated with eating. Participants are asked to respond to questions about the way in which they eat (e.g. "I notice when foods and drinks are too sweet") on a 1–4 point response scale (1 = Never/Rarely, 4 = Always/Usually). The scale comprises of 5 subscales, which can be combined to create a composite Mindful Eating score. Higher scores indicate more mindful eating.

The Mindful Eating Questionnaire has reportedly shown good convergent validity ($r = 0.41$, $p < .01$) with general mindfulness (Beshara, Hutchinson, & Wilson, 2013) and with mindfulness skills developed through yoga practice (Framson et al., 2009). Good divergent validity has been established from moderate intensity exercise (Framson et al., 2009). The questionnaire has been used repeatedly to investigate links between mindfulness, eating behaviours and weight (Beshara et al., 2013; Framson et al., 2009), both in cohort studies (Moor, Scott, & McIntosh, 2013) and in intervention randomised controlled trials (Kidd, Graor, & Murrock, 2013; Mason et al., 2016).

The overall scale exhibited good reliability ($\alpha = 0.82$), as did most subscales (awareness $\alpha = 0.83$, distraction when eating $\alpha = 0.68$, disinhibition $\alpha = 0.76$, external eating $\alpha = 0.51$ and emotional eating $\alpha = 0.76$). Two subscales, external eating and distraction yielded lower reliability ratings. However, this is common among shorter subscales (Field, 2009) and the external eating and distraction subscales are comprised of only 6 and 3 items respectively. After examining the individual items and estimates of the alpha-if-deleted for each scale, both reliability ratings were improved through the deletion of a single item each (item #1 from the distraction subscale and #8 from the external eating subscale). The subsequently improved External eating ($\alpha = 0.63$) and Distraction ($\alpha = 0.77$) subscales were used in analyses.

2.3.2. Self-Report Habit Index: SRHI (Verplanken & Orbell, 2003)

This 12-item questionnaire measures the degree to which a particular behaviour is habitual. According to Verplanken and Orbell (2003), this scale attends to several features thought to be associated with habitual behaviour, including frequent repetition, difficulty controlling habitual behaviour, a lack of awareness when performing the behaviour, energy efficiency and a sense of identity (e.g. Behaviour x is something that's "typically me"). When administering the scale, participants are asked to endorse statements about a specific behaviour (e.g. "(Behaviour x is something…) I do frequently") by responding on a 5-point response scale (1 = Disagree, 5 = Agree). Total scores are out of 60, with higher scores indicating stronger habits.

Factor analyses during the scale's construction supports a one-factor structure (Verplanken & Orbell, 2003). This measure has shown good one-week test-retest reliability ($r = 0.91$, $p < .01$), exhibited good reliability in the current study ($\alpha = 0.87$). Convergent validity has been established ($r = 0.58$, $p < .001$) using the response frequency measure of habit (Verplanken, Aarts, Knippenberg, & Knippenberg, 1994), and is sensitive to differing habit strengths; the scale can successfully differentiate between behaviours which are performed on a daily versus weekly basis (Verplanken & Orbell, 2003).

2.3.3. Self-Compassion Scale: SCS (Neff, 2003a)

This 26-item questionnaire is comprised of 6 sub-scales which are combined to create a composite Self-Compassion Score. Participants are asked to endorse statements such as "I'm disapproving and judgmental about my own flaws and inadequacies" on a 1–5 point response scale (1 = Almost never, 5 = Almost always). Negative scales (self-judgement, isolation and over identification) are reversed during scoring. Each subscale yields a final score out of 5 with the composite score out of 30. Higher scores indicate more self-compassion.

Factor analyses during the scale's construction (Neff, 2003a) supports 6 underlying factors (one for each subscale). This scale is widely used (MacBeth & Gumley, 2012) and according to (Neff, 2003a) the Self-Compassion Scale has shown good convergent validity ($r = 0.41$. $p = .01$) with the Social Connectedness Scale (Lee & Robbins, 1995), and the positive subscales of the Meta-Mood Trait Scale (Salovey, Mayer, Goldman, Turvey, & Palfai, 1995), which measures Emotional Intelligence (Attention: $r = 0.43$, $p < .01$; Clarity: $r = 0.43$, $p < .01$; Repair: $r = 0.55$, $p < .01$) as well as negative correlations with the Depressive Experiences Questionnaire (Blatt, D'Afflitti, & Quinlan, 1976) subscale Self-Criticism ($r = -0.65$, $p < .01$). The composite score exhibited good reliability ($\alpha = 0.94$), as did the subscales self-kindness ($\alpha = 0.84$), common humanity ($\alpha = 0.82$), mindfulness ($\alpha = 0.72$), self-judgement ($\alpha = 0.90$), isolation ($\alpha = 0.82$) and over-identification ($\alpha = 0.80$).

2.3.4. Manipulation checks and explanatory factors: practice, effort, commitment, intention and plan quality

At baseline, two single-item questions measured the strength of intention and commitment to practice the mindful eating exercise (both 0–10 response scales, (0 = 'Not very Committed/Do not really Intend', 10 = 'Very Committed/Strongly Intend'). Participants also nominated their target snack and estimated how often they consumed this snack, on average. At follow-up, participants were asked how many times they had practiced the mindful eating exercise, and how much effort they felt they had expended while engaging in the exercise (0–10 response scale, 0 = 'Did not try to complete', 10 = 'Put in best effort'). Single-item measures were constructed in accordance with the recommendations of Ajzen, Joyce, Sheikh, and Cote (2011). Given these guidelines and the support of previous research for single-item measures to reliably capture goal-intentions (Sheeran, Webb, & Gollwitzer, 2005) and action effort (Maslyn & Uhl-Bien, 2001), it was decided to minimise participant-burden by incorporating these measures as single-items. Participants also reported how often they had eaten their snack during the study fortnight.

A measure of action plan quality was derived from The *Goal-Setting Evaluation Tool for Diabetes* (GET-D). This measure was designed to assist self-management in diabetes (Teal, Haidet, Balasubramanyam, Rodriguez, & Naik, 2012) but has also been used in weight loss intervention programs (Dibb-Smith, Brindal, Chapman, & Noakes, 2016). The GET-D assigns points based on a series of questions (e.g. "Does the plan identify how often the action(s) will be taken?"). A score of plan quality is yielded (0–19); higher scores indicate better quality plans. One of the criteria "intensity of action" pertains to exercise; this was adapted for our study to a "specify food amount" criteria, to better suit the nature of the task. Inter-rater reliability between two coders (ADS, JD) was acceptable (Kappa = 0.81).

Table 1
Paired *t*-tests determining significant differences between scores at Time 1 and Time 2 (N = 78).

Variable name	Mean (SD)		*t*	*p*	*df*	*d*
	Time 1	Time 2				
Snack food consumed	19.97(43.15)	13.48(21.73)	1.124	0.265	77	0.19
Self-Compassion (Total)	18.65(4.72)	17.67(4.28)	3.41	0.001	77	0.21
Self-Judgement	2.55(0.92)	2.81(0.99)	−4.19	< 0.001	77	0.27
Isolation	2.74(1.00)	2.97(0.94)	−3.10	0.003	77	0.24
Over Identification (with emotion)	2.75(0.92)	2.99(0.90)	−3.36	0.001	77	0.26
Mindfulness	2.74(0.90)	2.59(0.73)	1.69	0.096	77	0.18
Common Humanity	2.75(0.93)	2.77(0.92)	−0.21	0.836	77	0.02
Self-Kindness	3.20(0.95)	3.09(0.85)	1.26	0.210	77	0.12
Mindful Eating (Total)	2.39(0.46)	2.51(0.29)	−2.64	0.010	77	0.31
Habit Strength	27.63(9.34)	35.12(10.52)	6.48	< 0.001	77	0.75
Snack Frequency	10.12(21.42)	6.61(10.76)	1.30	0.199	77	0.21

2.4. Intervention

The intervention file was a power-point presentation-styled PDF and contained an introduction written by a registered psychologist (ADS), explaining the premise of mindful snacking. The 'eating one raisin' exercise (Williams et al., 2007) was the task used in the intervention to cultivate mindful snacking. The task includes written instructions for participants to look at, smell, touch, taste, swallow and mindfully engage in the experience of eating a raisin. This exercise was selected for several reasons. Firstly, according to a recent narrative review on mindfulness and weight control (Mantzios & Wilson, 2015), intervention effects are maximised when mindfulness exercises focus on food and eating experiences, rather than more general mindfulness exercises (e.g. attending to the breath). Secondly, this particular exercise has been associated with greater enjoyment of food (Hong, Lishner, Han, & Huss, 2011). As anticipation of greater enjoyment has been linked to the selection of smaller portion sizes (Cornil & Chandon, 2016), and as mindful eating has been linked to both decreased instances of later snacking (Higgs & Donohoe, 2011) and decreased binge eating (Smith, Shelley, Leahigh, & Vanleit, 2006), it was reasoned that deliberate use of this mindful snacking using this exercise may assist participants to enjoy their snacks and thus feel more sated by them, assisting them in selecting smaller portions or fewer snacking sessions in the future, without feeling deprived.

For the purposes of the intervention, this exercise was adapted so that participants instead focussed on eating their nominated snack instead of a single raisin. Given the prominent role of environmental cues in habitual behaviour (Neal et al., 2006), an additional element dedicated to observing location ('where') was added at the beginning of the exercise. As emotion is relevant to both snacking and emotional eating (Wilkinson, Rowe, & Heath, 2013), two small elements were also added, to mindfully observe thoughts and feelings ('anticipation' and 'afterwards').

The exercise was delivered via email in a PowerPoint-style PDF file. Participants were able to open the file and easily access the next screen of text with a single button press, minimising keyboard use, to facilitate the handling of food. It required no audio capabilities and Adobe Acrobat Reader is freely available to the public.

3. Results

3.1. Data analysis

Paired *t*-tests investigated significant differences between baseline and follow-up. Effect sizes were calculated using Cohen's *d*. Bonferroni corrections were made where subscales were investigated, adopting a *p*-value of $p = .007$ for the Self-Compassion Scale, and a *p*-value of $p = .008$ for the Mindful Eating Questionnaire. A generalised linear model was constructed in SPSS (IBM, 2016) to examine the effects of intervention practice on outcome variables, controlling for baseline scores. Prior to analysis, the practice variable was transformed using a natural logarithm transformation, due to a positive skew (Field, 2009).

3.2. Manipulation checks

The number of intervention practice sessions varied considerably between participants, with the total reported practice sessions ranging from zero to 97 times ($M = 13.30$, $SD = 16.85$) over the intervention fortnight. Based on self-report (0–10 response scale), participants believed they engaged in the exercise with a moderate amount of effort ($M = 6.05$, $SD = 0.287$). Free-text data entered during baseline, revealed that participants had appropriately chosen snacks and not meals as their target; most commonly chosen snacks included chocolate (n = 24, 29.1%), and potato chips (n = 15, 19.0%). Action plan text revealed that participants planned to practice the mindful eating exercise appropriately with snacks, between mealtimes. Participants reported eating their chosen snacks multiple times each week at baseline ($M = 10.12$, $SD = 21.85$). At completion, participants reported they ate their chosen snack less frequently ($M = 6.61$, $SD = 10.83$). Many participants also practiced mindful eating with other foods (n = 61, 79.2%). Practice with alternative foods ($M = 6.35$ $SD = 10.55$) tended to occur just as frequently as practice with selected snacks ($M = 6.96$ $SD = 12.68$).

3.3. Hypothesis a: mindful eating scores at Time 2 will be significantly higher than baseline scores

Mindful Eating Questionnaire scores significantly improved from Time 1 to Time 2 when an alpha of $p = .05$ was adopted ($t(77) = -2.64$, $p = .010$, $d = 0.31$), with a small effect size (Table 1). The MEQ subscales were further investigated. However the MEQ Total score did not remain significant after a Bonferroni correction was made for multiple analyses, adopting an alpha criterion of $p = .008$.

3.4. Testing Hypothesis b: habitual snacking behaviour will significantly decrease from baseline to Time 2

Participants reported eating their snack food less during the study fortnight than they did at baseline, though this difference was not significant (Table 1). Habit Strength increased from baseline to follow-up ($t(77) = 6.48$, $p < .001$, $d = 0.75$), with a large effect size. Practice was not a significant predictor of Habit Strength at follow-up, indicating that the increase Habit Strength between baseline and follow-up was not significantly related to the amount of times that participants practiced the mindful snacking exercise.

Table 2
Generalised linear models, investigating the main effect of practice in producing Time 2 scores, whilst controlling for Time 1 (N = 78).

Variable name	B[a]	95CI[a]		X^2	df	p
		Lower	Upper			
Self-Compassion (Total)	0.786	0.455	1.358	0.745	1	0.388
Self-Judgement	1.039	2.069	2.735	0.306	1	0.580
Isolation	0.914	0.796	1.048	1.657	1	0.198
Over Identification (with emotion)	0.985	0.856	1.135	0.042	1	0.838
Habit Strength	0.462	0.067	3.196	0.612	1	0.434

[a] Shown *B* values and 95% Confidence Interval values are exponentiated (e^x), as the Practice variable was transformed using a natural logarithm.

3.5. Hypothesis c: Self-Compassion Scores at Time 2 will be significantly higher than baseline scores

Self-compassion significantly decreased from baseline to follow-up ($t(77) = 3.41$, $p = .001$, $d = 0.21$), with a small effect, meaning that people exhibited worse/less self-compassion after two weeks. The subscales of the SCS were further investigated. There were significant increases in Self-Judgement ($t(77) = -4.19$, $p < .001$, $d = 0.27$), Isolation ($t(77) = -3.10$, $p = .003$, $d = 0.24$) and Over-Identification with emotions ($t(77) = -3.36$, $p = .001$, $d = 0.26$), with small effects.

Generalised linear models revealed that Practice was not a significant predictor of any changes in the SCS (Table 2), indicating that these changes between baseline and follow-up were not significantly related to the amount of times that participants practiced the mindful eating exercise.

3.6. Hypothesis d: exploratory investigation into Practice and factors underlying change

As Practice was not a significant predictor, alternative explanatory factors for the differences between baseline and follow-up were explored. Factors explored for explanatory value included Effort, Commitment, Intention, and Plan Quality. Habit Strength was also explored as an explanatory factor for Self-Compassion (Table 3).

Habit Strength was related to the SCS subscale, Self-Judgement ($p = .028$), such that for every unit of increase in Habit Strength, Self-Judgement increased by 0.15. Effort was related to the SCS subscale, Isolation ($p = .018$), such that for every unit of increase in Effort, Isolation increased by 0.60.

4. Discussion

The aim of this study was to pilot a short mindful eating intervention. We hypothesised that (a) mindful eating would increase, (b) habit strength would decrease, (c) self-compassion may increase, and (d) practice would be significantly associated with these changes.

Participants did not exhibit significantly more mindful eating at follow-up (as per improvements in the MEQ subscales, after correcting for multiple analyses), leaving hypothesis (a) unsupported. Since the overall effect size was small, the authors considered that the study was slightly underpowered to detect small changes in this construct. Interestingly, in another recent mindful eating intervention Kidd et al. (2013) incorporated a qualitative focus group, and found upon completion, that their participants reported over-estimating their mindful eating scores at baseline. Participants reflected that they had only realised how mindlessly they previously ate *after* practising and engaging in mindful eating tasks. Research on mindful eating is still in its infancy and tendencies for different populations to under or over-report are still largely unknown (Mantzios & Wilson, 2015). As our sample were also new to mindful eating, it is possible that they similarly overestimated their mindful eating at baseline, explaining the lack of statistical significance.

An unexpected finding was that snacking habit-strength increased significantly, leaving hypothesis (b) unsupported. This is particularly surprising as the frequency of snack consumption tended to decrease over the study fortnight. The authors considered two possibilities. Firstly, although trait-based mindfulness is reported as interfering with counter intentional habits (Chatzisarantis & Hagger, 2007), perhaps there is something about mindful eating that strengthens habitual consumption, particularly as it enhances food-enjoyment (Hong et al., 2011). Recent critiques of mindfulness have noted that it is important to

Table 3
Generalised linear models, investigating the main effect of exploratory variables in producing Time 2 scores, whilst controlling for Time 1 (N = 78).

Factor	Outcome	B	95CI		X^2	df	p
			Lower	Upper			
Effort	Self-Compassion (Total)	−0.012	−0.216	0.191	0.014	1	0.905
	Self-Judgement	−0.031	−0.081	0.018	1.537	1	0.215
	Isolation	−0.060	−0.110	−0.010	5.616	1	0.018
	Over Identification (with emotion)	−0.029	−0.080	0.023	1.194	1	0.274
	Habit Strength	−0.402	−1.141	0.337	1.139	1	0.286
Intention	Self-Compassion (Total)	−0.042	−0.270	0.186	0.130	1	0.719
	Self-Judgement	0.015	−0.042	0.071	0.259	1	0.611
	Isolation	−0.018	−0.075	0.040	0.361	1	0.548
	Over Identification (with emotion)	−0.011	−0.069	0.048	0.131	1	0.717
	Habit Strength	−0.593	−1.404	0.217	2.061	1	0.151
Commitment	Self-Compassion (Total)	−0.112	−0.335	0.112	0.960	1	0.327
	Self-Judgement	0.031	−0.025	.-086	1.180	1	0.277
	Isolation	0.004	−0.053	0.061	0.021	1	0.885
	Over Identification (with emotion)	−0.017	−0.074	0.040	0.339	1	0.560
	Habit Strength	−0.286	−1.104	0.532	0.470	1	0.493
Plan Quality	Self-Compassion (Total)	0.081	−0.080	0.242	0.969	1	0.325
	Self-Judgement	< −0.001	−0.040	0.040	< 0.001	1	0.997
	Isolation	−0.006	−0.047	0.035	0.083	1	0.774
	Over Identification (with emotion)	0.007	−0.035	0.048	0.104	1	0.747
	Habit Strength	−0.021	−0.633	0.591	0.005	1	0.946
Habit	Self-Compassion (Total)	0.031	−0.023	0.085	1.260	1	0.262
	Self-Judgement	−0.015	−0.028	−0.002	4.804	1	0.028
	Isolation	−0.009	−0.022	0.005	1.565	1	0.211
	Over Identification (with emotion)	−0.003	−0.017	0.011	0.186	1	0.666

establish contraindications for this treatment (Hanley, Abell, Osborn, Roehrig, & Canto, 2016; Van Dam et al., 2018), and perhaps this is one. However, this seems inconsistent with previous research associating greater enjoyment with selection of smaller portion sizes (Cornil & Chandon, 2016), and mindful eating to decreased instances of later snacking (Higgs & Donohoe, 2011). It also appears at odds with the observation of decreased frequency of snack consumption in our sample. An alternative explanation may concern the limitations self-report measures. Both Hagger, Rebar, Mullan, Lipp, and Chatzisarantis (2015) and Sniehotta and Presseau (2012) caution against overreliance on the SHRI and self-report measures; part of the habit construct is thought to operate outside of awareness. Hagger et al. (2015) theorises that the SHRI likely captures the subjective *experience* of habit, rather than the actual habitual processes per se. As the aim of mindfulness is to enhance awareness of one's own experience, large increases in habit strength may reflect increased awareness of (and thus reported) habitual experiences, rather than increased habit strength itself.

Contrary to prediction, self-compassion also decreased, leaving hypothesis (c) unsupported. The effects were small (d = 0.21–0.27), but this result has important implications. Total self-compassion, as well as subscales Self-Judgement, Isolation and Over-Identification all worsened over the two-week period. A possible explanation may be the email-based nature of our intervention. When not explicitly taught, self-compassion is still often modelled by the leaders in mindfulness programs (Neff & Dahm, 2015). As self-compassion is thought to be based in the mammalian caregiving system (Goetz, Keltner, & Simon-Thomas, 2010; Neff & Dahm, 2015) and as mindfulness is thought to be within a neurologically distinct system (Neff & Dahm, 2015; Siegel, Germer, & Olendzki, 2009), it is possible that the face-to-face learning environment enables this caregiving system to activate for implicit learning (e.g. via perceptions of mentorship between teacher and student) — and this was absent in our study. Use of recorded video instruction may be a closer simulation to face-to-face learning, which could facilitate implicit modelling and learning of self-compassion in future research. Neff additionally suggests that co-cultivation is less likely when mindful tasks focus on external physical sensations (e.g. seeing and hearing), rather than internal states (such as thoughts and feelings). While mindful eating can incorporate internal states (e.g. sensations of hunger and satiety) our mindful eating exercise predominantly focussed on physical sensations (such as asking participants to look at, smell, touch and taste their snacks). Thus, the same guidelines which prompted this study to focus on mindful eating (Mantzios & Wilson, 2015) may have simultaneously distanced it from the co-cultivation of self-compassion.

However, self-compassion did not only fail to increase; it decreased. Interestingly, the three negative subscales were the ones that exhibited change. The authors considered that public discourse heavily moralises issues of weight and consumption (Cowling, 2016) and snacking can be associated with self-judgement and guilt (Schuster, Painter, Bernas & MacKenzie, 2017). Our intervention recruited participants who were interested in eroding a snacking habit; presumably because it was perceived as problematic. Thus, it may be that our sample experienced heightened self-judgement (and lower self-compassion) associated with deliberately approaching (rather than avoiding) snacks perceived as problematic. If this is the case, future research may wish to incorporate measures capturing constructs pertaining to guilt or shame around eating. Our sample was largely new to the practice of mindful eating, and this may have made it more difficult for them to non-judgmentally approach such experiences. Future research should consider that more extensive mindfulness training, emphasising acceptance, or specific self-compassion training may be required before participants are able to cultivate acceptance towards experiences previously perceived as problematic.

Practice of the intervention material was not associated with the observed changes in either Self-Compassion or Habit, prompting further questioning into why scores changed. A significant limitation of this study is that causality cannot be inferred from this design and it is possible that another factor within the intervention, (e.g. the act of enrolling in a study, or devising action plans), acted as a mechanism of change. These mechanisms seem intuitively unlikely to cause changes in habit or self-compassion constructs, but the possibility cannot be excluded. Interestingly, our models revealed significant associations of both Effort and Habit strength with self-compassion outcomes, suggesting that these may offer some strength as an explanation. Constructs of habit, effort and engagement may be important for future research to measure alongside change in addition to practice of intervention materials in future studies. Indeed, engagement is considered predictive of success in online weight control interventions (Neve, Morgan, Jones, & Collins, 2010) and the impact of habit strength has been widely acknowledged (Gardner et al., 2011).

The lack of available control group was a significant limitation of this study. The aim of this study was to investigate whether exposure to a simple emailed intervention exercise could plausibly assist with snacking behaviour; thus a pilot, no-control exercise was appropriate to our aims. However, while effort has been made to speculate on likely explanatory variables behind changes in outcome variables, future research would benefit greatly from the direct comparison a control group allows. It should also be noted that the reliability of the Mindful Eating Questionnaire was problematic. While an attempt was made to improve the reliability of the subscales, the External Eating subscale continued to exhibit issues with internal consistency (α = 0.63). This is consistent with the subscale's reported performance elsewhere (e.g. Apolzan et al., 2016; Kidd et al., 2013). Our attempt to modify the scale to increase its reliability may have implications for the generalisability of our findings and they should be interpreted with caution. It should be noted that our sample was predominantly female and entirely drawn from those living inside Australia; replication is required before being reasonably able to generalise these findings to other populations. This includes populations bound by demographics such as BMI or SES, as our participants did not record these details.

Despite these limitations, our study contributes several important findings. We used a well-known mindful eating exercise to target a specific unwanted eating habit, and found large effects. These effects are worth further investigation; they may reflect greater awareness, facilitating a shift from habitual processes towards more conscious action. If instead this reflects a genuine strengthening of habitual process, this is still an important finding, shedding light on a significant limitation of mindful eating. Finally, although self-compassion is often implicitly taught alongside mindfulness, future research would benefit from considering explicit teaching methods, as well as investigating both how this is translated in mindful eating contexts and when using online tools.

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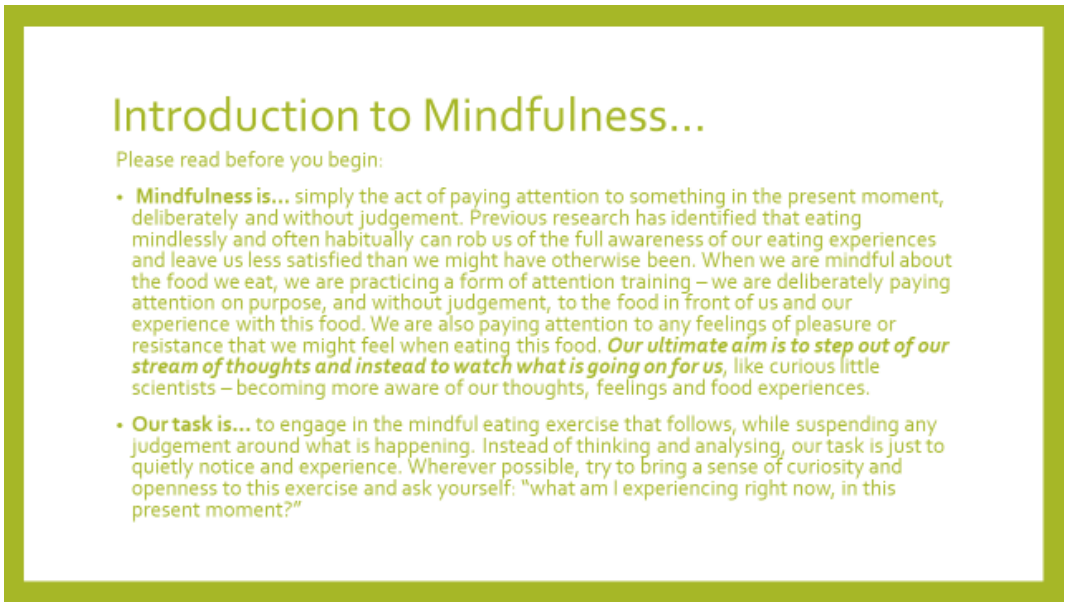
Appendix D: Mindful Snacking Exercise as Given to Participants

Page 1



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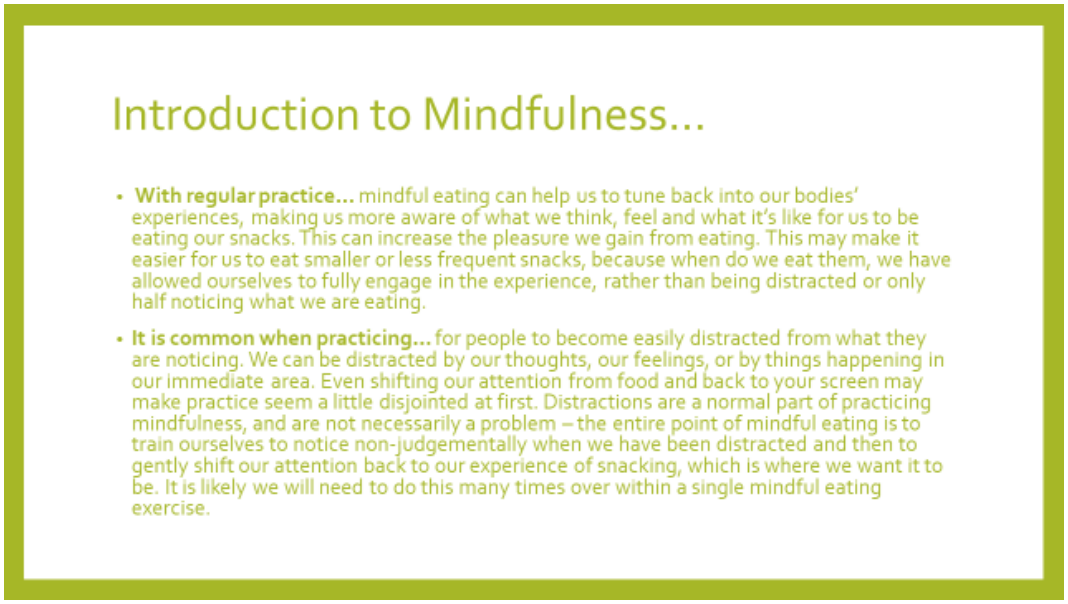
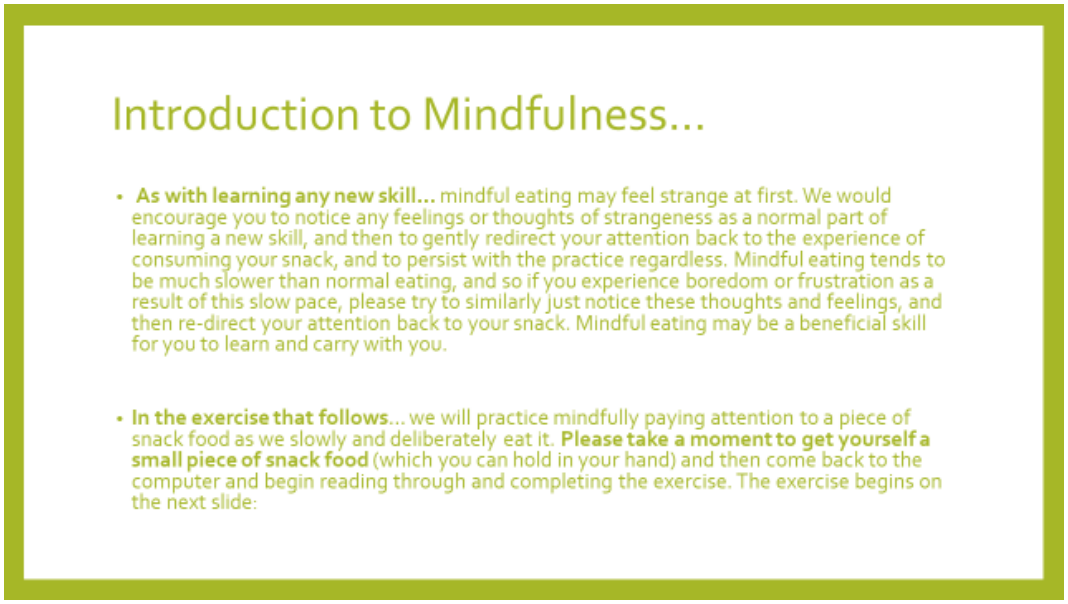
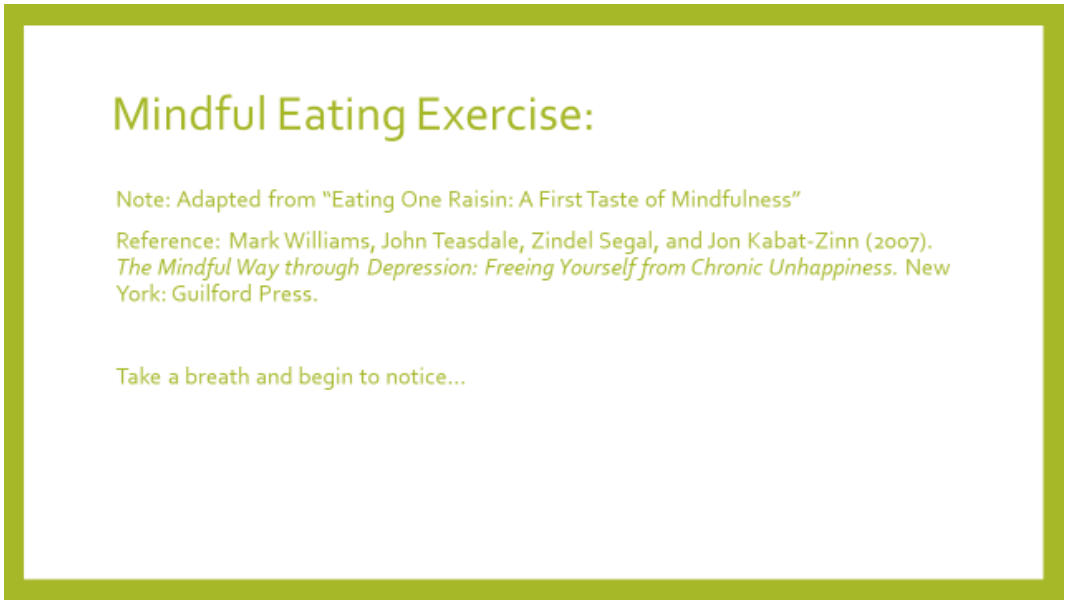

Introduction to Mindfulness…
• With regular practice… mindful eating can help us to tune back into our bodies' experiences, making us more aware of what we think, feel and what it's like for us to be eating our snacks. This can increase the pleasure we gain from eating. This may make it easier for us to eat smaller or less frequent snacks, because when do we eat them, we have allowed ourselves to fully engage in the experience, rather than being distracted or only half noticing what we are eating.
• It is common when practicing… for people to become easily distracted from what they are noticing. We can be distracted by our thoughts, our feelings, or by things happening in our immediate area. Even shifting our attention from food and back to your screen may make practice seem a little disjointed at first. Distractions are a normal part of practicing mindfulness, and are not necessarily a problem – the entire point of mindful eating is to train ourselves to notice non-judgementally when we have been distracted and then to gently shift our attention back to our experience of snacking, which is where we want it to be. It is likely we will need to do this many times over within a single mindful eating exercise.

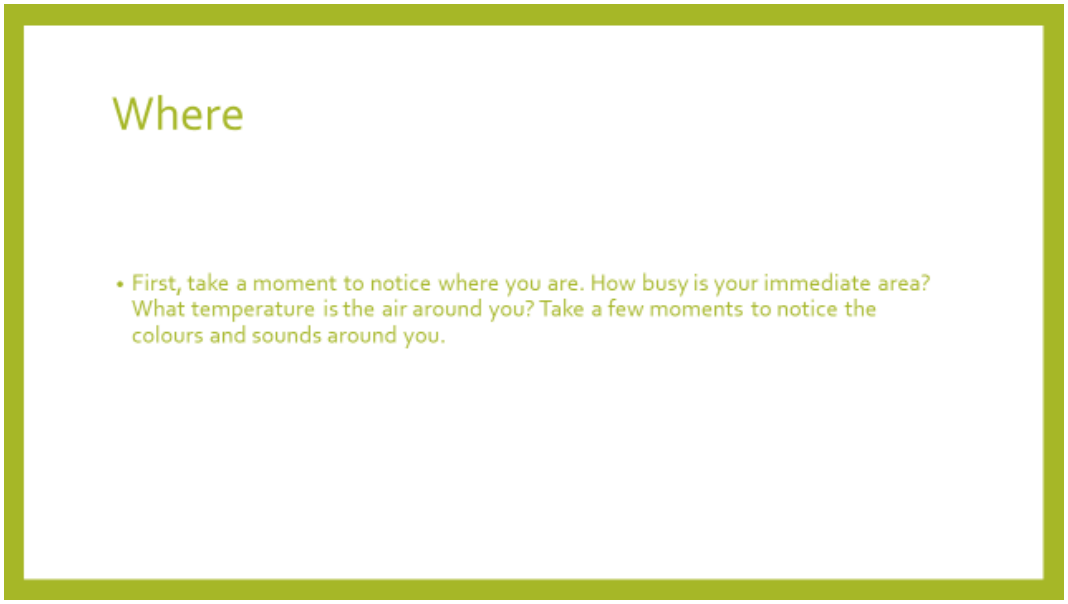
Page 3


Introduction to Mindfulness…
• As with learning any new skill… mindful eating may feel strange at first. We would encourage you to notice any feelings or thoughts of strangeness as a normal part of learning a new skill, and then to gently redirect your attention back to the experience of consuming your snack, and to persist with the practice regardless. Mindful eating tends to be much slower than normal eating, and so if you experience boredom or frustration as a result of this slow pace, please try to similarly just notice these thoughts and feelings, and then re-direct your attention back to your snack. Mindful eating may be a beneficial skill for you to learn and carry with you.
• In the exercise that follows… we will practice mindfully paying attention to a piece of snack food as we slowly and deliberately eat it. Please take a moment to get yourself a small piece of snack food (which you can hold in your hand) and then come back to the computer and begin reading through and completing the exercise. The exercise begins on the next slide:

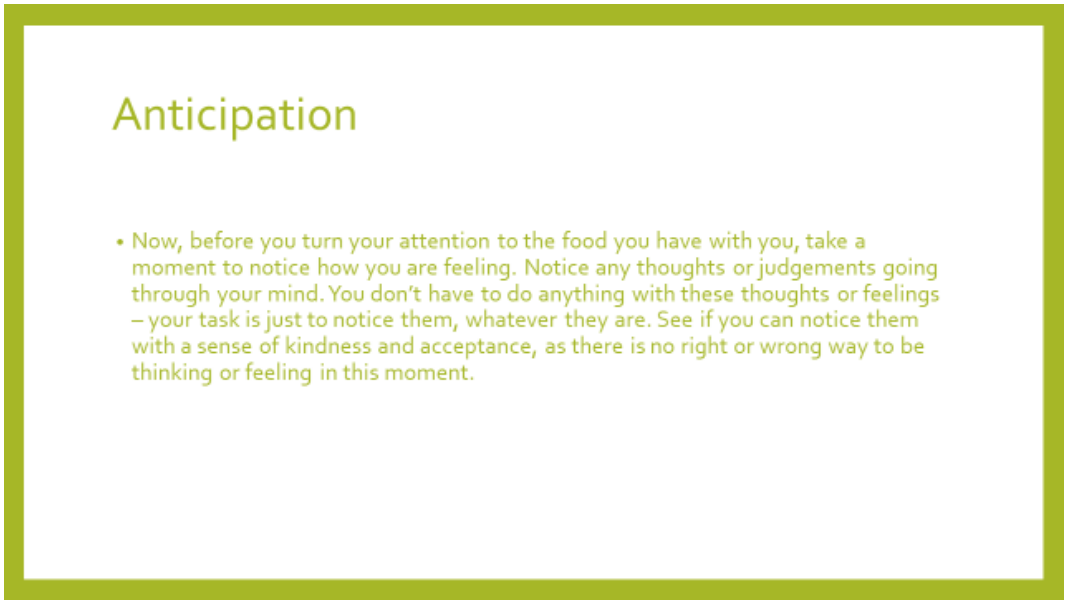
Page 4


Mindful Eating Exercise:
Note: Adapted from "Eating One Raisin: A First Taste of Mindfulness"
Reference: Mark Williams, John Teasdale, Zindel Segal, and Jon Kabat-Zinn (2007). The Mindful Way through Depression: Freeing Yourself from Chronic Unhappiness. New York: Guilford Press.
Take a breath and begin to notice...

Page 5


Where
• First, take a moment to notice where you are. How busy is your immediate area? What temperature is the air around you? Take a few moments to notice the colours and sounds around you.

Page 6


Anticipation
• Now, before you turn your attention to the food you have with you, take a moment to notice how you are feeling. Notice any thoughts or judgements going through your mind. You don't have to do anything with these thoughts or feelings – your task is just to notice them, whatever they are. See if you can notice them with a sense of kindness and acceptance, as there is no right or wrong way to be thinking or feeling in this moment.

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Holding
• When you are ready, take your piece of food and hold it in the palm of your hand or between your finger and thumb. Focusing on it, imagine that you're a curious scientist who has never seen an object like this before in your life. What weight does this piece of food have? What temperature is it? How large or small does it feel in your hand?

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Seeing
• Take time to really see it; gaze at your food with care and full attention. Let your eyes explore every part of it, examining any highlights where the light shines, any darker parts or hollows, any folds and ridges, and any asymmetries or unique features.

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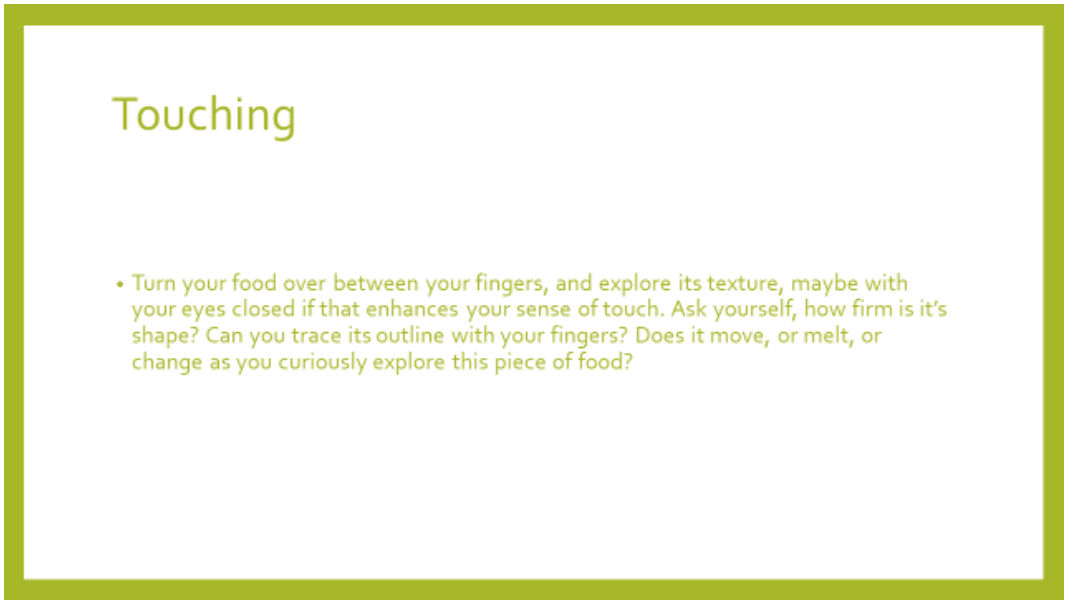
Touching
• Turn your food over between your fingers, and explore its texture, maybe with your eyes closed if that enhances your sense of touch. Ask yourself, how firm is it's shape? Can you trace its outline with your fingers? Does it move, or melt, or change as you curiously explore this piece of food?

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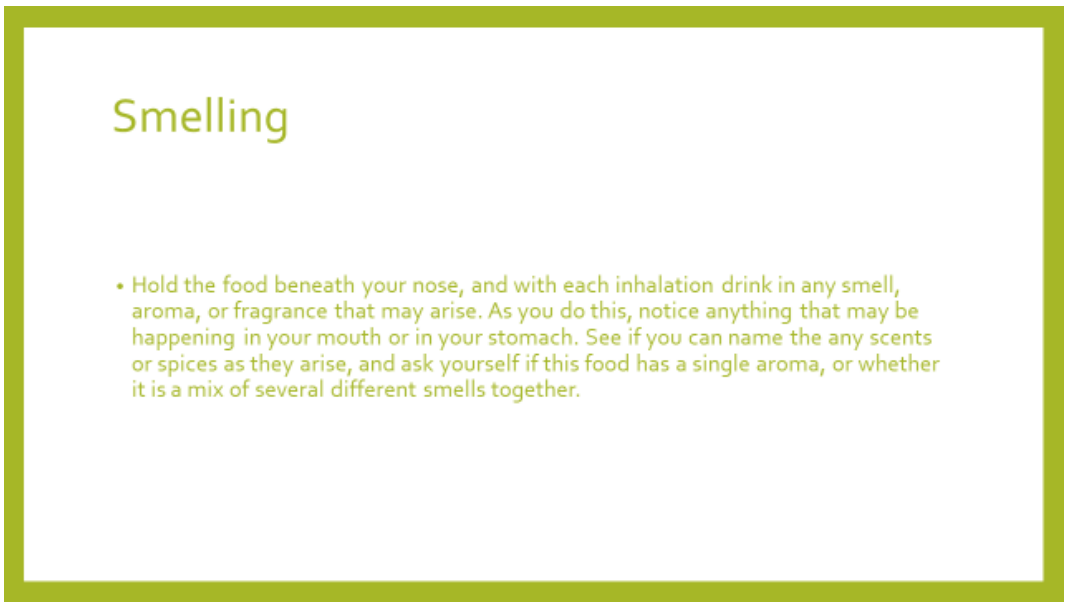

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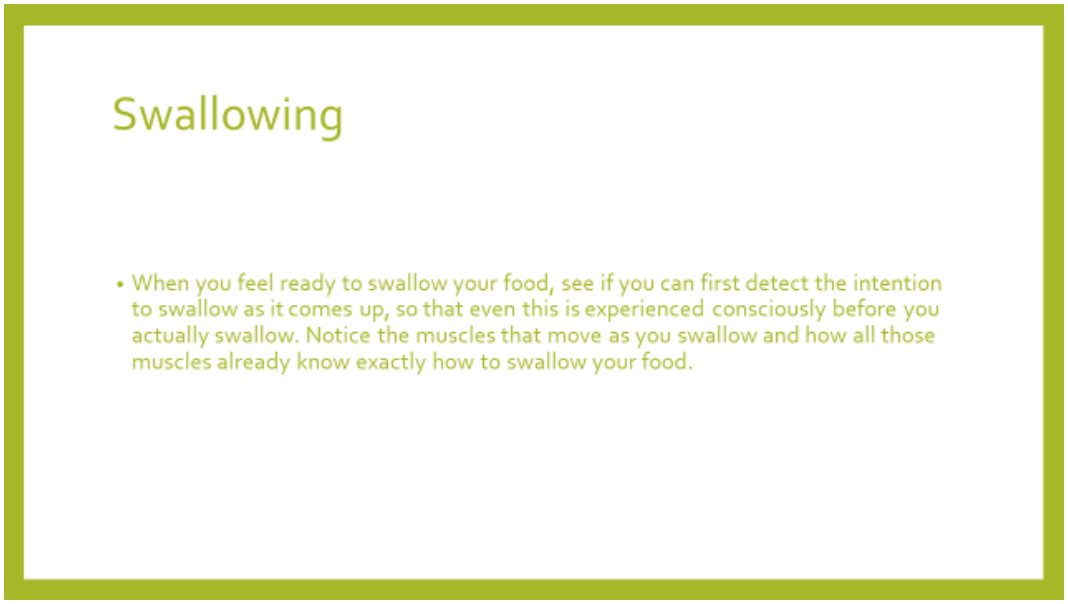

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Weekly Mindful Eating Diary

	Snack 1	Snack 2	Snack 3
Where Where were you? What did you notice?			
When What day/time was it?			
How much How much of your snack did you have?			
Anticipating Notice thoughts/feelings beforehand			
Holding What did you notice?			
Seeing What did you notice?			
Touching What did you notice?			
Smelling What did you notice?			
Tasting What did you notice?			
Chewing What did you notice?			
Swallowing What did you notice?			
Following What did you notice?			
Afterwards Notice thoughts/feelings afterwards			