Increasing Fruit and Vegetable Consumption using Implementation Intentions

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The candidate confirms that the work submitted is her own and that appropriate credit has been given where reference has been made to the work of others.

"I give you every seed-bearing plant

On the face of the whole earth

And every tree that has fruit with seed in it.

They will be your food"

(Genesis 1:29)

~§~

"Don't go getting none of that fruit n' stuff.

Just fetch some sweets and kebabs"

(Amy Winehouse, placing her backstage dietary requests for V festival,

Staffordshire, 2008)

Abstract

Developing interventions to increase fruit and vegetable consumption is an important goal for health professionals due to accumulated evidence for their health protective effects. The main aim of this thesis is to test the efficacy of implementation intention-based interventions to increase fruit and vegetable intake in a young adult, student population. The thesis consists of three broad sections: an introductory Chapter; four empirical Chapters, and a general summary and discussion.

First, justification for the study of fruit and vegetables for health promotion is provided. This is followed by an introduction to the theoretical background and operation of implementation intentions. A systematic review of previous work applying implementation intentions to fruit and vegetable intake is presented, generating the more specific aims and directions of the thesis.

Chapter 2 tests an intervention designed to improve the long-term efficacy of implementation intentions. 'Booster' implementation intentions are found to improve their long-term impact, whilst ruling out the potential for demand characteristics. The third and fourth Chapters investigate whether interventions to increase fruit and vegetables could be improved by separating the two food groups; suggesting that fruit is more amendable to change than vegetable intake and that the behavioural strategies governing their consumption are distinct. Chapter 5 combines 'action' and 'coping' planning with the booster concept of Chapter 1. Preliminary support is generated for the value of the intervention in promoting long-term behaviour change.

Finally, Chapter 6 summarises and evaluates the empirical work presented in the thesis, and compares the findings to the systematic review of Chapter 1. Potential

limitations are highlighted. Conclusions which can be drawn from these studies and their implications for the existing research literature are discussed.

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Abbreviations

AICR = American Institute for Cancer Research

ANOVA = analysis of variance

ANCOVA = analysis of covariance

BSE = breast self-examination

CHD = coronary heart disease

CVD = cardiovascular disease

DNA = deoxyribonucleic acid

DoH =Department of Health

DV = dependent variable

EPIC = European Prospective Investigation of Cancer

FFQ = food frequency questionnaire

IARC = International Agency for Research on Cancer

ITT = intention to treat

IV = independent variable

M = mean

MAP = model of action phases

MI = myocardial infarction

MANOVA = multivariate analysis of variance

NCI = National Cancer Institute

NHS = National Health Service

PBC = perceived behavioural control

RDIF = recommended daily intake of fruit

RDIFV = recommended daily intake of fruit and vegetables

RDIV = recommended daily intake of vegetables

RCT = randomised controlled trial

SD = standard deviation

TPB = theory of planned behaviour

TTM = transtheoretical model

UK = United Kingdom

US = United States

WCRF = World Cancer Research Fund

WHO = World Health Organisation

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In memory of Suzanna K. Laycock.

Chapter 1 - Interventions to Increase Fruit and Vegetable Intake

1.1 General Introduction

The present Chapter provides justification for the study of fruit and vegetables for health promotion. An outline of the evidence-based heath benefits of fruits and vegetables is presented, followed by an overview of previous intervention efforts and the problems arising from these. Section 1.5 introduces the model of action phases (MAP; Gollwitzer, 1990; Heckhausen & Gollwitzer, 1987) and implementation intentions (Gollwitzer, 1993; 1996; 1999) as the theoretical basis on which to develop future fruit and vegetable interventions. A systematic review of the current published literature applying implementation intention-based interventions to fruit and vegetable intake is presented in Section 1.6, which highlights themes to direct future research. Based on findings from the systematic review, the present Chapter concludes with the general aims of the thesis.

1.2 The Evidence-based Health Benefits of Fruit and Vegetables

Nutrition-related diseases represent a major focus for public health interventions worldwide. Non-communicable conditions, such as cardiovascular disease (CVD), diabetes, obesity, cancer and respiratory conditions account for 59% of the 56.5 million deaths annually, and 45.9% of the global burden of disease (World Health Organization [WHO] fact sheets). It is estimated that up to 80% of CVD, 90% of type-2 diabetes and one third of cancers could be avoided by changing lifestyle, including diet (WHO, 2003). Diet-related high cholesterol, high blood pressure,

obesity and insufficient consumption of fruit and vegetables have been cited as the key inter-linking risk factors playing a causal role in the majority of these diseases. In particular, it is estimated that up to 2.7 million lives could be saved each year if fruit and vegetable consumption were sufficiently increased (WHO, 2003). To put this into context, World Cancer Research Fund review (WCRF/American Institute for Cancer Research [AICR], 1997) state that making a simple dietary change such as eating sufficient amounts of fruit and vegetables each day could by itself reduce cancer rates by more than 20 per cent, and is identified as second only to reducing smoking as the most effective strategy to reduce risk (Department of Health [DoH], 2001; 2002).

Epidemiological studies suggest that fruit and vegetables may protect against chronic disease because they are rich in a number of potentially preventative nutrients including vitamins, minerals, phytochemicals and fibre (Ness & Powles, 1997). Although the specific mechanisms of action are still relatively unclear, suggested pathways by which these protective effects may be mediated include the blockage or suppression of carcinogens and the prevention of oxidative DNA damage (Watson, 2001). In addition to vitamins, minerals and dietary fibre, fruit and vegetables also provide a wide range of secondary non-nutrient constitutes which have been suggested to be partly responsible for the health benefits of these foods (Tomás-Barberán & Gil, 2008). These secondary metabolites include various chemical families such as terpenoids (caroteniods, essential oils, etc), phenolic compounds, and nitrogen and sulphur-containing compounds, which again are thought to assist in neutralising free radicals that are the origin of many age-related diseases (International Agency for Research on Cancer [IARC], 2003; Tomás-Barberán & Gil, 2008; Waladkhani & Clemens, 2001). Long term, regular intake of related supplements such as beta-carotene do not appear to exert the same effects, suggesting

that the micronutrients, phytochemicals and metabolites present in fruit and vegetables have protective properties that cannot be acquired elsewhere (Mayne, 1996). Additionally, fruit and vegetables are generally low energy dense foods, and if eaten in place of high energy dense, fatty and sugary foods, can help prevent obesity-related chronic diseases (Berrino & Villarini, 2008).

The protective effects of increased fruit and vegetable consumption are associated most strongly with a decreased risk of coronary heart disease (CHD), stroke and certain types of cancer (Hung et al., 2004; Ness & Powles, 1997). The bulk of epidemiological evidence suggests that particular cancers associated with low intake of fruit and vegetables are of the mouth and oesophagus, and gastrointestinal cancers such as cancer of the stomach and bowel (IARC, 2003). Additionally, fruits and vegetables have been found to differ in their associations with health and disease. For example, evidence suggests that low vegetable consumption may be more associated with cancers of the digestive tract (Slattery et al., 1997), lung (Dorgan et al., 1993), and ovary (Rose, Boyar & Wynder, 1986); whereas fruit consumption may be specifically associated with protection from hMLH1 protein-deficient colon cancer (Wark et al., 2005) and cancer of the bladder (Herbert & Miller, 1994). Finally, evidence is also emerging about a positive role for fruit and vegetable consumption in reducing the risk of cataracts, diverticulosis, chronic obstructive pulmonary disease and hypertension (Van Dyun & Pivonka, 2000).

1.3 Current Recommendation Guidelines and Consumption Levels

Epidemiological evidence of the link between low fruit and vegetable consumption and the major causes of death and health expenditure has led several governments to set targets to reduce morbidity and mortality from these conditions.

The WHO's (1990) recommendation of at least 400g of fruit and vegetables (excluding potatoes and other starchy tubers) per person per day has formed the basis of health promotion strategies in a number of countries worldwide, including the UK (WHO, 2005; Williams, 1995). These strategies promote the consumption of at least five 80g portions of different fruit and vegetables per day. Because 400g is the minimum recommendation intake, other countries have national programmes promoting higher levels of between 5 to 10 daily portions, for example 6 portions in Denmark; 5 – 10 portions in Canada, and 5 – 9 portions in the US; whose recommendations are divided into 2 – 4 fruit and 3 – 5 vegetable portions daily due to growing recognition of the distinct health benefits associated with each (National Cancer Institute [NCI], 2005; see Section 1.2). This trend is also reflected in Australia, whose 7 recommended portions are divided into 2 fruit and 5 vegetable portions per person, per day (WHO, 2005).

While national and international health campaigns to increase fruit and vegetable consumption grow, nutritional surveys show that adults and children in most regions of the world are not meeting the minimum suggested consumption goals of 400g per day. In the UK, fruit and vegetable consumption falls below the recommended level of 400g, with current levels averaging 288g per day (Doyle & Hosfield, 2003; Henderson, Gregory, & Swan, 2002). In terms of age-associated trends in consumption, data from the Health Survey for England, 2001 further suggest that low fruit and vegetable intake is especially prevalent in young adults aged 16 – 24 years, with less than one fifth (17%) consuming the government recommended daily intake of fruit and vegetables (RDIFV) (Doyle & Hosfield, 2003). Additionally, evidence indicates that levels of fruit and vegetable consumption show a steady decline from early to late adolescence (Larson, Neumark Sztainer, Hannan & Story,

2007). This is of concern because the precursors of nutritionally-related adult diseases such as CHD, stroke and cancer are frequently established during this transitional period, meaning that the food habits formed in adolescence and early adulthood have the potential to influence the health status of the next generation (Horwarth, 1991; Song, Schuette, Huange, & Hoerr, 1996). Thus, young adults represent a particularly important target group for fruit and vegetable interventions.

1.4 Interventions to Increase Fruit and Vegetable Intake from Health Promotion

Large-scale health campaigns to promote fruit and vegetable intake typically focus upon a combined provision of educational and motivational materials. While a variety of methods are applied in attempts to increase fruit and vegetable intake, theoretically-based interventions are considered best practice (see Michie & Abraham, 2004). Interventions aiming to increase motivation to perform the behaviour usually target psychological variables such as attitudes or salient beliefs about fruit and vegetable consumption; both of which are central concepts in social cognition models of health behaviour. Armitage and Conner (2000) argue that most motivational models are subsumed within the theory of planned behaviour (TPB); a model frequently used by health psychologists to examine the proximal influences on a person's decision to engage in a behaviour (Ajzen, 1988; 1991). In the TPB, behaviour is determined by intentions to engage in that behaviour and by the degree of perceived behavioural control (PBC) over it. Intentions relate to the person's decision to exert effort to perform the behaviour, and PBC reflects the perceived ease or difficulty of performing the behaviour (Ajzen, 1991). Intentions are determined by attitudes, subjective norms and PBC. Attitudes represent the degree to which a person

has favourable or unfavourable evaluations of the behaviour in question, and subjective norm relates to the perceived social pressure to perform or not perform the behaviour. Interventions based on the TPB therefore attempt to change behaviour by targeting underlying cognitions, which, in turn, affect motivation to perform the behaviour. The TPB has been demonstrated to provide a good account of the factors underpinning motivation for a variety of health behaviours (Armitage & Conner, 2001) and for fruit and vegetables specifically (Bogers, Brug, Assema & Dagnelie, 2004; Brug, Lechner & De Vries, 1995).

However, interventions targeting motivational factors have generally achieved limited results in the area of fruit and vegetable promotion (Pomerleau, Lock, Knai & McKee, 2005; Rayner, 1998). For example, the large-scale US Gimme 5 project combined media marketing campaigns, workshops and lesson activities to increase knowledge, attitudes and PBC towards increasing fruit and vegetable intake in a student population over a three-year period (Nicklas, Johnson, Myers, Farris, & Cunningham, 1998). At follow-up, students' knowledge scores, attitudes and PBC towards their consumption had increased significantly over the control group. With regards to the target behaviour of fruit and vegetable intake, however; the final amount of daily portions consumed did not differ from the control group who received dietary information alone (Nicklas et al., 1998). In contrast, other projects targeting motivational variables in combination with information in the form of self-help programmes have generated small increases in intake. For example, an increase of 0.20 daily portions of fruit and vegetables was demonstrated after one year and seven months in the large-scale NCI Working Well Trial emphasising PBC, skill building and awareness (Sorensen et al., 1996). Similarly, an increase of 0.30 portions per day over an 18-month period was reported in the NCI Seattle 5 A Day project,

which targeted perceptions of social support with the aim of increasing motivation and confidence to perform the behaviour (Beresford et al., 2001). However, given that these interventions were based upon the widespread provision of materials and the intensive, long-term involvement of health professionals, with regards to these modest outcomes it would appear that costs per serving increase are substantial. Furthermore, the diverse and multi-component approach of these and many campaigns to increase fruit and vegetables often leads to a failure to identify a specific theoretical framework on which to evaluate findings. As a result, the accurate assessment of any genuine effect of the intervention is seriously undermined (Ammerman, Lindquist, Lohr & Hersey, 2002; Rayner, 1998).

1.4.1 The Intention-Behaviour Gap

An additional reason for the limited gains in fruit and vegetable consumption from the studies outlined in Section 1.4 may relate more directly to their reliance upon educational and motivational factors. Research has shown that although motivational variables are good predictors of behaviour, they fare less well when predicting actual behaviour change; suggesting that motivational-based interventions alone may be insufficient to effectively promote action (Sheeran, 2002). More specifically, the apparent gap between motivation and action can mostly be attributed to participants termed 'inclined abstainers', namely, those with positive intentions who fail to act (Orbell & Sheeran, 1998). Evidence for the magnitude of the 'intention-behaviour' discrepancy was demonstrated in a review of health behaviour interventions, which showed that the median proportion of participants with positive intentions who did not go on to perform the behaviour was as high as 47%; whereas the median proportion of participants with negative intentions who acted was only

7% (Sheeran, 2002). These findings provide evidence that a substantial gap can be found between people's health-related motivation and their subsequent goal attainment.

In relation to fruit and vegetable intake, evidence indicates that despite the current levels of under-consumption, consumers are found to hold overtly positive attitudes and intentions towards fruit and vegetables, in addition to being well aware of the associated health-promoting messages (see Lyly, Soini, Rauramo & Lähteenmäki, 2004; Margetts, Martinez, Saba, Holm & Kearney, 1997). Further indication that consumers are motivated to increase their consumption comes from applications of the transtheoretical model (TTM; Prochaska & DiClemente, 1984). The TTM states that there are five stages of change through which individuals progress to achieve successful maintenance of a new behaviour; precontemplation (not thinking about changing behaviour); contemplation (thinking about changing behaviour); preparation (intending and planning to change behaviour); action (making active attempts to change behaviour); and maintenance (successful action of behaviour for 6 months or more) (DiClemente et al., 1991). In relation to eating the recommended daily intake of fruit and vegetables, studies from nationally representative adult and young adult samples typically demonstrate that the most frequently reported stages of change are the 'preparation' and 'action' stages, suggesting that the majority of consumers are either intending or have already made some attempt to increase their intake (Campbell et al., 1999; Di Noia, Schinke, Prochaska & Contento, 2005; Horacek, Greene, Georgiou, White & Ma, 2002; Van Duyn et al., 1998). Studies using the TPB to explain and predict fruit and vegetable intake further support these findings, with reported correlations between behavioural intention and future fruit and vegetable consumption typically averaging only $r = .30$

(e.g. r = .35, Brug, De Vet, De Nooijer & Verplanken, 2006; r = .42, Cox, Anderson, Lean & Mela, 1998a; r = .23, De Bruijn et al., 2007). This is despite all studies reporting above mid-point scores on intention to consume recommended daily portions, showing that on average, intention may represent a desire to eat differently but may not translate into actual behaviour change (see also Armitage, 2007). In light of this, it is clear that an important direction for future research is to develop strong, theory-based interventions to help consumers translate their positive intentions towards eating more fruit and vegetables into ongoing action.

1.5 Implementation Intentions

1.5.1 Theoretical Background

One theory addressing the intention-behaviour gap is Gollwitzer's (1993; 1996; 1999) concept of implementation intentions. The theoretical background to the implementation intention construct is the MAP (Gollwitzer, 1990; Heckhausen & Gollwitzer, 1987). The MAP is a model for understanding goal achievement that is based on the distinction between the motivational issue of goal setting (intention formation) and the volitional issue of goal striving (intention realisation) (Sheeran, Milne, Webb, & Gollwitzer, 2005). The model assumes that the processes underlying intention formation and intention realisation are qualitatively different. Therefore, as health behaviour models such as the TPB (Ajzen, 1988; 1991) focus upon and provide clear guidance to the motivational phase of goal setting, a second volitional phase is also required to help convert the motivational cognitions into behaviour. Implementation intentions provide an explicit theoretical framework of the processes that govern intention realisation.

1.5.2 Overview of the Model

Implementation intentions are specific volitional planning strategies that facilitate the translation of intentions into action by explicitly stating the when, where and how of what one will do. Whereas goal intentions specify what one wants to achieve (i.e. "I intend to do X!"), implementation intentions act in service to the goal intention by specifying the situational context and the behaviour that one will perform to achieve it. Implementation intentions are also known as 'if-then' plans, because they form a link between a contextual situation ('if') with a pre-determined behavioural strategy ('then'); for example, "*if* situation Y occurs, *then* I will initiate goal-directed behaviour Z!". In relation to the goal of increasing fruit and vegetable intake, one might specify the goal-directed behaviour "to eat a banana", and link it with the suitable opportunity "Monday morning at breakfast time". Therefore the implementation intention may take the form: "*if* it is Monday morning at breakfast time, *then* I will add a banana to my cereal!" Thus, implementation intention formation is the volitional process of linking in memory specified opportunities to act (situations) with the means of attaining goals (behavioural strategies) (Sheeran et al., 2005a).

1.5.3 Operation of the Model

Section 1.4.1 indicated that intentions to change health behaviours are only modestly related to subsequent behaviour. Common self-regulatory problems that can overcome goal striving include failure to prioritise the goal, failure to get started, or getting derailed due to competing demands on cognitive resources (Gollwitzer & Sheeran, 2006). Implementation intentions therefore instigate goal attainment by

enabling people to see and seize opportunities to act, by enhancing the identification of both the critical situation and the goal-directed response.

Laboratory studies have provided evidence that the execution of behaviour specified in an implementation intention exhibits features of automaticity; that is they engender effects that are immediate, efficient, and operate outside of conscious awareness (cf. Bargh, 1992; 1994; Sheeran et al., 2005a). For example, specifying a good opportunity to act (in the 'if' component of the plan) means that the critical situation becomes highly accessible, and contextual information processing is enhanced (Aarts, Dijksterhuis, & Midden, 1999; Webb & Sheeran, 2004, Experiment 1). Subsequently, the critical cues in the environment are easily accessed and detected, even when cue identification is highly challenging (Webb & Sheeran, 2004; 2008). In addition to the role of heightened accessibility of the situational cue, evidence also suggests that the formation of the effectual behavioural response (in the 'then' component of the plan) results in a 'strategic abdication of action control' (Sheeran et al., 2005a, pp. 295). In other words, forming an implementation intention makes performance of the goal-directed behaviour conditional upon encountering the situation, facilitating swift and effortless execution of action (Brandstätter, Lengfelder & Gollwitzer, 2001; Gollwitzer & Brandstätter, 1997; Sheeran, Webb, & Gollwitzer, 2005, Study 2; Webb & Sheeran, 2004, Experiment 3). Thus, goal achievement is promoted because the person is perceptually ready to encounter the situational cues specified in the 'if' component of the plan, and because the behavioural strategy specified in the 'then' component of the plan is activated by means of strategic automatisation when the cues are encountered (see Gollwitzer & Sheeran, 2006; Webb & Sheeran, 2008).

1.5.3.1 Mediators of the Model

In light of the above, the mechanisms through which implementation intentions are thought to exert their effects are promotion of a heightened identification of good opportunities to act, and the automatic execution of the behavioural response. Further research has addressed mediators of these processes. In addition to the accessibility of situational cues mentioned above (cf. Aarts et al., 1999), the factor generating most evidence for explaining how implementation intentions affect goal achievement is the strength of the cue-response association. Two lab-based experiments using a lexical decision task and sequential priming procedure have independently showed that the impact of if-then plans on behaviour is mediated by the strength of the link between the specified situation and subsequent action (Webb & Sheeran, 2004; see also Webb & Sheeran, 2008). Further indirect support that a strong cue-response link is key to implementation intention efficacy is reported by Oettingen, Hönig & Gollwitzer (2000, Study 3); who demonstrated that participants who formed a specific goal intention to perform arithmetic tasks were much less likely to achieve their goal than participants who formed an implementation intention to perform the tasks in an 'if-then' format. Although the experiment did not test the underlying mechanisms directly, this finding was interpreted as support for the benefit of strengthening the cue-response link by setting up an explicit 'if-then' contingency between specific situations and specific actions (Oettingen et al., 2000, Study 3). More recently, these results were extended from the laboratory to a field study of young adults' fruit and vegetable intake. Chapman, Armitage and Norman (in press) compared the effects of an implementation intention manipulation formed in a specific 'if-then' format with a similar 'global' planning instruction without the defining conditional structure. Daily fruit and vegetable intake at follow-up showed an increase of 0.50 portions in the if-then condition in

comparison to 0.31 portions in the global planning condition, providing further applied support for the idea that forming a strong cue-response link is an important explanatory factor for the impact of implementation intentions on behaviour (Chapman et al., in press)..

Finally, current research serves to undermine the idea that implementation intention effects can be explained in terms of motivational processes. There is little empirical support for the idea that forming an implementation intention increases motivational variables such as intention, PBC, attitude or social norm towards the behaviour in question. Most implementation intention intervention studies across domains measure TPB variables at either pre-test, post-test or both; and again at follow-up (e.g. Armitage, 2004; Sheeran & Orbell, 1999; Milne, Orbell & Sheeran, 2002; Verplanken & Faes, 1999), however, no differences in motivational constructs are reported in either the experimental group, or between the experimental and control groups. Furthermore, a recent meta-analysis of thirty four studies testing implementation intention effects on goal intention and self-efficacy reported a very small average effect size for both constructs (*d*s < .10), concluding that the relationship between implementation intentions and goal attainment was very unlikely to be explained by changes in intention or degree of confidence to perform the behaviour (Webb & Sheeran, 2008). Taken together, these findings provide compelling evidence that motivation is not the mechanism by which implementation intentions exert their effects. Rather, accessibility of cues and the strength of cue-response links appear to be the explanatory processes.

1.5.4 Application of the Model

The impact of implementation intentions on behavioural performance was tested in a comprehensive meta-analysis conducted by Gollwitzer and Sheeran (2006). The meta-analyses included ninety four independent tests from 63 reports and a total sample of 8461 participants including university students, members of the public and clinical samples towards a variety of goal domains. The overall impact on goal achievement was d = .65, representing an effect size of medium-to-large magnitude (Cohen, 1992). Findings also indicated that implementation intentions were similarly effective whether the study was correlational or experimental (ds = .70 and .65, respectively); the outcome was measured objectively (d = .67) or by self-report (d = .63); or from published versus unpublished tests (ds = .65 and .67, respectively) (Gollwitzer & Sheeran, 2006).

In the area of health behaviours, increasing evidence suggests that implementation intention-based interventions are effective in moving people towards achieving a wide variety of goals, ranging from health-protective behaviours such as exercise (e.g. Milne et al., 2002) to preventing health-risk behaviours such as smoking (e.g. Higgins & Conner, 2003). Looking specifically at diet, Verplanken and Faes (1999) conducted the first implementation intention-based intervention to promote healthy eating in a student population. Participants were allocated to one of two conditions, a control group and an implementation intention group, in which students were asked to plan exactly what they would eat and drink during one specified day in the next five days. All participants were asked to keep a diary of everything they ate and drank during this period. Diary ratings by a dietician, who was blind to the purposes of the study, concluded that participants who formed an implementation intention to improve their diet had eaten significantly more healthily than the control group at follow-up. Additionally, the experimental group were found

to have eaten significantly more healthily on the specific day they chose at the beginning of the study, speaking to the idea that the specified situation was easily accessible to them after forming an implementation intention (Verplanken & Faes, 1999). Further support for the efficacy of implementation intentions to promote healthy eating has been demonstrated by Sheeran and Milne (2002), who focused the manipulation on reducing the consumption of unhealthy snacks rather than increasing the intake of healthy foods. Congruent with Verplanken and Faes (1999), findings from two studies indicated that forming implementation intentions assisted healthy eating by significantly reducing self-reported snacking over a one-week period (Sheeran & Milne, 2002).

Another dietary-related area of interest is reducing fat intake, which was first tested by Armitage (2004) in a randomised controlled trial (RCT) among a sample of two hundred and sixty four company employees. Participants allocated to the experimental condition were requested to form an implementation intention to eat a low fat diet in the next month. Measures of total fat intake, saturated fat intake, and fat as a proportion of total energy intake were assessed at baseline and one-month follow-up. Within-participants analyses revealed that participants in the experimental group demonstrated significant reductions in all three measures of fat intake in comparison to no change in the control group, providing initial evidence that a simple instruction to form an implementation intention can be effective in this domain. Similar findings have been generated from an individual implementation intention training intervention aimed at reducing saturated fat intake among patients rehabilitating from myocardial infarction (MI) (Luszczynska, Scholz & Sutton, 2007). Patients in both control and experimental groups reported an initial decrease in fat intake at two weeks' follow-up; however, in contrast to the control group, the

experimental group demonstrated a further reduction at two months, and at eight months after MI (Luszczynska et al., 2007a). Aside from adding to the body of evidence showing that implementation intentions are a useful means of instigating change in complex dietary behaviour, the findings of Luszczynska et al. (2007a) are also important in that they suggest these changes have the potential to last for at least six months after the initial intervention.

In summary, evidence across domains suggests that forming an implementation intention makes an important difference to whether or not desired outcomes are achieved. Furthermore, existing literature supports the use of implementation intentions in changing health behaviour, including dietary goals. In the specific area of fruit and vegetable intake, the application of implementation intention-based interventions is in its infancy. The following Section presents a systematic review of current intervention efforts in order to evaluate the success of research to date.

1.6 Implementation Intention-based Interventions to Increase Fruit and Vegetable Intake: A Systematic Review

A systematic review was undertaken to collect and summarise evidence from published literature on all implementation intention-based interventions that were designed to promote an increase in fruit and / or vegetable consumption in children and adults. The goal of this review was to: (1) describe the studies that apply implementation intentions to fruit and / or vegetable intake; (2) categorise the methods and implementation intention manipulations that are being used to increase fruit and / or vegetable intake; (3) examine the effects of implementation intention

manipulations on fruit and / or vegetable intake in the current literature, and (4) highlight limitations of previous work in order to enhance future intervention efforts in this area.

1.6.1 Method

1.6.1.1 Literature Search and Inclusion Criteria

The review set out to include all published intervention studies applying implementation intentions as the theoretical framework to encourage consumption of fruit and / or vegetables as the primary focus[1]. Papers were identified by searching Web of Science, MEDLINE and PsycInfo databases (1990 – July, 2008). The search was conducted using the keyword search terms: fruit(s), vegetable(s), diet(ary) intervention, and healthy eating, in all combinations with the following: implementation intention(s), if-then, plan(s), and planning. Papers were then screened by thorough reading of titles, abstracts, or full papers using the criteria for inclusion and exclusion (Table 1.1). To find articles in addition to those identified through the databases, the reference lists of eligible articles were scanned, as well as tables of contents for the two most recently published issues available online from the journals where eligible articles had already been identified.

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[1] It was decided not to pursue unpublished sources (e.g. Ph.D theses) because this fails to account for articles currently in press, submitted, or in preparation for publication, or undergraduate dissertations. Further, as Gollwitzer & Sheeran's (2006) meta-analyses of 94 tests found no difference in effect size between published and unpublished manuscripts, there is little reason to suspect the present review would suffer from publication bias (see Section 1.5.4).

Table 1.1: *Criteria for Inclusion and Exclusion*

Papers Meeting Inclusion Criteria
a) The study promoted a diet high in fruit and / or vegetables
b) The study employed an experimental manipulation designed specifically to invoke formation of an implementation intention
c) The study identified fruit and vegetable consumption differentiated from other outcomes, either in a combined fruit and vegetable measure, as separate fruit and vegetable outcomes or as individual measures of specific fruits and vegetables
d) Papers published in peer-reviewed journals
e) Papers based on research with humans
Papers to be Excluded
a) The study did not address fruit and / or vegetable intake
b) The study did not have an equivalent comparison condition not exposed to the implementation intention manipulation
c) The study addressed multiple health behaviours and the effect of fruit and / or vegetable intake could not be separated out from the other behaviours (e.g. general healthy eating).
d) Papers in which the primary outcome (e.g. fruit and / or vegetable intake) was not measured
e) Papers reported in languages other than English

1.6.1.2 Data Extraction Procedure

The following information was extracted from all eligible studies within each relevant article: (a) study setting and population; (b) the study paradigm or procedure; (c) specifics of the implementation intention manipulation and the type of control or comparison condition used; (d) the method of data collection; (e) independent and dependent variables; (f) the results relevant to the implementation intention manipulation; and (g) data needed to calculate effect sizes, including exact cell sizes of the number of participants included in the analyses wherever possible.

1.6.1.3 Estimation of Effect Size

Because of the small number of studies examined and heterogeneity in the types of implementation intention interventions and assessment methods, meta-analyses were not attempted. Where necessary, authors were contacted to request data required to calculate effect sizes, which were estimated using the following three methods depending on the study design:

(1) Cohen's *d*: the unbiased standardised effect statistic chosen to quantify differences between the experimental and comparison conditions (Hedges & Olkin, 1985). This was calculated using an Excel® program (Wilson, 1996) that divided the group mean difference by the pooled standard deviation using the following formula:

$$d = \frac{\chi_1 - \chi_2}{(SD_1 + SD_2)/2}$$

where χ_1 is the mean of condition 1, χ_2 the mean of condition 2, SD_1 the standard deviation of condition 1, and SD_2 the standard deviation of condition 2. Cohen's *d* is a directional coefficient and ranges from $-\infty$ to $+\infty$. According to Cohen's power primer, $d = .20$ should be considered a 'small' effect size, $d = .50$ a 'medium' effect size, and $d = .80$ a 'large' effect size (Cohen, 1992).

(2) Net effect of quantity (amount per day): the difference between the change in fruit and / or vegetable intake in the intervention group (I) and control group (C) = (follow-up intake$_I$ – baseline intake$_I$) – (follow-up intake$_C$ – baseline intake$_C$). All effects were standardised to represent the number of portions per day.

(3) Net effect of frequency (days per week): the difference between the number of days fruit and / or vegetables were consumed in the intervention group (I) and control group (C) = (follow-up frequency$_I$ – baseline frequency$_I$) – (follow-up frequency$_C$ – baseline frequency$_C$). All effects were standardised to represent the number of days per week.

1.6.1.4 Multiple Measures

Where papers contained data for multiple measures of an independent variable (IV) or dependent variable (DV), the samples were treated as separate units rather than combined as an average *d* for each study. Therefore, separate *d*s for each variable are presented.

1.6.2 Results

1.6.2.1 Retrieval of Papers

Two hundred and thirty four unduplicated papers were identified for review. Of these, thirty six papers reported interventions designed to increase fruit and vegetable intake involving planning. Thirty papers were excluded as they did not meet the eligibility criteria, resulting in a total of 6 articles eligible for review.

1.6.2.2 Systematic Review Results

Data extracted from eligible studies are summarised in table and text form. Table 1.2 summarises the final samples, study location, the length of follow-up and a general description of the study paradigm, the control groups and implementation intention manipulations used. Table 1.3 summarises the method of data collection and

the design of the studies with a description of the IV and DVs, followed by a summary of the results and effect sizes available for each study.

Table 1.2: *General Characteristics of Studies Included in the Review*

Reference	*n*	Attrition Rate at Follow-up	Sample	Study Location	Study Description	Length of Follow-up	Control Group	Implementation Intention Manipulations
Armitage, 2007	82	32% (*N* = 120)	Students in self-catering halls of residence aged 18 – 20 (*M* = 19.50, *SD* = 2.08)	UK University	RCT testing a single implementation intention intervention	Two weeks	Passive control	Self-generated plans regarding when and where to perform behaviour
Gratton et al., 2007	198	66% (*N* = 450)	School children aged 11 – 16 (*M* = 13.1, *SD* = 1.32)	UK secondary school	RCT comparing a TPB motivational intervention with an implementation intention volitional intervention	One week	Active control: unrelated implementation intention manipulation	Self-generated plans regarding how, when and where to perform the behaviour
Jackson et al., 2005	94	22% (*N* = 120)	Patients attending secondary prevention CHD clinics in primary care (*M* age = 64.84, *SD* = 8.55)	UK NHS primary care clinic	RCT comparing the effects of completing a TPB questionnaire with completing a TPB questionnaire combined with an implementation intention intervention	(1) 7 days (2) 28 days (3) 3 months	Active control: request to perform behaviour, unrelated filler task	Self-generated plans regarding what, when and where to perform the behaviour. Example given
Kellar and Abraham, 2005	146	33% (*N* = 218)	First and second year psychology undergraduate students aged 18 – 50 (*M* = 21.39)	UK University	RCT testing an intervention combining persuasive communication (targeting self-efficacy and intention) and an implementation intention	One week	Active control: unrelated filler task	(a) Self-generated plans regarding where and when fruit and vegetables would be bought (b) Plan lunchtime meals (c) Plan evening meals
Luszczynska et al., 2007b	200	30% (*N* = 285)	Internet users in the general population aged 18 – 60 (*M* = 28.98, *SD* = 9.78)	UK	RCT comparing a self-efficacy intervention with a combined self-efficacy and implementation intention intervention	Six months	Active control: messages relating to importance of healthy nutrition and seeking support if not achieving goal	(a) Self-generated plans regarding when, where and how to perform the behaviour (b) Plan how to behave in a tempting situation. Example given
De Nooijer et al., 2006	293	45% (*N* = 535)	Members of an adult Dutch internet panel (*M* age = 33)	Netherlands	RCT testing a single implementation intention intervention	One week	Passive control	(a) Self-generated plans regarding when, where and how to perform the behaviour. Specific examples given for when, where and how (b) Plan how to remind themselves of their plans

Table 1.3: ***Summary of Data Collection Method, Design, Results, and Effect Sizes of Studies Included in the Review***

Reference	Data Collection	IV	Primary DV	Secondary DV	Results Summary		Effect size of IV on Primary DV			
							d	Net Quantity/d	Net Frequency/w	*p*-value
Armitage, 2007	**(1) Paper-and-pencil questionnaire** **(2) Single-item self-report measures of behaviour**	**2 Conditions: control; experimental**	(1) Quantity: number of pieces of fruit eaten in the last two weeks (2) Frequency: number of days (of the last 14) an extra piece of fruit was eaten	(1) attitude (2) subjective norm (3) PBC (4) behavioural intention	Significant increases in both DVs in the experimental condition but not in the control condition. No effect on any secondary DV	DV(1) DV(2)	.61 .47	.30 -	- .79*	< .05 < .05
Gratton et al., 2007	**(1) Paper-and-pencil questionnaire** **(2) Food diaries**	**3 Conditions: control; motivational intervention (MI); volitional intervention (VI)**	(1) Quantity: mean amount of combined fruit and vegetable portions eaten over one week	(1) attitude (2) subjective norm (3) PBC (4) behavioural intention	Significant increases in behaviour in both experimental conditions, but only the volitional intervention increased behaviour significantly over the control group. The volitional intervention also significantly increased subjective norm, PBC and behavioural intention	VI MI	.71 .39	.49 .27	- -	< .01 < .01
Jackson et al., 2005	**(1) Paper-and-pencil questionnaire** **(2) Telephone interviews**	**3 Conditions: control (C); TPB questionnaire (TPB); TPB questionnaire + implementation intention (TPBII)**	(1) Quantity: mean amount of combined fruit and vegetable portions eaten over 24 hours	(1) intention	Significant increases in behaviour in all conditions at all time points from baseline. No differences between conditions. No effect for secondary DV	T1: TPBII TPB T2: TPBII TPB T3: TPBII TPB	–.11 .21 .21 .28 .06 .22	–.59 –.05 .67 .11 –.34 –.09	- - - - - -	< .01 < .01 < .01

(*continued*)

Table 1.3 (*continued*)

Reference	Data Collection	IV	Primary DV	Secondary DV	Results Summary	Effect size of IV on Primary DV				
							d	Net Quantity/d	Net Frequency/w	*p*-value
Kellar and Abraham, 2005	**(1) Paper-and-pencil questionnaire** **(2) Single-item self-report measures of behaviour**	2 Conditions: control; experimental	Frequency: number of days over the past week that: (1) at least one piece of fruit was eaten (2) four or more servings of vegetables were eaten (3) the RDIFV was eaten	(1) attitude (2) self efficacy (3) intention (4) anticipated regret	Significant increases in all DVs in the experimental condition, but not in the control condition. The experimental condition also significantly increased intention and anticipated regret. Increases in RDIFV were partially mediated by intention and anticipated regret	DV(1) DV(2) DV(3)	.40 .22 .34	- - -	.79 .57 .51	= .01 = .05 = .01
Luszczynska et al., 2007b	**(1) Web and email-based questionnaires** **(2) Single-item self-report measure of behaviour**	3 Conditions: control; experimental group with a self-efficacy treatment (SE); experimental group with a combined self-efficacy and planning treatment (SEP)	Frequency: (1) how often a portion of fruit and / or vegetables had been eaten within the last two weeks	(1) intention (2) self efficacy (3) action plans	Significant increases in behaviour in both experimental conditions, but no difference between them. No change in the control condition. No change in intention. Self-efficacy and action planning mediated the change in behaviour in the combined self-efficacy and planning condition	SE SEP	.62 .53	- -	.79 .54	< .01 < .01
De Nooijer et al., 2006	**(1) Email-based questionnaires** **(2) 14-item FFQ** **(3) Single-item self-report measures of behaviour**	2 Conditions: control; experimental	(1) Frequency: mean daily fruit consumption in the previous month (2) Frequency: self-assessed change in fruit consumption after one week (3) Frequency: number of days during the last week that an extra piece of fruit was eaten	(1) goal intention (2) commitment to implementation intention	No significant impact on behaviour for DV(1) or DV(2). Significant increases in behaviour for DV(3) in the experimental condition but not the control condition. The increase in DV(3) was dependent on goal intention at baseline. Commitment to the implementation intention at baseline was significantly associated with higher levels of all DVs	DV(3)	.27	-	.60*	< .05

***Note*: * = as only follow-up data were collected, this effect size represents the difference between intervention group (I) and control group (C) at follow-up (follow-up frequency$_I$ – follow-up frequency$_C$)**

1.6.2.3 Study Characteristics

1.6.2.3.1 Samples

Participants were drawn from a range of populations (Table 1.2). With the exception of one study, all participants exposed to implementation intention manipulations were adults aged eighteen years or older. Two of these studies were conducted on university students (Armitage, 2007; Kellar & Abraham, 2005); two on internet users (De Nooijer, De Vet & Brug, 2006; Luszczynska, Tryburcy & Schwarzer, 2007), and one on CHD patients in a clinical setting (Jackson et al., 2005). The final study was conducted on secondary school children (Gratton, Povey & Clark-Carter, 2007). All of the studies except one were conducted in the UK. Attrition rates varied considerably from 22% in the clinical setting to 66% in the school setting.

1.6.2.3.2 Study Description and Length of Follow-up

All studies employed RCT designs (Table 1.2). Four studies tested the effects of an implementation intention manipulation with either one or two comparison groups, and two studies tested a combined intervention with an implementation intention component (see Section 1.6.2.4.2). The length of the studies range from short-term follow-ups of one and two weeks (n = 4), to longer-term follow-ups of three and six months (n = 2) (Table 1.2). One study measured behaviour at three follow-up time points; one week, one month, and three months (Jackson et al., 2005).

1.6.2.3.3 Control Groups

Various control conditions were used. Armitage (2007) and De Nooijer et al. (2006) employed a standard format passive control condition, whereby the

participants randomised to the control group completed a questionnaire about the target health behaviour, and received no further instruction. In contrast, various applications of more active control conditions are employed by the four remaining studies. Two studies applied unrelated filler tasks, for example answering general questions related to filling in the health questionnaire (Kellar & Abraham, 2005), and forming an implementation intention to complete homework (Gratton et al., 2007). In addition to filler tasks, two studies provided the control group with additional information relevant to the study (Table 1.2). These include messages related to healthy nutrition and support seeking (Luszczynska et al., 2007b), and a specific request to increase fruit and vegetable intake in the control group in the clinical setting (Jackson et al., 2005).

1.6.2.3.4 Implementation Intention Manipulations

All participants exposed to an implementation intention were requested to self-generate and write down their own plans, either on paper or online. However, the instructions for generating the plans varied across studies (Table 1.2). Three studies employed a single implementation intention manipulation with slightly different instructions regarding 'when and where'; 'how, when and where', and 'what, when and where' to perform the behaviour (Armitage, 2007; Gratton et al., 2007; Kellar & Abraham, 2005). Alternatively, the remaining three studies gave multiple instructions to generate implementation intentions. Variations of instructions to plan the 'when, where, and how' to perform the behaviour were combined with instructions to plan evening and lunchtime meals (Kellar & Abraham, 2005); how to behave in a tempting situation (Luszczynska et al., 2007b), and how to remind themselves of the plans they had made (De Nooijer et al., 2006). To aid plan formation, three of the studies gave specific examples. Additionally, one study focused the implementation

intention manipulation on where and when the fruit and vegetables would be bought, rather than on the target behaviour of fruit and / or vegetable consumption (Kellar & Abraham, 2005).

1.6.2.4 Summary of Study Design, Results and Effect Sizes

1.6.2.4.1 Data Collection Method

All studies employed a self-reported, questionnaire format. Four of the questionnaires were paper-and-pencil based, and two were web / email-based (Table 1.3). To assess fruit and / or vegetable intake, three studies used single item measures (Armitage, 2007; Kellar & Abraham, 2005; Luszczynska et al., 2007b); one asked participants to record all food consumed over one week in food diaries (Gratton et al., 2007), and one used a 24-hour recall telephone interviewing method to assess consumption at three time points, with prompts given to facilitate recall of consumption and portion size of everything eaten or drank in the previous 24 hours (Jackson et al., 2005). Finally, De Nooijer et al. (2006) took two single item measures of fruit intake in addition to using a 14-item FFQ (food frequency questionnaire) to record the frequency of fruit consumption over one month.

1.6.2.4.2 Independent Variables

Three studies compared two conditions; an experimental implementation intention condition with a passive control group (Armitage, 2007; De Nooijer et al., 2006), or an active control group (Kellar & Abraham, 2005). In contrast, two studies compared an experimental implementation intention condition with an active control group and one other comparison group, i.e. an experimental motivational condition based on the TPB (Gratton et al., 2007); and a TPB questionnaire-only condition (Jackson et al., 2005). The final two studies tested a combined experimental condition

consisting of an implementation intention and a motivational component. Kellar and Abraham (2005) targeted self-efficacy and intention in combination with an implementation intention manipulation, and compared this to an active control condition. Luszczynska et al. (2007b) targeted self-efficacy combined with an implementation intention manipulation, and compared this with an active control condition and one other comparison group; namely an experimental self-efficacy-only condition (see Table 1.3).

1.6.2.4.3 Primary Dependent Variables

Primary DVs varied widely across studies (Table 1.3). Two studies focused the intervention on fruit only, and asked participants to eat an extra piece of fruit each day for one week (De Nooijer et al., 2006) and two weeks (Armitage, 2007). Three studies focused on fruit and vegetables as a combined food group, and asked participants to consume: (1) five portions of fruit and vegetables for the next 7 days (Gratton et al., 2007); (2) two extra portions of fruit and vegetables each day over the next three months (Jackson et al., 2005), and (3) five portions of fruit and vegetables per day (Luszczyska et al., 2007b). The remaining study also focused on fruit and vegetables as a combined food group and asked participants to consume the RDIFV over one week (Kellar & Abraham, 2005). However, participants were informed that the recommended daily intake of fruit (RDIF) was at least one portion per day, and the recommended daily intake of vegetables (RDIV) was four or more servings per day; and in contrast to the other studies, measures of compliance to the RDIF, RDIV, and the RDIFV were taken separately. Two studies applied quantity measures of behaviour (portions of fruit and / or vegetables consumed per day); three studies applied frequency measures of behaviour (days per week the fruit and / or vegetables

were consumed), and one study applied one quantity and one frequency measure (Armitage, 2007; see Table 1.3).

1.6.2.4.4 Secondary Dependent Variables

In addition to the primary DVs, all studies measured at least one component of the TPB in order to assess and / or control for motivation towards the behaviour (Table 1.3). All studies took measures of intention to perform the behaviour, which was operationalised as either '(behavioural) intention' (n = 5), or 'goal intention' (De Nooijer et al., 2006). Other assessed components of the TPB were attitude (n = 2); subjective norm (n = 2); PBC (n = 2); self-efficacy (n = 2). Additional secondary variables included anticipated regret in relation to failing to eat the RDIFV (Kellar & Abraham, 2005); 'action plans' to assess the levels of planning activity at baseline and follow-up (Luszczynska et al., 2007b), and 'commitment' to assess the degree of commitment to the implementation intention formed at baseline (De Nooijer et al., 2006).

1.6.2.5 Effects of the Implementation Intention Manipulations

1.6.2.5.1 Primary Dependent Variables

As noted in Section 1.6.1.4, the small number of studies eligible for review demonstrated a marked heterogeneity in intervention design, assessment method and availability of data. Therefore, direct comparisons of results and interpretations should be made with caution. However, meaningful results can be attained by comparing studies using similar categories of primary dependent variable.

1.6.2.5.1.1 Combined Fruit and Vegetable Intake

Of the studies applying implementation intention manipulations to increase fruit and vegetable intake as a combined food group, two of the four demonstrated a significant effect over control groups (Gratton et al., 2007; Kellar & Abraham, 2005; see Table 1.3). Both the motivational TPB-based intervention and the volitional implementation intention-based intervention tested in Gratton et al. (2007) significantly increased fruit and vegetable intake from baseline to follow-up. However, only the volitional intervention increased intake significantly over the control group, indicating that it was more effective in changing behaviour. Kellar and Abraham (2005) also found that their combined persuasive communication and implementation intention intervention successfully promoted eating the RDIFV in comparison to controls. These findings represent small-to-medium (d = .34, Kellar & Abraham, 2005) and medium-to-large effect sizes (d = .71, Gratton et al., 2007).

Luszczynska et al. (2007b) provide partial support for the efficacy of implementation intentions to increase combined fruit and vegetable intake, given that their combined self-efficacy and implementation intention intervention significantly increased intake over the control group (d = .53). However, no difference was demonstrated at follow-up between the combined intervention and the self-efficacy-only intervention, suggesting that the planning manipulation had no additional impact. Finally, although Jackson et al. (2005) reported significant increases in fruit and vegetable intake at seven days, one month, and three months' follow-up, no differences were reported between the control, TPB comparison and TPB + implementation intention conditions. Thus, no support was generated for the impact of implementation intentions on combined fruit and vegetable intake over and above standard provision of information (Table 1.3).

1.6.2.5.1.2 Fruit Intake

As illustrated in Table 1.3, the two implementation intention-based interventions to increase fruit consumption generated significant changes in behaviour over one week (De Nooijer et al., 2006), and two weeks (Armitage, 2007) in comparison to controls. However, De Nooijer et al. (2006) reported a significant increase only in the measure of the number of days during the last week that an extra piece of fruit was eaten (d = .27), whereas the measures of self-assessed change in fruit intake and the FFQ did not demonstrate a change in fruit intake over time. In comparison, Armitage (2007) demonstrated medium effect sizes of d = .61 and d = .47 for both the quantity and frequency measures of fruit intake. Additionally, Kellar and Abraham (2007) provide support for the efficacy of the combined persuasive communication and implementation intention intervention to successfully promote fruit consumption. Their separate measure of fruit intake demonstrated a higher level of adherence to the RDIF at follow-up in the experimental condition, in comparison to controls (d = .40).

1.6.2.5.1.3 Vegetable Intake

The only study to take a separate measure of vegetable intake was Kellar and Abraham (2005). Again, their combined persuasive communication and implementation intention intervention successfully promoted eating the RDIV in comparison to controls, representing a small effect size of d = .22 (Table 1.3).

1.6.2.5.2 Secondary Dependent Variables

The following Section compares the studies on effects of the implementation intention manipulations on categories of secondary dependent variable, including the TPB variables highlighted in Section 1.6.2.4.4, anticipated regret towards failing to eat the RDIFV, commitment to the implementation intention, and action planning.

The effect of the implementation intention manipulations on intention to perform the behaviour was tested in four studies (Table 1.3). Armitage (2007) and Luszczynska et al. (2007b) found no significant effect, providing evidence that the effects of the manipulation on behaviour were not due to changes in intention. In their combined implementation intention and motivational intervention, Kellar and Abraham (2005) reported a significant increase in intention and anticipated regret to consume the RDIFV from baseline to follow-up; however, the effects of the intervention were only partially mediated by the motivational variables, suggesting that the implementation intentions worked independently of the motivational component. In contrast, Gratton et al. (2007) found a significant increase in intention from baseline to follow-up in their volitional implementation intention intervention, but surprisingly, not in their TPB motivational intervention (Table 1.3). Two studies assessed whether the effects of implementation intentions on behaviour were dependent on goal intention strength at baseline (De Nooijer et al., 2006; Jackson et al., 2005). Support for this was demonstrated by De Nooijer et al. (2006), who additionally reported that commitment to the implementation intention at baseline was significantly associated with higher levels of fruit consumption at follow-up. Conversely, Jackson et al. (2005) found no effect on behaviour for intention strength at baseline; however, it should be noted that the reported increase in fruit and vegetable intake was not attributable to the intervention (see Section 1.6.2.5.2)

The results from studies regarding the effects of implementation intention manipulations on the remaining cognitions are sparse and mixed. No effect was demonstrated for attitude towards the behaviour across the studies (Table 1.3). Two studies found contrasting effects for subjective norm and PBC, with a significant increase over time demonstrated in both variables in the school setting (Gratton et al.,

2007), but no effects demonstrated in the student population (Armitage, 2007). Finally, in their combined self-efficacy and implementation intention intervention, Luszczynska et al. (2007b) demonstrated that the change in self-efficacy and action planning simultaneously predicted the subsequent change in fruit and vegetable consumption, providing evidence that the volitional and motivational components of the intervention worked independently.

1.6.3 Discussion

The preceding review examined the specific methods by which implementation intention manipulations have been applied to increase fruit and / or vegetable intake. The review provided initial support for implementation intentions in this area, but also raised questions to be addressed in future research. Starting with an overall evaluation of the effects on primary and secondary DVs, the following Section seeks to evaluate and draw salient themes from the review in order to direct future studies. Particular attention is focused upon issues surrounding rates of attrition, the variation in control groups, the format of the implementation intentions, the length of follow-up, and conceptual issues regarding the aggregation of fruit and vegetables into a single food group.

1.6.3.1 Evaluation of Implementation Intention Effects on Primary Dependent Variables

In the review, implementation intentions demonstrated a significant effect on fruit and / or vegetables over controls in a total of seven tests from four of the six studies, representing small-to-medium and medium-large effect sizes for combined fruit and vegetable intake (*d*s = 0.34 to 0.71); small and medium-large effect sizes for

fruit intake (*d*s = 0.27 to 0.61), and a small effect for vegetable intake (*d* = .22) (Table 1.3). It is encouraging that two of the four studies (Armitage, 2007: *d* = .61 and Gratton et al., 2007: *d* = .71) generated effect sizes comparable to the magnitude of Gollwitzer and Sheeran's (2006) meta-analysis finding of *d* = .65 across 94 independent tests (see Section 1.5.4). It is also encouraging that medium-to-large effect sizes were found for both single item and diary measures of behaviour; and that significant effects were generated by both paper-and-pencil and online methods in a range of populations, supporting Gollwitzer & Sheeran's (2006) conclusions that variation in methodology and design does not appear to bias the impact of implementation intentions (Section 1.5.4). Importantly, behaviour change was successful without the presence of a health professional, giving the interventions the added practical benefit of being a potentially time and cost effective means of reaching large populations.

Two studies did not find any effect for the intervention over and above control or comparison groups; however, methodological difficulties were evident that might account for the null findings. For example, Jackson et al. (2005) note that to achieve a power of 0.80 based on a small to medium effect size for implementation intention interventions, the required sample size at follow-up was 157. As recruitment was slower than anticipated, only 97 participants completed the study, meaning that their statistical tests were underpowered. An additional limitation was apparent in Luszczynska et al. (2007b), whose combined implementation intention and self-efficacy intervention failed to increase fruit and vegetable intake over and above self-efficacy alone. Although no differences were found between the experimental groups at follow-up, the self-efficacy intervention was tailored to contain a personal salutation and individual feedback, whereas the planning intervention was not. Thus,

the potential effects of experimenter demand cannot be overruled. A further point worthy of discussion is that De Nooijer et al. (2006) found support for implementation intentions on the single item self-report measure, but not on the main measure of fruit intake, the FFQ. As De Nooijer et al. (2006) note, however, the follow-up of the study was one week, whereas the FFQ assessed the mean daily fruit consumption over the last month. Therefore, it is unlikely that the responses on the FFQ were sensitive enough to detect small changes in behaviour over the week-long period. In light of this, a further assessment of the effects as measured by a FFQ with a corresponding time interval is warranted.

1.6.3.2 Evaluation of Implementation Intention Effects on Secondary Dependent Variables

In addition to demonstrating an overall positive impact of the interventions on fruit and vegetable consumption, the findings from the secondary dependent variables also yielded some support for the theoretical underpinnings of implementation intentions. For example, support for the key assumption that implementation intentions are effective for people who are already motivated to perform the behaviour (Section 1.5.1) was generated by De Nooijer et al. (2006), who showed that the efficacy of their intervention to increase fruit was dependent on baseline intention and commitment to the plan. Further, findings from five of the six studies provided evidence that the changes in fruit and / or vegetable intake could not be explained by changes in motivation. This is consistent with Gollwitzer's (1993) MAP and previous research suggesting that motivation is not a mediating factor, providing support for their genuine volitional mechanisms (Section 1.5.3.2). However, Gratton et al. (2007) reported an increase over time in participants' levels of subjective norm, intention and

PBC towards eating fruit and vegetables over one week in the volitional intervention. Gratton et al. (2007) offer the explanation that additional unmeasured variables, such as prior behaviour, may have mediated the effect of the intervention on cognitions, but that this could not be concluded from their data. However, as the intervention took place in a school setting, it is possible that the extra involvement of teachers may have engendered an additional degree of experimenter demand, and thereby inadvertently increased the childrens' expectations of success and self-efficacy towards the behaviour. Given that recent meta-analyses demonstrate a very unlikely role for motivation in explaining implementation intention effects, this explanation would appear more plausible (cf. Webb & Sheeran, 2008; Section 1.5.3.1). Nonetheless, future studies of fruit and vegetable intake should continue to control for these effects in order to further clarify this issue.

1.6.3.2.1 Overview

A general overview of the findings therefore suggests that implementation intentions appear a promising basis on which to develop interventions to promote fruit and vegetable intake, although further research is required to generate more conclusive support. Although limited by the small number of eligible studies, a number of common themes and important issues arise from reviewing the current literature. The following Section highlights five specific limitations across studies that emerge from the review, in addition to providing suggestions for how future research may address these difficulties in order to enhance future interventions.

1.6.3.3 Attrition Rate

As shown in Table 1.2, attrition rates varied considerably across studies, ranging from 22% (Jackson et al., 2005) to 66% (Gratton et al., 2007). Gratton et al.

(2007) state that a large attrition rate is typical of self-report studies. However, other authors have argued that the analyses of health outcomes from participants who receive the intervention exactly as planned can give a misleading impression of progress and introduce bias in randomised trials (Dumville, Torgerson & Hewitt, 2006; Hollis & Campbell, 1999). For example, the exclusion of participants lost to withdrawal or non-compliance limits the analyses to findings based on sub-groups of the sample, therefore leading to reduced generalisability and potential inflation of type 1 error (Fergusson, Aaron, Guyatt & Herbert, 2002). Indeed, it has been proposed that a loss of as little as 20% or over to follow-up in RCTs has the potential to pose a serious threat to validity (Fewtrell et al., 2008). Given that the highest attrition rate was almost 70% in the present review, this is of particular concern in this area of research. To avoid this issue, most researchers and statisticians agree that steps should be taken to guard against the potential bias introduced by attrition, by comparing participants according to the group to which they were randomly allocated, regardless of compliance or withdrawal (Fergusson et al., 2002). Such analyses treat nonresponders as "no changers", and is referred to as intention to treat (ITT). ITT is regarded as the gold standard for analysing RCTs because it permits an unbiased estimate of treatment effect and because it permits noncompliance and protocol deviations that are likely to reflect real-life situations, hence yielding more conservative, yet realistic findings (Fergusson et al., 2002; Hollis & Campbell, 1999; Moher, Schulz & Altman, 2001). Therefore, in line with recommendations for improving the quality of randomised trials (e.g. Gravel, Opatrny & Shapiro, 2007; Schulz & Grimes, 2002), it is suggested that future RCTs assessing the impact of implementation intentions on fruit and vegetable intake should apply ITT analyses, to reduce the potential for bias and attain a more practical interpretation of the effects.

1.6.3.4 Variation in Control Groups

A second discrepancy revealed in the studies reviewed is the variation in control group formats. In accordance with most prior health-related implementation intention trials (e.g. Milne et al., 2002; Orbell, Hodgkins & Sheeran, 1997), two of the studies assigned participants to an implementation intention condition or a passive control condition (Armitage 2007; De Nooijer et al., 2006). Participants in the implementation intention condition were given a questionnaire about the target health behaviour, instructions to make a behavioural change and instructions to plan for how they will perform the behaviour; whereas participants in the passive control condition completed the questionnaire only. More recently, however, it has been argued that the method of employing passive control groups may be problematic, as it becomes unclear whether it is forming an implementation intention per se, or telling people to change their behaviour that causes the subsequent behaviour change (De Vet, 2007). In contrast, a more active control condition was employed by Jackson et al. (2005), who directly instructed cardiac patients in all conditions to increase their fruit and vegetable intake. Although the intervention group received an additional instruction to plan this change as precisely as possible, no additional effects for implementation intentions were found. Jackson et al. (2005) discuss this finding in terms of differences in demand characteristics between their active control condition and the standard passive control groups in previous research, and suggest that actively instructing participants to make behavioural changes may at least partially account for the effects previously attributed to implementation intentions. Jackson et al. (2005) argue that this may be a particular limitation of studies conducted on student samples, because students are more likely to be aware of the study aims and hypotheses.

The three remaining studies employed more active control conditions in the form of unrelated filler tasks, such as questions about how easy or difficult completing the questionnaire had been so far (Kellar & Abraham, 2005); making plans to complete homework for the week (Gratton et al., 2007), and the provision of nutritional and support-related information (Luszczynska et al., 2007b). Therefore the control and experimental tasks were equal in terms of duration. However, while filler tasks such as these control for potential differences in attentional demands, they do not control for the expectancy effects of encouragement to change behaviour (Jackson et al., 2005). Thus, the genuine impact of implementation intentions on fruit and vegetable intake are called into question. It would therefore be valuable for future research to investigate the role of demand characteristics more thoroughly, in particular the potential differences between passive and active control conditions.

1.6.3.5 Implementation Intention Format

The third inconsistency in the literature relates to the format of the implementation intentions, which vary considerably across studies. The manipulations ranged from the standard 'when, where and how' instructions applied in most previous implementation intention studies (e.g. Milne et al., 2002; Orbell et al., 1997) to additional instructions to plan meals (Kellar & Abraham, 2005) and remind oneself of the plan (De Nooijer et al., 2006). Additionally, some studies supplemented their instructions with practical examples, whereas others did not. This is problematic for two reasons. First, the inconsistency in instructions given to participants to form implementation intentions renders comparison across studies and evaluation of the applied theory difficult. Indeed, from the variation in format it is somewhat unclear whether studies are deploying directly comparable interventions.

Second, it is argued that instructions for manipulations in the reviewed studies may be potentially failing to generate the formation of an implementation intention as specified by the theoretical framework. For example, as outlined in Section 1.5.3.1, laboratory studies have demonstrated that a key mediating factor for the impact of implementation intentions on behaviour is the strength of the link between the specified situational cue and the goal-directed behaviour (Webb & Sheeran, 2004; 2008). Furthermore, both laboratory and recent applied research have shown that forming implementation intentions in a contingent 'if-then' format appears to be important in generating strong intervention effects, presumably because they maximise the mental link between cue and response (Chapman et al., in press; Oettingen et al., 2000, Study 3; see Section 1.5.3.1). However, as the instructions in the studies reviewed do not specifically link a situational cue with a goal-directed response, it is plausible that the strength of the cue-response link is undermined, thus potentially compromising the impact of the implementation intention. Therefore, future studies would benefit from employing instructions to generate plans in the defining 'if-then' format, in order to strengthen the underlying mechanisms and further augment the effect of implementations on fruit and vegetable intake.

1.6.3.6 Length of Follow-up

The review revealed that four studies generated support for implementation intentions to increase fruit and / or vegetables. However, one collective limitation of these studies is the length of time over which they were conducted. The studies of De Nooijer et al. (2006), Gratton et al. (2007) and Kellar and Abraham (2005) had brief follow-ups of one week, and Armitage (2007) was conducted over a two-week period. Therefore, all evidence to support the efficacy of implementation intentions in

this area is based on short-term success. This is problematic, given that dietary changes need to be performed over the long-term before actual health gains can be detected (Conner, Norman & Bell, 2002). The ability to maintain changes in dietary composition therefore requires repetitive and permanent adoption of a modified eating pattern, which is influenced by a variety of individual preferences, family variables, demographic and lifestyle factors (Kumanyika et al., 2000). It has been proposed that the formation of implementation intentions may be particularly efficacious in promoting the maintenance of eating behaviour due to their underlying similarity with habits, which are formed through satisfactory repetition of specific behavioural responses to cues in the environment (Verplanken & Aarts, 1999; Verplanken & Faes, 1999). However, the review of the current literature revealed that, methodological difficulties aside, the only two studies that did not demonstrate an independent effect for implementation intentions were conducted over longer time periods of three months (Jackson et al., 2005) and six months (Luszczynska et al., 2007b). This is despite revealing a mediating role for planning, demonstrating that participants had adhered to and completed the instructions of the implementation intention manipulation (Luszczynska et al., 2007b). This would suggest that in the area of fruit and vegetable consumption, implementation intentions may be effective for initiating goal striving, but only appear to work in the relatively short-term.

In the related domain of dietary fat intake, Luszczynska et al. (2007a) suggest that implementation intentions show promise in promoting longer-term effects, generating optimism that these results may be transferable to the area of fruit and vegetable consumption (see Section 1.5.4). However, it is noteworthy that Luszczynska et al. (2007a) applied an individually-delivered implementation intentions training programme, meaning that their intervention was more intensive

than usual implementation intention interventions. As discussed in Section 1.4, extensive provision of materials or delivery of training is costly in both time and expense. Further, despite the encouraging results, these methods may potentially serve to undermine a specific evaluation of implementation intentions, as it is not possible to fully tease apart the potential influences of the experimenter involvement. Therefore, an important priority for future research is to investigate the trend of short-term impact found in the area of fruit and vegetable intake to date, in addition to developing cost effective ways to improve the consumption of large, generally healthy populations using implementation intentions over the long-term.

1.6.3.7 Changing Fruit and Vegetable Consumption as a Combined Food Group

One final conceptual issue arising from the literature reviewed above is that four studies have attempted to change both fruit and vegetable consumption using a single implementation intention (Gratton et al., 2007; Jackson et al., 2005; Kellar & Abraham, 2005; Luszczynska et al., 2007b). This is also of potential concern due to suggestions that targeting fruit and vegetables as an aggregated food group may introduce a margin of uncertainty around the collection and interpretation of data (IARC, 2003). For example, fruits and vegetables have markedly distinct tastes, culinary uses and practices (Brug et al., 2006; IARC, 2003; Trudeau, Kristal, Li & Patterson, 1998). Fruits are mostly sweet and eaten raw, at breakfast, as individual between-meal snacks, or as desserts (Anderson, Cox, Reynolds, Lean & Mela, 1998; Taylor-Nelson, 1990). In contrast, many vegetables typically require more thoughtful preparation (e.g. chopping and cooking) before they are eaten, and are rarely consumed alone as snack foods (Armitage, 2007; IARC, 2003; Trudeau et al., 1998). This in turn may have implications for implementation intention-based interventions,

in that the situations in which they are consumed, and the behavioural strategies required to attain recommended intake targets may differ considerably between food groups. However, as optimal implementation intention strategies for fruit and vegetables have not been analysed to date, this important issue remains unclear. Given that epidemiological evidence further suggests that fruits and vegetables differ in their associations with health and disease (see Section 1.2), a direct investigation of these ideas would be a worthy avenue for future research.

1.7 Chapter Summary

The present Chapter provided an overview of the evidence-based health benefits of fruit and vegetables, as well as offering justification for the study of fruit and vegetables for health promotion. Interventions to date have had only limited impact on individuals' health, which is reflected by current UK statistics on fruit and vegetable consumption. As such, well-controlled interventions based explicitly on psychological models of health behaviour may prove efficacious. Due to their strong grounding in theory and relative success in other health domains, implementation intentions are likely to be particularly useful in this area.

The systematic review presented in Section 1.6 draws together evidence of the efficacy of implementation intentions to promote fruit and / or vegetable consumption from current published literature. Despite a small number of eligible studies and marked heterogeneity in methodology, the review supports the potential of implementation intentions to successfully increase intake. However, the review highlighted numerous limitations and areas for improvement in the research to date. These themes provide the basis on which to develop several testable hypotheses regarding the application of implementation intention-based interventions to promote

higher fruit and vegetables intakes, which will be addressed directly in the remainder of the thesis.

1.8 General Aims of the Thesis

In conclusion of the present Chapter, the first general aim of the thesis is to further assess the efficacy of implementation intentions to increase fruit and vegetable intake. In doing so, various methodological difficulties highlighted in previous research will be addressed, such as the potential bias associated with rates of attrition. To promote strong cue-response links, a contingent 'if-then' format will be applied throughout. The second general aim of the thesis is to investigate the potential role of demand characteristics that have been suggested to underlie previous implementation intentions effects (cf. Jackson et al., 2005). In particular, the potential confounding differences between passive and active control groups will be examined to further delineate the genuine effects of implementation intentions. The third general aim is to address important themes regarding the long-term maintenance of behaviour; and the fourth aim is to investigate the conceptual value of combining fruit and vegetables as an aggregated food group. More specifically, the thesis will design and assess methods of extending the impact of implementation intentions to increase fruit and vegetables longitudinally, and determine whether the effects of the interventions can be improved by targeting fruit and vegetables separately. The thesis can therefore be broadly divided into three sections: an introduction and systematic review of the literature (Chapter 1), empirical work investigating the themes highlighted in the systematic review (Chapters 2 to 5), and summary and future directions (Chapter 6).

1.9 The Next Step

The following Chapter presents a study that provides a direct test of two of the broad aims listed above. First, the study will trial an intervention to improve the long-term efficacy of implementation intentions on fruit and vegetable intake. Second, the study will provide two tests of demand characteristics, including a comparison of passive and active control groups, in order to explore alternative explanations of potential intervention effects.

Chapter 2 - Evidence that Boosters Augment the Long-term Impact of Implementation Intentions on Fruit and Vegetable Intake[2]

2.1 Abstract

The present Chapter reports a study that tests the efficacy of a single implementation intention to increase fruit and vegetable intake over a six-month period, and investigates whether deploying a second implementation intention at 3 months can sustain the long-term impact, compared with passive and active control groups. Participants (N = 650) completed single-item and FFQ measures of behaviour and motivation at baseline before being randomised to one of six conditions in a between-persons design. ITT analysis revealed that for the single-item measure: (1) a single implementation intention was an effective means of initiating fruit and vegetable increase over a three-month period, but this effect was not sustained over 6 months; (2) administering a second implementation intention at 3 months was successful in increasing intake over 6 months, and acted as a booster on the initial impact; and (3) neither the passive nor active control condition had any impact on behaviour. However, no effects of the manipulations on fruit and vegetable intake were found when behaviour was assessed by the FFQ measure. Secondary analyses provided further evidence that reported increases in intake were not related to demand characteristics.

2.2 Introduction

[2] A version of the study reported in Chapter 2 is currently in press in the journal Psychology and Health: Chapman, J., & Armitage, C. J. (in press). Evidence that boosters augment the long-term impact of implementation intentions on fruit and vegetable intake. *Psychology and Health*.

2.2.1 Is a Single Implementation Intention Sufficient to Engender Long-term Behaviour Change?

The systematic review in Chapter 1 revealed that implementation intention-based interventions to increase fruit and vegetable intake have yielded more positive findings in short-term, as opposed to long-term studies. These findings suggest that, in the area of fruit and vegetable intake, implementation intentions may be particularly efficacious initiators of behaviour change, but fare less well in the maintenance of behaviour (see Section 1.6.3.6). In addition to fruit and vegetable intake, the application of implementation intentions to other areas of health behaviour have also generated less success in studies with longer-term follow-ups, e.g. smoking cessation in an adolescent population over eight weeks (Higgins & Conner, 2003) and parental sun protection behaviour over 5 months (Osch, Reubsaet, Lechner & De Vries, 2008). Further research testing the efficacy of implementation intentions to promote breast self-examination (BSE) reported that although the intervention yielded a medium effect size on behaviour at one month follow-up ($p < .01$, $d = .40$), this effect was reduced to marginal significance at six months ($p = .10$) (Prestwich et al., 2005, Study 1). Similarly, a recent RCT of the effects of implementation intentions on women's walking behaviour reported that step counts measured by a pedometer were significantly higher in the experimental group than the control group at six weeks' follow-up, but no continued benefit was found for the last 5 weeks of the study (Arbour & Martin Ginis, in press). Taken with the results of the systematic review (Section 1.6), these findings suggest that the initial impact of implementation intentions may be subject to deterioration over time.

2.2.2 How Can the Long-term Impact of Implementation Intentions be Improved?

Consistent with this idea, Koestner and colleagues (2006) give two reasons as to why implementation intentions appear less effective for long-term goals. First, they argue that implementation intentions are cognitive strategies that are vulnerable to memory decay and interference over time. Second, they highlight the potential role of evolving obstacles and distractions over time, which may not be anticipated at the initial formation of the plan. For example, they argue that the simultaneous pursuit of competing goals over time may result in changes to the individual's priorities and circumstances. In turn, this could lead to a gradual decline in the relevance of the original links forged between specified situational cues and goal directed behaviours that are crucial for implementation intentions to exert their effects (cf. Gollwitzer, 1993). This suggests that a single implementation intention may be insufficient to engender longitudinal impact, and provides a plausible theory to explain the lack of long-term implementation intention effects in the literature reviewed above. The present study will therefore test this hypothesis by assessing whether the long-term impact of a single implementation intention can be enhanced by administering an additional implementation intention at mid-point. In light of the rationale put forward by Koestner et al. (2006), it is proposed that this will act as an opportunity to remind oneself of the original plan and update if necessary; which may serve to extend and maintain the specific volitional benefits that are demonstrated in short-term interventions, but appear to diminish over time.

2.2.3 Can Demand Characteristics Explain the Effects of Implementation Intentions?

Implementation intention-based manipulations have demonstrated a positive effect on fruit and vegetable intake in studies employing passive control conditions and more active control conditions using unrelated filler-tasks (see Chapter 1, Section 1.6.3.4). However, these studies have failed to control for the potential confounding effects of experimenter encouragement to make behavioural changes, calling the genuine effects of the intervention into question (cf. Jackson et al., 2005). Additionally, it has been argued that studies conducted on students may be particularly susceptible to experimenter demand because they are more likely to be aware of the study aims than participants from other populations. The present study will therefore test these ideas directly by assessing awareness of study aims in a student population.

2.2.4 Aims and Hypotheses

In light of the above, the specific aims of the present study were threefold: (1) to test whether the impact of a single implementation intention is sufficient to increase fruit and vegetable intake over six months; (2) to investigate whether the long-term impact of implementation intentions on fruit and vegetable intake can be improved by administering a second implementation intention instruction at 3 months, and (3) to test whether demand characteristics could account for the impact of the intervention, by including both passive and active control conditions and investigating awareness of study aims.

The hypotheses were as follows. First, as previous research has shown that the success of implementation intention-based interventions to increase fruit and vegetables has been restricted to shorter-term follow-ups, it was predicted that a single implementation intention would initiate behaviour change, but this effect

would not be demonstrated at six months. Second, in line with Koestner et al. (2006), it was predicted that giving participants the opportunity to form a second implementation intention at a mid-point in the study would sustain the initial goal striving and therefore extend the effect of the initial implementation intention to the end of the six-month period. Third, it was predicted that an active control condition would lead to a slight increase in fruit and vegetable intake over the course of the study, but there would be no change in behaviour in the passive control condition.

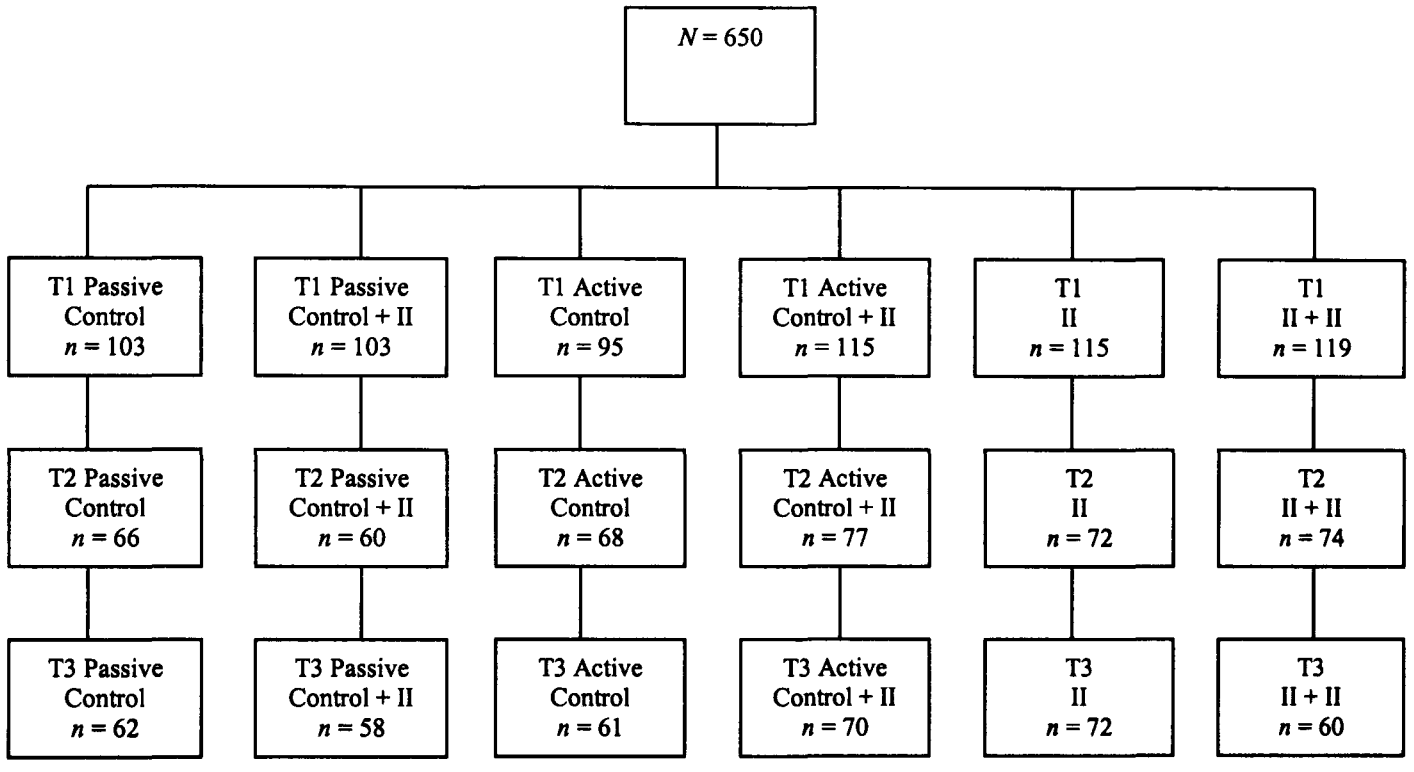
2.3 Method

2.3.1 Participants

The sample comprised undergraduate students from a UK university. A power calculation based on Gollwitzer and Sheeran's (2006) meta-analysis of implementation intention interventions was used to predict sample size. A medium-large size effect of d = .65 with alpha = 0.05 and power = 0.80 requires at least 40 participants per group. Of the one thousand paper-and-pencil questionnaires distributed at baseline, 650 were returned completed. Four hundred and seventeen participants completed an internet-based follow-up questionnaire at three months, a response rate of 64% of the questionnaires completed at baseline. Three hundred and eighty three participants completed a second internet-based follow-up at six months, a final response rate of 59% of the questionnaires completed at baseline and 92% of the questionnaires completed at 3 months. The average age of the baseline sample ranged from 18 - 41 years (M = 19.66, SD = 2.05), 71% were female (n = 460), and 87% were White (n = 567). Due to the large attrition rates found in previous studies, the

people who dropped out at three and six months were treated as no-changers, and analysed on an ITT basis (see Chapter 1, Section 1.6.3.3; Figure 2.1).

Figure 2.1: *Diagram of Participant Progress through the Phases of the Experiment*



Note: T1 = Baseline, T2 = 3 months' follow-up, T3 = 6 months' follow-up, II = Implementation Intention

2.3.2 Design

A randomised controlled design was used with the between-persons factor of *condition*, which had six levels: (1) passive control (PC); (2) passive control plus an implementation intention at 3 months (PC + II); (3) active control (AC); (4) active control plus an implementation intention at 3 months (AC + II); (5) implementation intention (II), and (6) implementation intention plus an implementation intention at 3 months (II + II). Although the main aim of the study was to test the impact of a second implementation intention in the II + II group, a second implementation intention was given at 3 months in the PC + II and the AC + II groups to control for

potential extraneous influences on fruit and vegetable intake. All dependent measures (fruit and vegetable intake and TPB variables) were taken at baseline, three months and six months' follow-ups (Figure 2.1).

2.3.3 Procedure

Data were collected from undergraduate students who were invited in class to participate in a study of 'dietary habits'. Paper-and-pencil questionnaires sorted into random order via a random number generator were distributed at the beginning of the class by individuals who were unaware of the conditions. To reduce the risk of cross-contamination, the questionnaires were completed under examination conditions and participants were requested not to discuss the contents of the questionnaires after completion. At the end of the class, the participants were instructed to place the questionnaires into a collection box. Participants were contacted again at three-months via their university email address, which they were asked to provide at baseline if they wished to continue with the study. In the follow-up email, a link was provided to an internet-based questionnaire, with the same layout as the baseline paper-and-pencil questionnaire. This procedure was repeated at six-month follow-up. Although participants were asked to provide their university email addresses, confidentiality was preserved as the addresses consist of a series of letters and numbers (representing the course code, start year of degree, and initials), rather than the student's full name. Participants were informed that participation was voluntary and that they were free to withdraw their data at any point.

2.3.4 Questionnaire Content

All questionnaires began with a detailed section regarding what constitutes a portion of fruit and vegetables, which was closely based on the UK DoH guide to the size of a portion of 5 A Day (DoH, 2008). Examples of fruit portions given were: 2 plums, 1 apple; examples of vegetable portions were: 2 broccoli spears, 3 heaped tablespoons of peas. This was followed by TPB items, single-item and FFQ measures of fruit and vegetable intake, the intervention manipulations where relevant, and finally an additional measure of demand characteristics. All of these are described in the following Sections.

2.3.5 Manipulations

2.3.5.1 Baseline

Participants randomised to the II and II + II conditions were presented with the following phrase: "We would like you to increase your daily intake of fruit and vegetables over the next 6 months[3]. Research has shown that planning is more effective if you first identify a situation, then decide what you will do in that situation. For example, you might find it useful to state: "If it is lunchtime at university, then I will eat an apple instead of crisps!" Please write your plans in the space provided, following the format in the example ("if...then...")". This was followed by a page of blank lines for the participants to formulate their own self-generated plans. These instructions were based on those of Chapman et al. (in press)

[3] Rather than asking participants to 'eat the current UK recommendation of 5 portions per day', the general target to 'increase daily fruit and vegetable intake' was applied for two reasons. First, eating the RDIFV may be considered an unrealistic and therefore off-putting goal for many people who currently consume lower daily amounts (e.g. 1 portion), and for these individuals health benefits would be gained by attempts to work towards higher levels (DoH, 2003). Second, as discussed in Chapter 1, the consumption of five portions per day is the minimum recommendation; with several governments setting targets of up to 10 portions per day (see Section 1.3). Therefore, individuals who currently consume higher daily amounts (e.g. 5 portions) should not be excluded from opportunities to increase their intake further.

in light of evidence that forming plans in a specific ("if...then...") format is superior in engendering behaviour change (see Chapter 1, Section 1.5.3.1).

Participants randomised to the AC and AC + II conditions were presented with the following brief statement designed to inform and encourage them to increase their consumption over the duration of the study: "We would like you to increase your daily intake of fruit and vegetables over the next 6 months." This is the same opening instruction used in the II and II + II conditions, and is closely based on the instructions given to the control group in Jackson et al. (2005), who were asked to eat two extra portions of fruit or vegetables each day for the next 3 months.

Participants randomised to the PC and PC + II conditions completed the questionnaire but received no further instructions.

2.3.5.2 Three Months

Participants in the PC + II, AC + II, and II + II conditions were presented with the same implementation intention phrase given above. Participants in the PC, AC and II condition completed the questionnaire but received no further instructions.

2.3.6 Measures

2.3.6.1 Theory of Planned Behaviour

In line with previous implementation intention studies, TPB variables were used to control for the effects of motivation (see Chapter 1, Section 1.6.2.4.4), and because it has been shown to provide a good account of the factors underpinning motivation (Armitage & Conner, 2001). For the measure of attitude, participants were presented with the stem: "For me, increasing my daily intake of fruit and vegetables

in the next six months is..." which they were asked to rate on three bipolar (-3 to +3) semantic difference scales, anchored by *bad-good*, *negative-positive*, and *foolish-wise*. Cronbach's α indicated that the attitude scale possessed good internal reliability at baseline (α = .85), 3-month follow-up (α = .86) and 6-month follow-up (α = .83). PBC was measured using items measured on three bipolar (-3 to +3) scales: "Increasing my daily intake of fruit and vegetables in the next six months would be *difficult-easy*", "How much personal control do you feel you have over increasing your daily intake of fruit and vegetables in the next six months? *no control-complete control*", and "How confident are you that you will be able to increase your daily intake of fruit and vegetables in the next six months? *not very confident-very confident*". The internal reliability of the scale was good at baseline (α = .87), at 3-month follow-up (α = .85), and 6-month follow-up (α = .84). Subjective norm was operationalised using three items: "Most people who are important to me think I should increase my daily intake of fruit and vegetables in the next six months", "Most people who are important to me would want me to increase my daily intake of fruit and vegetables in the next six months", and "Most people in my social network would approve of my increasing my daily intake of fruit and vegetables in the next six months". These were measured by averaging responses made on unipolar (+1 to +7) scales, *strongly disagree-strongly agree*. The items formed an internally reliable scale at baseline (α = .87), 3-month follow-up (α = .81) and 6-month follow-up (α = .89). Behavioural intention was measured on a bipolar (-3 to +3) scale using three items: "I *intend* to increase my daily intake of fruit and vegetables in the next six months *strongly disagree-strongly agree*", "I *want* to increase my daily intake of fruit and vegetables in the next six months *strongly disagree-strongly agree*", and "How likely is it that you will increase your daily intake of fruit and vegetables in the next six

months? *very unlikely-very likely*". Again, reliability was high at baseline (α = .91), 3-month follow-up (α = .89) and 6-month follow-up (α = .92).

2.3.6.2 Fruit and Vegetable Intake

Two measures of fruit and vegetable intake were used. First, participants were required to report their daily intake using a single open-ended item: "Over the past week, how many portions of fruit and vegetables have you eaten on average per day?" followed by a blank space to write the answer. This item was used in previous research that showed it was sensitive to intervention effects and correlated highly with previously validated measures (Chapman et al., in press).

Second, participants completed a FFQ by recording their average consumption, in the last year, of 80g servings of common fruits and vegetables. This measure was a section taken from an epidemiological instrument originally developed and validated for the European Prospective Investigation of Cancer (EPIC; Bingham et al., 1994; McKeown et al., 2001). Frequency measures were presented as a checklist with 9 response options: *"Never or less than once per month"*, *"1-3 per month"*, *"1 per week"*, *"2-4 per week"*, *"5-6 per week"*, *"1 per day"*, *"2-3 per day"*, *"4-5 per day"* and *"6 or more per day"*. Total daily frequencies of consumption of fruit and vegetables (thirty one items) were calculated from the questionnaire by summing consumption rate per month for each item, and dividing by 30. Frequencies for two items labelled "peaches, plums, apricots" and "strawberries, raspberries, kiwi fruit" were divided into three to adjust for seasonal variability; this was necessary to avoid overrepresentation of use, because participants had been asked to estimate their use of these fruits specifically when in season. Following the recommendation of previous research, six items were excluded from the calculation

(see Gibson, Wardle & Watts, 1998). "Tinned fruit" was excluded because it is a non-specific fruit item that was listed after the other individual fruits, therefore there was a risk that the duplication of estimated fruit could have occurred. The additional five items were excluded from the calculation because of peculiarities of use, for example they are associated with ingredients rather than whole portions; they are not standard fruits or vegetable items per se, or again because of risk of duplication. These items were "onions", "garlic", "coleslaw", "tofu, Soya meat, TVP, vegeburger" and "dried lentils, beans, peas".

2.3.6.3 Demand Characteristics

A further measure of demand characteristics used in previous research (see Chapman et al., in press), was added to test for the degree of awareness of the study aims between conditions. To measure the degree of awareness of the study aims and hypotheses, a single open-ended item was included at the end of the baseline questionnaire, followed by four blank lines for participants to write their answers. This item was worded: "We are interested in what people think while they're completing questionnaires like this. In particular we'd like to know what you think are the main purposes of this study. Please write your answers in the space provided". For the three-month and 6-month follow-up questionnaires, this item was worded: "Previously, we asked you what you thought were the main purposes of this study. If you have had any more thoughts, please write them in the space provided".

2.4 Results

2.4.1 Representativeness Check and Attrition Biases

To gauge the potential generalisability of the findings, baseline fruit and vegetable intake was compared to recent population data. Data from the Health Survey for England (2001) indicate a mean intake of 3.60 portions (Doyle & Horsfield, 2003). Despite our recruiting a student population, the single-item measure showed that the present sample had a mean reported intake of 3.57 (SD = 1.21) per day, indicating that they were eating similar amounts of fruit and vegetables compared with the country as a whole. In contrast, participants reported a mean daily intake of 5.46 (SD = 3.13) portions of fruit and vegetables on the FFQ, which is 1.89 portions higher than the self-report measure. However, this average may be a considerable overestimation due to the large number of relevant items in the FFQ, and the use of an annual recall period (cf. Cox et al., 1997; Krebs-Smith, Heimendinger, Subar, Patterson & Pivonka, 1995). As the two measures were significantly correlated at baseline (r = .65, p < .01), the 3.57 portions reported by the single item measure may therefore represent a more accurate estimation of daily fruit and vegetable intake (see Section 2.5.4).

Multivariate Analysis of Variance (MANOVA) showed there were no significant differences between responders and non-responders on their fruit and vegetable intake measured by the single-item or FFQ, TPB variables or age, regardless of whether they dropped out at 3 months, $F(7, 632) = 1.01$, $p = .42$, $\eta_p^2 = .01$, or 6 months, $F(7, 632) = 1.57$, $p = .14$, $\eta_p^2 = .02$. No statistically significant univariate tests were found. Chi-square showed no differences between responders and non-responders for gender at 3 months, χ^2 (1) = 0.12, $p = .73$, or at 6 months, χ^2 (1) = 0.29, $p = .59$; or ethnicity at 3 months, χ^2 (1) = 0.01, $p = .92$, or at 6 months, χ^2 (1) = 0.02, $p = .89$. Finally, no significant differences were found between drop-out

rates for condition at 3 months, $\chi^2(5) = 4.55$, $p = .47$, or at 6 months, $\chi^2(5) = 5.84$, $p = .32$.

2.4.2 Randomisation Check

The experimental and control conditions were compared on the two measures of past behaviour, TPB variables and age to check whether randomisation was achieved. The MANOVA was nonsignificant, $F(7, 632) = 1.56$, $p = .15$, $\eta_p^2 = .02$, as were all univariate Analysis of Variance (ANOVAs). Gender and ethnicity were tested using nonparametric tests, and again no significant differences were found, χ^2 (5) = 8.57, $p = .08$, and χ^2 (5) = 1.22, $p = .94$, respectively. Together, these data suggest that prior to the implementation intention manipulations, participants in the experimental and control groups ate similar portions of fruit and vegetables per day, and were equally motivated to increasing their daily portions (see Table 2.1 for means and standard deviations for all variables at all time points).

Table 2.1: *Means and Standard Deviations for all Variables at all Time Points*

Variable	Time	Passive Control Without II at 3 months *M* (*SD*)	Passive Control With II at 3 months *M* (*SD*)	Active Control Without II at 3 months *M* (*SD*)	Active Control With II at 3 months *M* (*SD*)	II Without II at 3 months *M* (*SD*)	II With II at 3 months *M* (*SD*)
SM Intake (portions per day)	Baseline	3.62	3.57	3.68	3.57	3.51	3.49
		(1.29)	(1.36)	(1.21)	(1.20)	(1.11)	(1.10)
	3 Months	3.54	3.58	3.64	3.64	3.78	3.82
		(1.25)	(1.47)	(1.13)	(1.26)	(1.15)	(1.13)
	6 Months	3.60	3.80	3.72	3.97	3.59	4.06
		(1.35)	(1.25)	(1.23)	(1.20)	(1.36)	(1.09)
FFQ Intake (portions per day)	Baseline	5.34	5.24	5.56	5.82	5.35	5.41
		(3.90)	(3.51)	(2.70)	(3.29)	(2.68)	(2.58)
	3 Months	5.46	5.31	5.53	5.65	5.51	5.76
		(3.04)	(3.62)	(2.69)	(3.02)	(2.76)	(3.14)
	6 Months	5.53	5.36	5.73	5.55	5.62	5.81
		(2.98)	(3.67)	(2.80)	(2.97)	(3.07)	(3.40)
Attitude	Baseline	2.38	2.34	2.35	2.35	2.36	2.33
		(0.79)	(0.82)	(0.82)	(0.68)	(0.72)	(0.86)
	3 Months	2.30	2.35	2.32	2.37	2.35	2.36
		(0.76)	(0.79)	(0.86)	(0.73)	(0.79)	(0.84)
	6 Months	2.26	2.37	2.33	2.37	2.33	2.34
		(0.78)	(0.73)	(0.88)	(0.67)	(0.77)	(0.80)
Subjective Norm	Baseline	5.01	4.97	4.72	4.99	4.85	4.93
		(1.34)	(1.22)	(1.50)	(1.28)	(1.47)	(1.49)
	3 Months	4.88	4.97	4.87	5.00	4.78	4.98
		(1.35)	(1.40)	(1.54)	(1.43)	(1.59)	(1.49)
	6 Months	4.82	5.00	4.83	5.03	4.74	4.94
		(1.38)	(1.28)	(1.41)	(1.28)	(1.48)	(1.48)
PBC	Baseline	1.52	1.45	1.54	1.55	1.44	1.47
		(1.19)	(1.38)	(1.11)	(1.07)	(1.26)	(1.17)
	3 Months	1.35	1.45	1.57	1.56	1.46	1.46
		(1.26)	(1.35)	(1.15)	(1.11)	(1.15)	(1.14)
	6 Months	1.36	1.43	1.53	1.54	1.46	1.43
		(1.28)	(1.28)	(1.16)	(1.11)	(1.20)	(1.11)
Intention	Baseline	1.70	1.55	1.79	1.62	1.63	1.66
		(1.06)	(1.22)	(0.99)	(1.15)	(1.21)	(1.15)
	3 Months	1.64	1.47	1.76	1.61	1.58	1.71
		(1.16)	(1.35)	(1.07)	(1.06)	(1.24)	(1.11)
	6 Months	1.68	1.49	1.72	1.61	1.55	1.68
		(1.16)	(1.31)	(1.25)	(1.05)	(1.22)	(1.08)

Note: SM = Single-item Measure, II = Implementation Intention

2.4.3 Effects of the Implementation Intention Interventions

The data were analysed according to ITT. A series of between-persons Analysis of Covariance (ANCOVAs) controlling for baseline measures were used to examine the effects of the six conditions (PC, PC + II, AC, AC + II, II, & II + II) on the dependent variables at three months' follow-up and 6 months' follow-up. For the results at both time points, planned contrasts were used to clarify where any differences between the levels of the between-persons factor lay.

2.4.3.1 Motivation Manipulation Check

The initial analyses examined whether the manipulations had any effect on participants' motivation to increase their daily intake of fruit and vegetables over the course of the study. At three months' follow-up, ANCOVAs controlling for baseline revealed no significant effects of condition for attitude, PBC, subjective norm, or intention, Fs(5, 645) = 0.38 to 1.35, ps = .86 to .24, η_p^2s < .02. Similarly, at six months' follow-up, ANCOVAs controlling for baseline revealed no significant effects of condition for attitude, PBC, subjective norm, or intention, Fs(5, 645) = 0.41 to 1.18, ps = .85 to .32, η_p^2s < .02. This provides evidence that motivation was unaffected by the manipulations, and no changes in any of the TPB variables were demonstrated (Table 2.1).

2.4.3.2 Fruit and Vegetable Intake at Three Months

The second analyses tested the effect of condition on fruit and vegetable intake at three months on both the single-item and FFQ measures of behaviour.

2.4.3.2.1 Single-item Measure

ANCOVA controlling for baseline fruit and vegetable intake revealed a significant difference among conditions at three months, $F(5, 649) = 4.86$, $p < .01$, $\eta_p^2 = .04$. Planned simple contrasts showed that participants in the II and the II + II groups reported significantly higher portions of fruit and vegetables at three months than any other condition ($ps < .02$), representing an increase of 0.27 and 0.33 portions, respectively (Table 2.1 and Figure 2.2). No differences in fruit and vegetable intake were found between the II and the II + II condition at three months ($p = .53$). This is in accordance with the prediction that implementation intentions would successfully increase fruit and vegetable intake in the shorter-term.

Further planned contrasts were performed to test the hypothesis that participants randomised to the active control conditions would increase fruit and vegetable intake more than those randomised to the passive control conditions. However, this prediction was not supported. No differences in follow-up fruit and vegetable portions were demonstrated between the control conditions at three months ($ps > .35$), indicating that providing participants with encouragement to increase their daily intake does not impact on behaviour.

2.4.3.2.2 FFQ Measure

The analyses were repeated to test the effect of condition on fruit and vegetable intake on the FFQ at three months' follow-up. However, ANCOVA controlling for baseline intake showed no difference among conditions at three months, $F(5, 649) = 0.54$, $p = .74$, $\eta_p^2 < .01$, suggesting that for this measure of behaviour, the manipulations did not appear to affect fruit and vegetable intake.

2.4.3.3 Fruit and Vegetable Intake at Six Months

The third set of analyses tested the effect of condition on fruit and vegetable intake at six months' follow-up, again on both measures of behaviour.

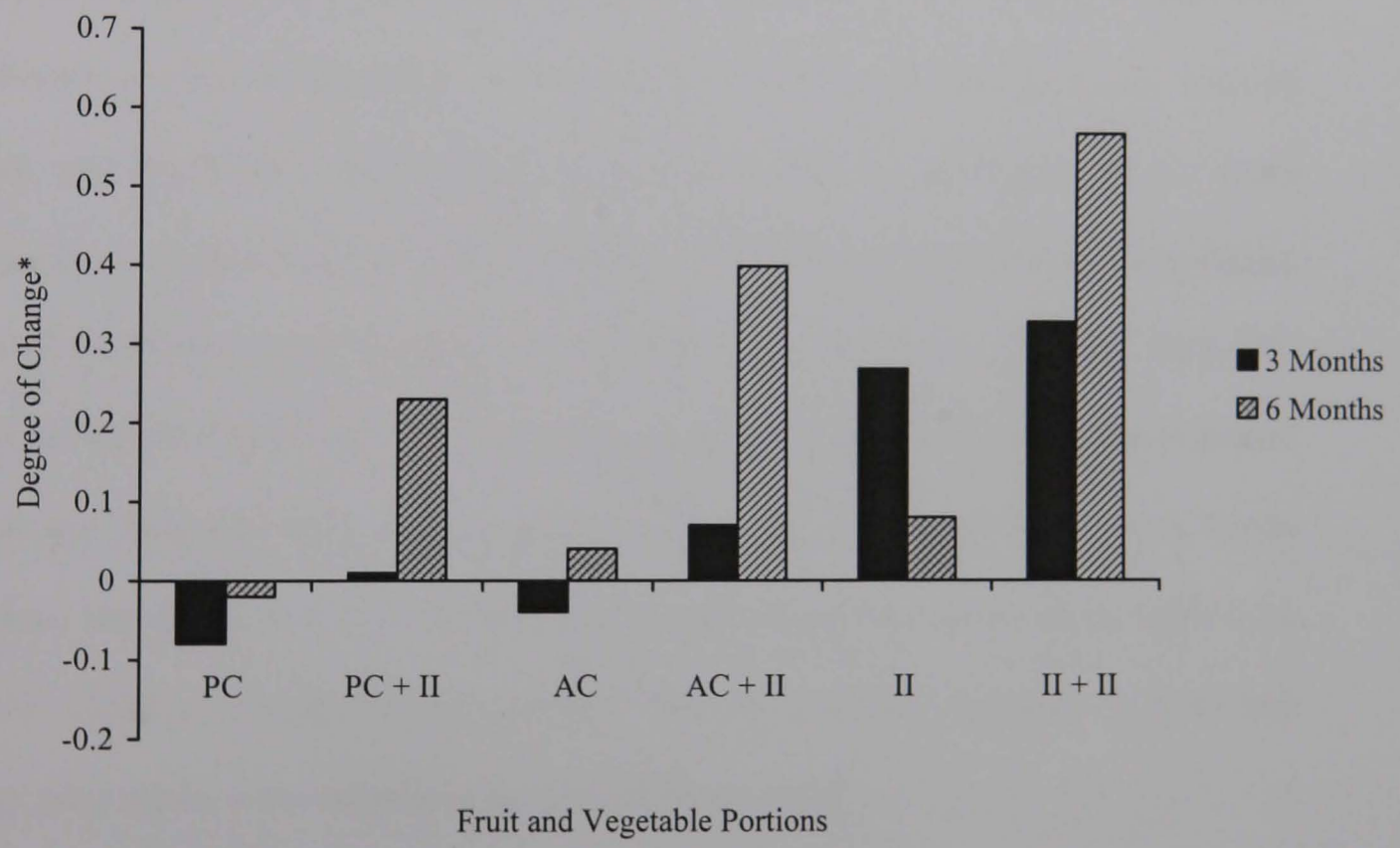
2.4.3.3.1 Single-item Measure

ANCOVA controlling for baseline fruit and vegetable intake revealed a significant difference among conditions at six months, $F(5, 649) = 7.92$, $p < .01$, $\eta_p^2 = .06$. This was broken down as follows. First, planned simple contrasts showed that there were no differences in fruit and vegetable intake at six months among the conditions PC, AC and II ($ps > .50$) (Table 2.1 and Figure 2.2). Furthermore, the fruit and vegetable intake of the II condition at six months had decreased by 0.19 portions. This is consistent with the hypothesis that the initial effect of a single implementation intention would not be sustained for the six-month period. In addition, no differential impact between the passive and active control groups over the full course of the study was demonstrated. Second, further planned contrasts were performed to assess the overall efficacy of the II + II intervention over six months. The planned comparisons demonstrated that participants in the II + II condition ate significantly more daily portions of fruit and vegetables at the end of the study than participants in the II condition ($p < .01$), demonstrating that the use of an implementation intention at three months not only served to extend the initial impact of the implementation intentions intervention, but also acted as a booster by increasing intake by a further 0.24 portions, leading to an overall increase of 0.57 portions (Table 2.1 and Figure 2.2). The hypothesis was therefore supported. The fruit and vegetable intake of the II + II condition was also significantly higher ($ps < .01$) at six months than all other conditions, except the AC + II group ($p = .19$). Consistent with the analysis at three months, there were comparable increases in intake in the groups who received an implementation intention at time 2.

2.4.3.3.2 FFQ Measure

The analyses were repeated to test the effect of condition on fruit and vegetable intake on the FFQ at six months' follow-up. ANCOVA controlling for baseline intake again showed no difference among conditions, $F(5, 649) = 0.74$, $p = .59$, $\eta_p^2 = .01$. Therefore, in contrast to the single-item measure, the manipulations had no effect on the fruit and vegetable intake as measured by the FFQ over the duration of the study.

Figure 2.2: *Effects of Condition on Fruit and Vegetable Intake on Single-item Measure at Three Months and Six Months' Follow-up, Controlling for Baseline*



Note: *portions per day

2.4.4 Demand Characteristics

The final section of analyses investigated whether the reported increases in fruit and vegetable intake were a consequence of demand characteristics, as indexed

by awareness of the study aims. The contents of the item asking participants to write what they thought were the main purposes of the study were collated from all three time points, and were analysed and coded, such that participants who were not aware of the purposes of the study at any time point = 1 (n = 367) and participants who were aware of the purposes of the study at any time point = 2 (n = 58). Participants were coded as 'aware' if they wrote that the purposes of the study were related to the study hypotheses (e.g., 'to increase fruit and vegetable intake' or 'fruit and vegetable intervention', 'seeing how behaviour changed over time', or 'how forming plans impacts on behaviour')[4]. Possible differences in awareness between the conditions were tested using nonparametric tests. The test was nonsignificant, $\chi^2(5) = 8.04$, p = .15, indicating there were no differences in awareness of the study hypotheses between conditions. Bivariate correlations were then performed to assess whether fruit and vegetable intake at follow-up was related to awareness of the study hypotheses at three months and six months. These correlations were nonsignificant for all condition groups for three months' follow-up, rs = .04 to .21, ps = .09 to .71, and six months' follow-up, rs = .06 to .20, ps = .10 to .61, demonstrating that reported fruit and vegetable intake was unrelated to awareness of the study hypotheses. Given that no significant effects were found over time for the TPB variables (see Table 2.1), these findings provide further evidence that the present increases in fruit and vegetable intake were not related to demand characteristics.

2.5 Discussion

[4] The majority of participants who were 'unaware' of the study aims wrote ideas such as 'surveying eating habits', 'attitudes towards fruit and vegetables', 'to increase awareness of the benefits of fruit and vegetables', and 'how different phrasing of questions affects answers'.

The present study tests of the efficacy of a single implementation intention to increase fruit and vegetable consumption over a six-month period, and a preliminary investigation into how introducing a second implementation intention at a later date can sustain initial goal striving and improve long-term impact. The study also aimed to investigate a further methodological issue of control group formats, to examine whether implementation intentions produce behaviour change effects even when the potential for experimenter demand is reduced. The following discussion begins with the main effect on fruit and vegetable intake from the single-item measure of behaviour, and considers the role of demand characteristics from the comparison of control groups and participant awareness of study aims. This is followed by a discussion of the contrasting findings from the FFQ. The present Chapter concludes with a general summary of results and suggestions for future work.

2.5.1 Effects of a Single Implementation Intention on Fruit and Vegetable Intake at Three Months' Follow-up, Assessed by Single-item Measure

The first important finding from the single-item measure is that implementation intentions appear to be an effective means of increasing fruit and vegetable intake for up to three months. As hypothesised, participants in both groups who received an implementation intention instruction at baseline reported eating significantly more fruit and vegetables than those in the passive and active control groups. A comparable increase of 0.27 and 0.33 daily portions over 3 months was found in both conditions, representing small effect sizes of d = .20 and d = .24 respectively, which are slightly lower than the effect sizes found in previous work in this area (e.g. Armitage, 2007; Gratton et al., 2007; see Chapter 1, Table 1.3). However, unlike previous research, the present study applied ITT analyses, meaning

that these estimates are likely to be more conservative because of dilution due to noncompliance. Therefore, these findings lend support to previous studies conducted over a short time period (e.g. Armitage, 2007; De Nooijer et al., 2006; Gratton et al., 2007; Kellar & Abraham, 2005), and generate confidence in the validity of their conclusions.

2.5.2 Effects of a Repeat Implementation Intention on Fruit and Vegetable Intake at Six Months' Follow-up, Assessed by Single-item Measure

The second key finding from the single-item measure of behaviour relates to the long-term effects of the manipulations at six months. In the single implementation intention group, the higher intake of fruit and vegetables demonstrated at three months had fallen by 0.19 portions at the six-month follow-up. As such, by the end of the study, no differences in intake were found between the single implementation intention condition and the control groups. In support of our prediction and in line with the literature reviewed in Chapter 1, this finding indicates that a single implementation intention appears insufficient to both initiate and maintain a higher consumption of fruit and vegetables over a six-month period.

However, a different pattern of results was demonstrated for participants who received an implementation intention at baseline and three months. At the end of the study, participants in this group ate the highest number of fruit and vegetables, resulting in an overall increase of 0.57 daily portions from baseline to six months. The result at six months represents a small-to-medium effect size of d = .38 in comparison with the effect size of d = .24 in the same group at 3 months. This is a particularly salient finding, as it suggests that the second implementation intention did not just serve to sustain the initial behaviour change as per our hypothesis, but

created a booster effect to further promote fruit and vegetable intake over and above the change demonstrated at three months.

2.5.3 The Role of Demand Characteristics

2.5.3.1 Active Control Versus Passive Control

The third main finding relates to the comparison of control groups. No significant differences were demonstrated between the passive and active controls, and as such, the hypothesis that an active control condition giving general encouragement to make behavioural changes would lead to an increase in fruit and vegetable consumption was not supported. This would suggest that, in contrast to the proposal of Jackson et al. (2005), actively encouraging participants to make behavioural changes does not account for the impact engendered by implementation intentions, and therefore generates support for their genuine effects[5] (see Section 1.6.3.4). However, it should be noted that although the present study controlled for the effects of encouragement to increase intake specified by Jackson et al. (2005), it did not control for the length of exposure to the health-related material, or the level of engagement of participants in the intervention. Therefore, the potential for bias from this position cannot be entirely overruled. However, given that previous implementation intention-based fruit and vegetable studies have found no effect for more active control groups focusing on the provision of health-related information

[5] Although no differences were found between passive and active controls, planned contrasts revealed there was no difference between the fruit and vegetable intake of the AC + II and the II + II conditions at six months' follow-up ($p = .19$), representing an increase of 0.40 and 0.57 portions, respectively. Therefore, it may be that there is some benefit in providing a message of encouragement followed by an implementation intention, however, given that there was no effect for the active control at three months, little support can be generated for the use of active controls overall.

(e.g. Luszczynska et al., 2007b) a degree of confidence can be generated from the present findings to some extent.

2.5.3.2 Awareness of Study Aims

In the additional test of demand characteristics, it was demonstrated that participants who received implementation intention instructions at any time point were no more likely to be aware of the study aims than those in the control groups, suggesting that participants were not simply acting in response to the intervention information. Moreover, whether or not participants were aware of the study aims did not seem to affect reported fruit and vegetable intake. This serves to undermine the suggestion that implementation intentions may work more effectively in student samples because they are more compliant with task demands (cf. Jackson et al., 2005). Together with the findings from the comparison of the active and passive controls reported above (Section 2.5.3.1), these results provide evidence to suggest that the effects of implementation intentions on fruit and vegetable intake in the present study appear robust.

2.5.4 Null Findings of Effects of Implementation Intentions on Fruit and Vegetable Intake, Assessed by FFQ

Before conclusions can be drawn, however, it is important to note that the findings generated from the single-item measure of behaviour were not replicated when fruit and vegetable intake was assessed by the FFQ. No differences between conditions were found at either three months, or six-month follow-up. These results are equivalent to those of De Nooijer et al. (2006), who found an effect for an implementation intention-based intervention on a single-item measure, but not on the

FFQ measure of behaviour[6]. One explanation for the null findings in the present study may be related to the differences in baseline intake. The FFQ results at baseline indicated that the mean daily intake of the present sample was 5.46 portions. This is considerably higher than the 3.57 portions reported by the single-item measure and the 3.60 portions reported in recent population data (e.g. Doyle & Horsfield, 2003). Findings from previous research have demonstrated that this is likely to be an overestimation. For example, when analyses of similar FFQs were compared to 16-day weighed food records, fruit and vegetable consumption was found to be overestimated by approximately 30%, with vegetable intake in particular almost doubled by the FFQ method (Bingham et al., 1994)[7]. Further, a review of the results from three large-scale FFQs measuring fruit and vegetable intake concluded that there is a direct relationship between the number of items and reported consumption, with more items leading to a greater tendency to exaggerate intakes (Krebs-Smith et al., 1995). This implies that the thirty one items measured in the present study may have led to inaccuracies in estimation of frequency and therefore biased the overall findings (cf. Cox et al., 1997; Gibson et al., 1998). An alternative explanation, however, is that the recall period for the FFQ used in the present study was one year. Although the study was conducted over the longer time frame of six months, it is possible that, similar to De Nooijer et al. (2006), the findings again may be

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[6] Because ITT analyses represent a conservative estimate and were not applied in De Nooijer et al. (2006), the analyses were repeated on participants for whom all data was available to compare across studies. However, this made no difference to the nonsignificant findings at any time point (*p*s = .37 to .65). Further repeated-measures analyses revealed that the small 0.15 daily portion increase from baseline to follow-up was nonsignificant, $p = .14$ (Table 2.1).

[7] Due to the findings of Bingham et al., the FFQ was split into fruit items and vegetable items to assess whether the measure showed differential effects on the two food groups. At baseline, mean fruit intake was 1.86 ($SD = 1.57$) and mean vegetable intake was 3.60 ($SD = 2.06$). ANCOVAs at 3 and 6 months were repeated but no effects were found for fruit (*p*s > .65) or vegetables (*p*s > .49). As a final check, the analyses reported in Footnote 6 (above) were repeated on FFQ fruits and FFQ vegetables, but again, no effects were found.

confounded by differing time intervals. Therefore, given that the FFQ measure was derived from a previously validated instrument (McKeown et al., 2001), caution must be warranted before generalising the findings of the single-item measure.

2.5.5 Motivation Manipulation Check

In light of recent literature suggesting that implementation intentions may increase motivation to eat fruit and vegetables (e.g. Gratton et al., 2007; see Section 1.6.3.2), TPB variables were assessed at baseline and follow-up. However, no differences between conditions for any of the TPB variables were found at any time point. Thus, consistent with previous research and Gollwitzer's (1993) MAP, these findings further demonstrate that the change in behaviour cannot be explained by a change in motivation, which offers additional support for their genuine volitional mechanisms (see Section 1.5.3.1).

2.6 Chapter Summary

In conclusion, the present Chapter offers evidence that the effect of a single implementation intention is sufficient to initiate a change in fruit and vegetable intake over three months, although this effect was not maintained across a six-month period. It was further demonstrated that introducing a second implementation intention at a later date can sustain initial goal striving and act as a booster, suggesting that 'booster' implementation intentions are a promising means of improving the long-term impact of the intervention. Additionally, the present study indicates that the unique effects of implementation intentions are genuine. Although these preliminary findings are promising, single-item effects were not replicated on the FFQ measure of behaviour, hence caution should be applied. More research is required to further

develop the preliminary idea of 'booster' implementation intentions to help people to maintain positive increases in fruit and vegetable intake over a prolonged period of time.

2.7 The Next Step

The preceding Chapter sought to address two of the broad aims of the thesis, namely, investigating ways to improve long-term behaviour change by implementation intentions on fruit and vegetable intake, and providing an assessment of demand characteristics. However, the present study may have suffered a potential conceptual ambiguity in that, like previous studies, combined fruit and vegetable consumption was targeted using a single implementation intention manipulation (see Section 1.6.3.7). Therefore, the following Chapter presents a study that seeks to explore the fourth broad aim of the thesis, in addition to providing a further test of the FFQ over an accurately corresponding time frame.

Chapter 3 - Are Fruit and Vegetables Conceptually Distinct? Evidence from a Comparison of Two Implementation Intention Interventions

3.1 Abstract

This study compares the efficacy of an implementation intention instruction to change fruit and vegetable intake as a combined food group, with an intervention comprising separate implementation intention instructions for fruit and vegetables. Participants (N = 580) completed single-item and FFQ measures of behaviour and motivation at baseline before being randomised to one of three conditions (active control; combined implementation intention; separate implementation intentions) in a mixed design. At two months' follow-up, ITT analyses revealed that for the single-item measure: (1) fruit intake had increased significantly over the control group in both experimental conditions, but contrary to prediction the increase was significantly higher in the combined implementation intention group; and (2) only participants randomised to the separate implementation intentions condition had increased their vegetable intake significantly over the control group at follow-up. However, no effects of the manipulations on fruit or vegetable intake were found when behaviour was assessed by the FFQ measure of behaviour. Additional analysis of the written content of the implementation intentions generated by participants revealed: (3) differences in the type and efficacy of behavioural strategies used to increase fruit and vegetables; (4) a preference for increasing fruit intake over vegetable intake, and (5) that fruit consumption appears more amenable to change than vegetable consumption.

3.2 Introduction

3.2.1 Do Fruit and Vegetables Require Different Behavioural Strategies?

The systematic review in Chapter 1 showed that previous studies have attempted to change both fruit and vegetables with a single implementation intention manipulation. This is potentially problematic, as fruit and vegetables have distinct culinary uses and practices (see Section 1.6.3.7). For example, fruits are more readily consumed as single between-meal snack foods, and eaten raw. In contrast, vegetables are more likely to be consumed as part of a meal, and are more likely to require preparation in the form of meal planning, peeling, chopping, and cooking (Brug et al., 2006; IARC, 2003). This distinction is highlighted by Kellar and Abraham (2005), who suggest that failure to facilitate planning of the necessary preparation may, at least for vegetables, hinder actual consumption. Following their combined motivational and preparatory-focused implementation intention intervention (e.g. planning 'when and where the fruit and vegetables would be purchased and prepared'), Kellar and Abraham report that the number of days on which the RDIV was eaten over one week had significantly increased by 0.57 (see Chapter 1, Table 1.3). Although this effect size was small (d = .22), the RDIV in Kellar and Abraham's study was four servings, which can be viewed as somewhat ambitious considering the national recommendation of fruit and vegetables combined is only five portions per day. In contrast, the number of days on which the RDIF was eaten had increased by 0.79. However, unlike the RDIV, the RDIF in Kellar and Abraham's study was only one portion per day, meaning that this goal was much easier to attain. Given that research indicates that vegetable intake is less amenable to change than fruit (see Section 3.2.2), these findings would suggest that preparatory strategies may be

particularly beneficial for promoting vegetable consumption. Alternatively, as fruit generally does not require the same level of preparation, it could be assumed that implementation intentions aimed at the target action of consumption may be more efficacious for fruit intake. This has potentially important implications for implementation intention-based interventions to increase fruit and vegetables, as the strategies underpinning successful plan formation may differ considerably across behaviours. It would therefore be useful to test these ideas directly, in addition to encouraging more behaviour-specific planning when promoting fruit and vegetable intake.

3.2.2 Is a Single Implementation Intention Manipulation Sufficient to Change Both Fruit and Vegetables?

A second potential problem with attempting to change fruit and vegetables with a single implementation intention comes from evidence that consumers who are trying to increase their intake demonstrate a marked preference for fruit. For example, Cox et al. (1998b) reported results from an intensive intervention trial focusing on food choice and consequent nutrient intakes. Participants were given educational, motivational and behavioural materials to encourage consumption of more than five portions of fruit and vegetables per day. At eight weeks follow-up, total fruit and vegetable intake had increased by 233g per day from baseline. However, 88% of this increase came from greater fruit consumption, with fruit intake increasing by 206g per day in comparison with a 27g per day increase for vegetables. Analyses of the preferred food choices of participants further revealed that three of the four most popular practical strategies for increasing total intake were aimed at increasing fruit: in the form of juice, as a between-meal snack and as a dessert (reported in Anderson

et al., 1998). This suggests that combined interventions aiming to increase total fruit and vegetables may inadvertently target fruit only, which is of particular concern given that fruit and vegetables differ in their association with health and disease (see Section 1.2). Again, the implication of these findings is that greater efforts are needed to promote the formation of separate strategies to increase fruits and vegetables simultaneously, rather than as an aggregated food group.

3.2.3 Aims and Hypotheses

In light of the above, the present study had three main aims. In an attempt to promote the formation of behaviour-specific plans, the first study aim was to test whether asking participants to generate two separate implementation intentions, one for fruit and one for vegetables, could improve the overall impact of the intervention in comparison with a combined implementation intention. This was to give participants the opportunity to fully consider the optimal behavioural strategies for each food group, and encourage the simultaneous increase of fruit intake and vegetable intake. The second aim of the study was to conduct a preliminary investigation into the types of behavioural strategies used in implementation intentions to increase fruit and vegetables, and to determine any differences in efficacy for each behaviour. The third aim of the present study was to explore the types of implementation intention made by participants when presented with a manipulation combining the food groups, and to assess the subsequent changes in behaviour.

The hypotheses were as follows: (1) separate implementation intentions would engender a significantly higher increase in fruit intake than a combined implementation intention, and (2) separate implementation intentions would engender

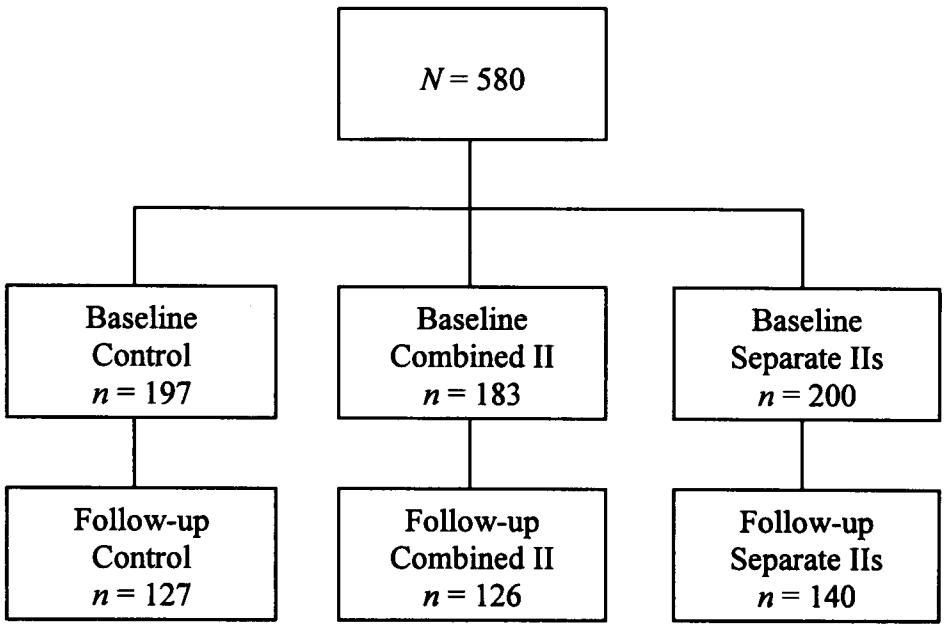
a significantly higher increase in vegetable intake than a combined implementation intention. For the analyses of the optimal behavioural strategies adopted by participants, it was further hypothesised that: (3) to increase fruit intake, a higher number of participants would generate behavioural strategies focusing on the 'target' action of consumption than the 'preparatory' actions of acquisition or meal planning; (4) to increase vegetable intake, a higher number of participants would generate 'preparatory' behavioural strategies than 'target' behavioural strategies; and (5) each strategy type would be significantly more effective in changing the respective behaviour. Finally, consistent with the findings of Cox et al. (1998b), it was hypothesised that when asked to increase fruit and vegetable intake using a combined implementation intention, participants would demonstrate a preference for increasing fruit intake over vegetable intake.

3.3 Method

3.3.1 Participants

The sample comprised students from a UK university. Five hundred and eighty online questionnaires were completed at baseline. Three hundred and ninety three participants completed a follow-up online questionnaire at two months, with a response rate of 68%. The age of the sample ranged from 18 - 44 years (M = 21.02, SD = 3.91), 74% were female (n = 431), and 82% were White (n = 475). The people who dropped out were treated as no-changers, and analysed on an ITT basis (Figure 3.1).

Figure 3.1: *Diagram of Participant Progress through the Phases of the Experiment*



Note: II = Implementation Intention

3.3.2 Design

A randomised controlled design was used with the between-persons factor of *condition*, which had three levels: (1) control; (2) combined implementation intention, and (3) separate implementation intentions. All dependent measures (fruit intake, vegetable intake and TPB variables) were taken at baseline and two months' follow-up (Figure 3.1).

3.3.3 Procedure

Data were collected from undergraduate students who were invited via group list email to participate voluntarily in a study of 'dietary habits'. The email contained a link to an online questionnaire, which randomly allocated participants to the control, combined or separate implementation intentions condition. Participants were contacted again for follow-up in two months' time via their individual email address, which they were asked to provide at baseline if they wished to continue with the

study. In the follow-up email, a link was provided to a second online questionnaire. Although participants were asked to provide their university email address, confidentiality was preserved as the addresses consisted of a series of letters and numbers (representing the course code, start year of degree, and initials), rather than the student's full name. Participants were informed that participation was voluntary and that they were free to withdraw their data at any point.

3.3.4 Questionnaire Content

All questionnaires began with a detailed section regarding what constitutes a portion of fruit and what constitutes a portion of vegetables. This was closely based on the UK DoH guide to the size of a portion of 5 A Day (DoH, 2008). Examples of fruit portions given were: 2 plums, 1 apple; examples of vegetable portions were: 2 broccoli spears, 3 heaped tablespoons of peas. This was followed by TPB items, single-item and FFQ measures of fruit intake and vegetable intake, and the intervention manipulations where relevant. All of these are described in the following Sections.

3.3.5 Manipulations

3.3.5.1 Combined Implementation Intention

Participants randomised to the combined implementation intention condition were presented with the following phrase: "We would like you to increase your daily intake of fruit and vegetables in the next two months. Research has shown that planning is more effective if you first identify a situation, then decide what you will do in that situation. For example, you might find it useful to state: "If it is lunchtime at university, then I will eat an apple instead of crisps!" or "If it is lunchtime at

university, then I will eat a salad instead of chips!" Alternatively, you could choose to focus on planning where to buy fruit or vegetables, or when and how you will prepare them. Take your time to think of strategies personal to you. Please write your plans in the space provided, following the format in the example ("if...then...")". This was followed by a space for the participants to formulate their own self-generated plans. The instructions were devised to encourage formation of plans in a specific if-then format (cf. Chapman et al., in press), and suggested the preparatory actions of acquisition and meal planning as ways to promote consumption (cf. Kellar and Abraham, 2005). The additional line "Take your time to think of strategies personal to you" was added to encourage thoughtful and personal plan formation.

3.3.5.2 Separate Implementation Intentions

Participants randomised to the separate implementation intentions condition received similar instructions to participants in the combined implementation intentions condition, but were given two separate instructions for forming their plans. The manipulation was as follows: "We would like you to increase your daily intake of fruit and vegetables in the next two months. Research has shown that planning is more effective if you first identify a situation, then decide what you will do in that situation. For example, you might find it useful to state: "If it is lunchtime at university, then I will eat an apple instead of crisps!" or "If it is lunchtime at university, then I will eat a salad instead of chips!" Alternatively, you could choose to focus on planning where to buy fruit or vegetables, or when and how you will prepare them. Take your time to think of strategies personal to you. Please write your plans to increase your FRUIT intake in the space provided, following the format in the example ("if...then..."). Please write your plans to increase your VEGETABLE

intake in the space provided, following the format in the example ("if...then...")". Both the fruit instructions and the vegetable instructions were followed by spaces to write their plans.

3.3.5.3 Control

Participants randomised to the control condition received a brief statement designed to encourage them to increase their fruit and vegetable consumption in the next two months: "We would like you to increase your daily intake of fruit and vegetables in the next two months." This is the same phrase applied in the active control condition in Chapter 2 (see Section 2.3.5.1), and was used as a further check to assess the potential effect of encouraging participants to perform the behaviour.

3.3.6 Measures

3.3.6.1 Theory of Planned Behaviour

TPB variables were used to control for the effects of motivation. This is in line with previous implementation intention studies (see Armitage, 2004), and because it has been shown to provide a good account of the factors underpinning motivation (Armitage & Conner, 2001). For the measure of attitude, participants were presented with the stem: "For me, increasing my daily intake of fruit and vegetables in the next two months is..." which was rated on two bipolar (-3 to +3) semantic difference scales, anchored by *bad-good*, and *negative-positive*. Reliability was good at baseline ($r = .72$, $p < .01$) and follow-up ($r = .78$, $p < .01$). PBC was measured using items measured on two bipolar (-3 to +3) scales: "How much personal control do you feel you have over increasing your daily intake of fruit and vegetables in the next two months? *no control-complete control*", and "How confident are you that you

will be able to increase your daily intake of fruit and vegetables in the next two months? *not very confident-very confident*" ($r = .74$, $p < .01$ at baseline, and $r = .81$, $p < .01$ at follow-up). Subjective norm was operationalised using two items: "Most people who are important to me think I should increase my daily intake of fruit and vegetables in the next two months", and "Most people in my social network would approve of my increasing my daily intake of fruit and vegetables in the next two months". These were measured by averaging responses made on unipolar (+1 to +7) scales, *strongly disagree-strongly agree* (baseline: $r = .75$, $p < .01$, and follow-up: $r = .85$, $p < .01$). Behavioural intention was measured on a bipolar (-3 to +3) scale using two items: "I *intend* to increase my daily intake of fruit and vegetables in the next two months *strongly disagree-strongly agree*", and "I *want* to increase my daily intake of fruit and vegetables in the next two months *strongly disagree-strongly agree*". Again, reliability was high at baseline ($r = .74$, $p < .01$) and follow-up ($r = .77$, $p < .01$).

3.3.6.2 Fruit and Vegetable Intake

Fruit intake and vegetable intake were assessed on two measures; single-item and FFQ, which are described in the following Section.

3.3.6.2.1 Single-item Measures

Participants were required to report their daily fruit and vegetable intake using the following open-ended items: "Over the past week, how many portions of fruit have you eaten on average per day?" and "Over the past week, how many portions of vegetables have you eaten on average per day?" each followed by a blank space to write the answer.

3.3.6.2.2 FFQ Measure

Second, participants completed a FFQ by recording their average consumption of 80g servings of common fruits and vegetables. Because a limitation of Chapter 2 was the discrepancy between the one-year recall period of the FFQ and the 6-month follow-up interval, the recall period was changed from 1 year to 2 months, to correspond with the time frame of the present study (see Section 2.5.4).

The FFQ measure of fruit and vegetables was a section taken from an epidemiological instrument originally developed and validated for EPIC (Bingham et al., 1994; McKeown et al., 2001). Frequency measures were presented as a checklist with 9 response options: *"Never or less than once per month"*, *"1-3 per month"*, *"1 per week"*, *"2-4 per week"*, *"5-6 per week"*, *"1 per day"*, *"2-3 per day"*, *"4-5 per day"* and *"6 or more per day"*. Total daily frequencies of consumption of fruit and vegetables (thirty one items) were calculated from the questionnaire by summing consumption rate per month for each item, and dividing by 30. Frequencies for two items labelled "peaches, plums, apricots" and "strawberries, raspberries, kiwi fruit" were divided into three to adjust for seasonal variability; this was necessary to avoid overrepresentation of use, because participants had been asked to estimate their use of these fruits specifically when in season. Following the recommendation of previous research, six items were excluded from the calculation (see Gibson et al., 1998). "Tinned fruit" was excluded because it is a non-specific fruit item that was listed after the other individual fruits, therefore there was a risk that the duplication of estimated fruit could have occurred. The additional five items were excluded from the calculation because of peculiarities of use, for example they are associated with ingredients rather than whole portions; they are not standard fruits or vegetable items per se, or again because of risk of duplication. These items were "onions", "garlic", "coleslaw", "tofu, Soya meat, TVP, vegeburger" and "dried lentils, beans, peas".

3.4 Results

3.4.1 Representativeness Check

Means and standard deviations for all variables are presented in Table 3.1. The single-item measures showed that the present sample had a mean daily portion fruit intake of 1.72 (*SD* = 1.01) and a mean daily vegetable intake of 1.83 (*SD* = 1.06), resulting in a total fruit and vegetable intake of 3.55 portions at baseline. This is comparable to the baseline total fruit and vegetable intake assessed by the single-item measure in Chapter 2 (3.57 daily portions, see Section 2.4.1) and data from the Health Survey of England (2001) who indicate a mean intake of 3.60 daily portions (Doyle & Horsfield, 2003). Also congruent with Chapter 2, the FFQ measure revealed higher levels of intake. On the FFQ, participants reported a mean daily intake of 2.05 (*SD* = 1.52) portions of fruit and 4.00 (*SD* = 2.34) portions of vegetables, resulting in a total daily fruit and vegetable intake of 6.05 portions. These figures are 0.33 daily portions higher than the single-item measure for fruit, and 2.17 daily portions higher than the single-item measure for vegetables. However, the single-item and FFQ measures were significantly correlated at baseline for both fruit (r = .64, p = .01) and vegetables (r = .57, p = .01), again suggesting that the results from the FFQ were considerably overestimated (see Section 3.5.2).

3.4.2 Attrition and Randomisation Check

MANOVA showed there were no significant differences between responders and non-responders on their fruit intake and vegetable intake measured by the single-item or FFQ, TPB variables or age, $F(9, 570) = 0.94$, $p = .49$, $\eta_p^2 = .02$. No statistically significant univariate tests were found. Chi-square showed no differences

between responders and nonresponders for gender, $\chi^2(1) = 2.31$, $p = .13$, or ethnicity, $\chi^2(1) = 2.04$, $p = .15$. Finally, no significant differences were found between drop-out rates for condition, $\chi^2(2) = 1.54$, $p = .46$.

The experimental and control conditions were then compared on fruit intake and vegetable intake assessed by the single-item and FFQ measures, TPB variables and age to check whether randomisation was achieved. MANOVA was nonsignificant, $F(9, 570) = 0.50$, $p = .81$, $\eta_p^2 = .01$, as were all univariate ANOVAs. Gender and ethnicity were tested using nonparametric tests, and again no significant differences were found, χ^2s (2) = 1.01 – 1.06, ps > .60. Together, these data suggest that prior to the implementation intention manipulations, participants in the experimental and control groups ate similar portions of fruit and vegetables per day, and were equally motivated to increasing their daily portions in the next two months (Table 3.1).

Table 3.1: ***Means and Standard Deviations for all Variables at all Time Points***

Condition	Time	SM Fruit Intake (portions per day)	SM Vegetable Intake (portions per day)	FFQ Fruit Intake (portions per day)	FFQ Vegetable Intake (portions per day)	Attitude	Subjective Norm	PBC	Intention
Control	**Baseline**	1.77	1.79	1.98	3.97	2.09	3.91	1.39	1.20
***M* (*SD*)**		(1.01)	(1.03)	(1.49)	(2.17)	(1.07)	(1.70)	(1.21)	(1.33)
	Follow-up	1.72	1.75	2.03	4.06	2.08	3.99	1.38	1.25
		(0.98)	(1.00)	(1.54)	(2.34)	(1.08)	(1.60)	(1.30)	(1.30)
Combined II	**Baseline**	1.69	1.84	2.07	3.89	2.15	4.02	1.49	1.28
***M* (*SD*)**		(1.02)	(1.16)	(1.47)	(2.49)	(1.05)	(1.85)	(1.35)	(1.38)
	Follow-up	2.14	1.90	2.17	3.81	2.08	4.10	1.40	1.29
		(1.03)	(1.06)	(1.76)	(2.41)	(1.21)	(1.68)	(1.32)	(1.42)
Separate IIs	**Baseline**	1.71	1.87	2.11	4.13	2.00	3.83	1.47	1.11
***M* (*SD*)**		(1.01)	(0.99)	(1.61)	(2.43)	(1.15)	(1.66)	(1.25)	(1.47)
	Follow-up	1.94	2.01	2.13	4.23	2.05	3.92	1.50	1.20
		(1.07)	(1.09)	(1.59)	(2.72)	(1.16)	(1.65)	(1.18)	(1.42)

Note: SM = Single-item Measure, II = Implementation Intention

3.4.3 Effects of the Implementation Intention Interventions

A series of between-persons ANCOVAs controlling for baseline measures were used to examine the effects of condition (control, combined implementation intention, and separate implementation intentions) on the dependent variables at follow-up. Simple planned contrasts were then used to clarify where differences between the three levels of the between-persons factor lay.

3.4.3.1 Motivation Manipulation Check

The initial analyses examined whether the manipulations had any effect on participants' motivation to increase their daily intake of fruit and vegetables over the course of the study. ANCOVAs controlling for baseline revealed no significant effects of condition for attitude, $F(2, 579) = 0.39$, $p = .68$, $\eta_p^2 < .01$; PBC, $F(2, 579) = 0.33$, $p = .72$, $\eta_p^2 < .01$; subjective norm, $F(2, 579) = 0.02$, $p = .98$, $\eta_p^2 < .01$, or intention, $F(2, 579) = 0.15$, $p = .83$, $\eta_p^2 < .01$. This provides evidence that motivation appears unaffected by the manipulations, and as such no changes in any of the TPB variables were demonstrated (Table 3.1).

3.4.3.2 Fruit Intake

3.4.3.2.1 Single-item Measure

The following analyses tested the effect of condition on the single-item measure of fruit intake over the two-month period. ANCOVA controlling for baseline fruit intake revealed a significant difference between groups at follow-up, $F(2, 579) = 20.60$, $p < .01$, $\eta_p^2 = .07$. Planned contrasts showed that participants in both the combined implementation intention group and the separate implementation intentions

group ate significantly more fruit than the control group at follow-up (*p*s < .01). However, contrary to the hypothesis, the fruit intake of the combined implementation intention condition was significantly higher than that of participants in the separate implementation intentions condition ($p < .01$), representing a 0.45 and a 0.23 daily portion increase from baseline to follow-up, respectively (Table 3.1 and Figure 3.2).

3.4.3.2.2 FFQ Measure

The analyses were repeated to test the effect of condition on the FFQ measure of fruit intake. In contrast to the single-item measure, ANCOVA controlling for baseline intake revealed no significant difference between conditions on FFQ follow-up fruit intake, $F(2,579) = 0.26$, $p = .77$, $\eta_p^2 < .01$.

3.4.3.3 Vegetable Intake

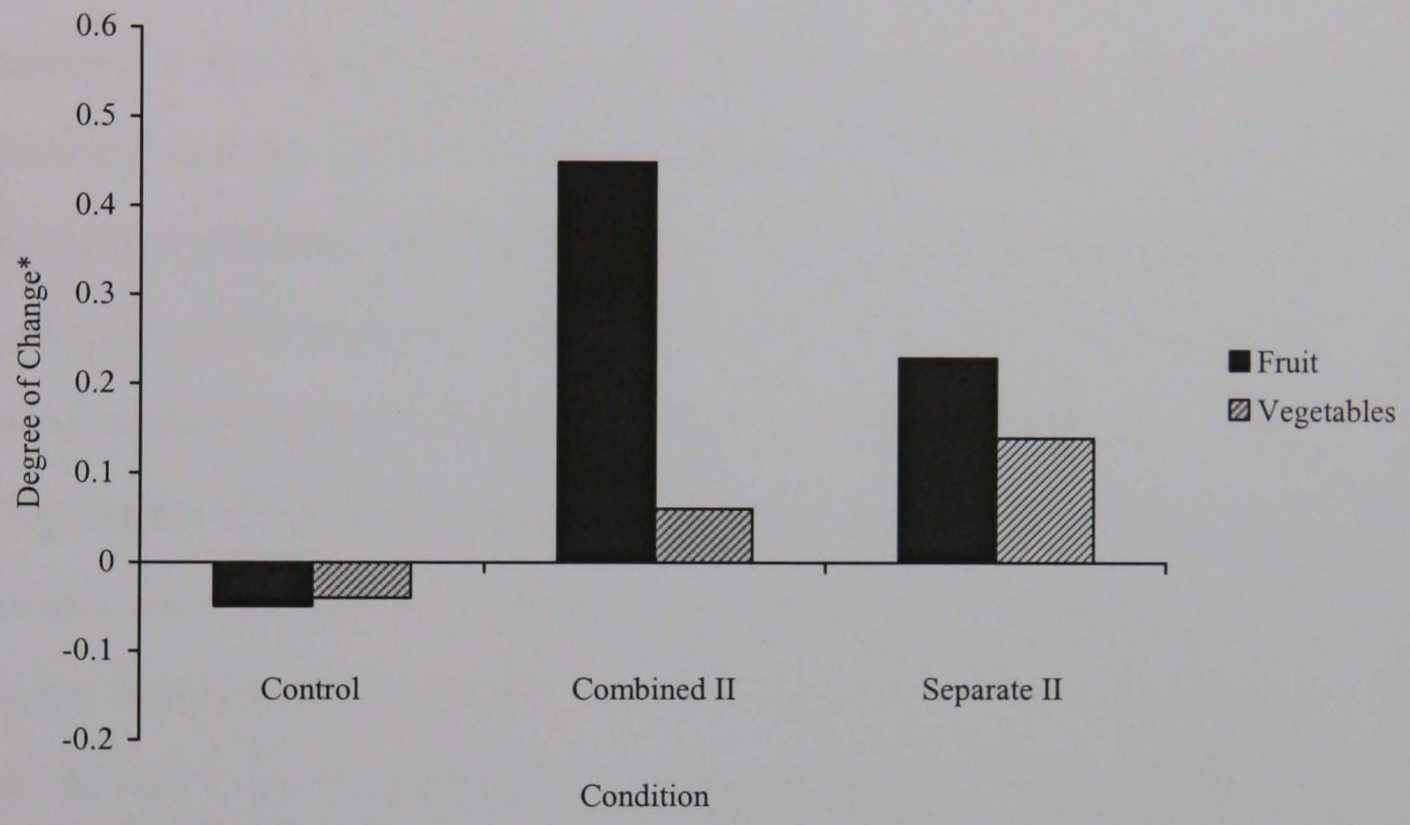
3.4.3.3.1 Single-item Measure

Differences between the conditions on single-item vegetable intake at follow-up were then tested using ANCOVA controlling for baseline. A significant difference was revealed, $F(2, 579) = 4.29$, $p = .01$, $\eta_p^2 = .02$. Planned contrasts showed that participants in the separate implementation intentions condition ate significantly more vegetables at follow-up than those in the control group ($p < .01$), representing an increase of 0.14 daily portions. No difference was found between the follow-up vegetable intake of the combined implementation intention and the control groups. Participants in the separate implementation intentions group also ate more portions of vegetables at follow-up than participants in the combined implementation intention group, but this difference failed to reach significance ($p = .24$) (Table 3.1 and Figure 3.2).

3.4.3.3.2 FFQ Measure

The analyses were again repeated to test the effect of condition on the FFQ measure. No significant difference between conditions on FFQ vegetable intake at follow-up was shown, $F(2,579) = 1.41$, $p = .32$, $\eta_p^2 = .01$.

Figure 3.2: *Effects of Experimental Conditions on Changes in Behaviour on Single-item Measure at Follow-up, Controlling for Baseline*



Note: *portions per day, II = Implementation Intention

3.4.4 Content Analysis of Implementation Intentions

The following Section presents analyses of the written content of the implementation intentions. The first set of analyses in Section 3.4.4.1 will focus on the behavioural strategies used in implementation intentions generated to increase fruit and vegetable intake, and the potential differences between them. The second set

of analyses in Section 3.4.4.2 explores the preferred type of implementation intention generated when participants are asked to increase intake as a combined food group.

3.4.4.1 What Types of Behavioural Strategy are Employed by Participants to Increase Fruit and Vegetable Intake?

The second aim of the study was to investigate the behavioural strategies used in implementation intentions to increase fruit intake and vegetable intake. Specifically, it was hypothesised that when forming fruit-increasing implementation intentions, a significantly higher number of participants would focus upon behavioural strategies geared towards the target goal of consumption. In contrast, it was predicted that when forming vegetable-increasing implementation intentions, a significantly higher number of participants would focus upon strategies geared towards achieving preparatory goals. This was addressed by calculating the number of participants who made implementation intentions containing target or preparatory strategies and comparing them within behaviours. A 'target strategy' was defined as one that focuses action on the actual consumption of the food (e.g. when, where or how the fruit would be consumed). An example of a target strategy is: "*If* it is breakfast time in the halls, *then* I will eat a banana!" The definition of a 'preparatory strategy' was taken from Kellar and Abraham (2005) and focused action on behaviours required to prepare the food for consumption (e.g. when, where or how the fruit would be purchased or prepared). An example of a preparatory strategy is: "*If* it is Monday evening, *then* I will prepare a fruit salad!" To avoid cross-contamination, the analyses presented in Section 3.4.4.1 were conducted on participants in the separate implementation intentions condition only (n = 200).

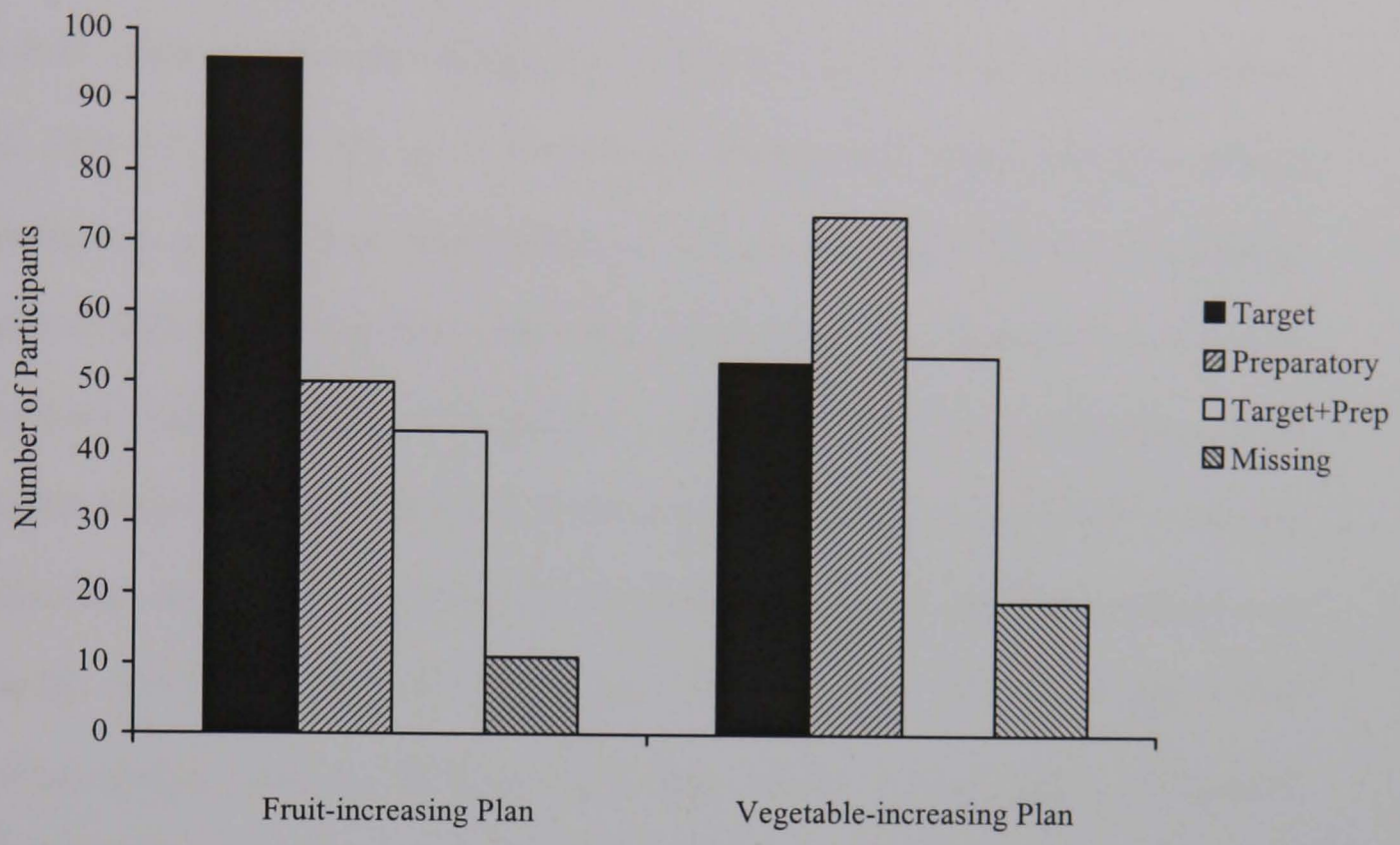
3.4.4.1.1 Behavioural Strategies used to Increase Fruit Intake

Content analysis revealed three types of behavioural strategy used in implementation intentions to increase fruit intake: target-focused (n = 96), preparatory-focused (n = 50) and a combination of target and preparatory strategies (n = 43). A further eleven participants did not fill in the implementation intention manipulation. Chi-square revealed that the number of participants using target strategies was significantly higher than the number of participants using preparatory strategies, $\chi^2(1) = 14.49$, $p < .01$, or any other type of strategy (ps < .01). This demonstrates that target-focused implementation intentions were the most popular choice for increasing fruit intake (Figure 3.3).

3.4.4.1.2 Behavioural Strategies used to Increase Vegetable Intake

The analysis was repeated on implementation intentions generated to increase vegetable intake. The implementation intentions of fifty three participants contained target-focused behavioural strategies; 74 used preparatory strategies, and 54 participants used a combination of target and preparatory strategies. A further nineteen participants did not fill in the implementation intention manipulation. The difference between the number of participants who made preparatory strategies and those who made target strategies was marginally significant, $\chi^2(1) = 3.47$, p =.06, as was the difference between the preparatory and target-and-preparatory strategies, $\chi^2(1) = 3.13$, p =.08; showing that preparatory plans were the most popular for increasing vegetable intake (Figure 3.3).

Figure 3.3: *Behavioural Strategies used in Implementation Intentions to Increase Fruit Intake and Vegetable Intake*



3.4.4.1.3 Which Type of Behavioural Strategy is Most Effective for Increasing Fruit and Vegetable Intake?

Supporting the hypotheses, the preceding analyses demonstrated that more participants generated target-focused behavioural strategies to increase fruit intake, and a higher number of participants chose preparatory-focused behavioural strategies to increase vegetable intake. The question then arises as to how these choices contributed to achieving the subsequent dietary goals. The following Section therefore tests the efficacy of behavioural strategy type, first for fruit and then for vegetable intake[8].

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[8] Because no effects of the manipulations were found for the FFQ, the remainder of the analyses in the present Chapter is conducted on the single-item measure of behaviour only.

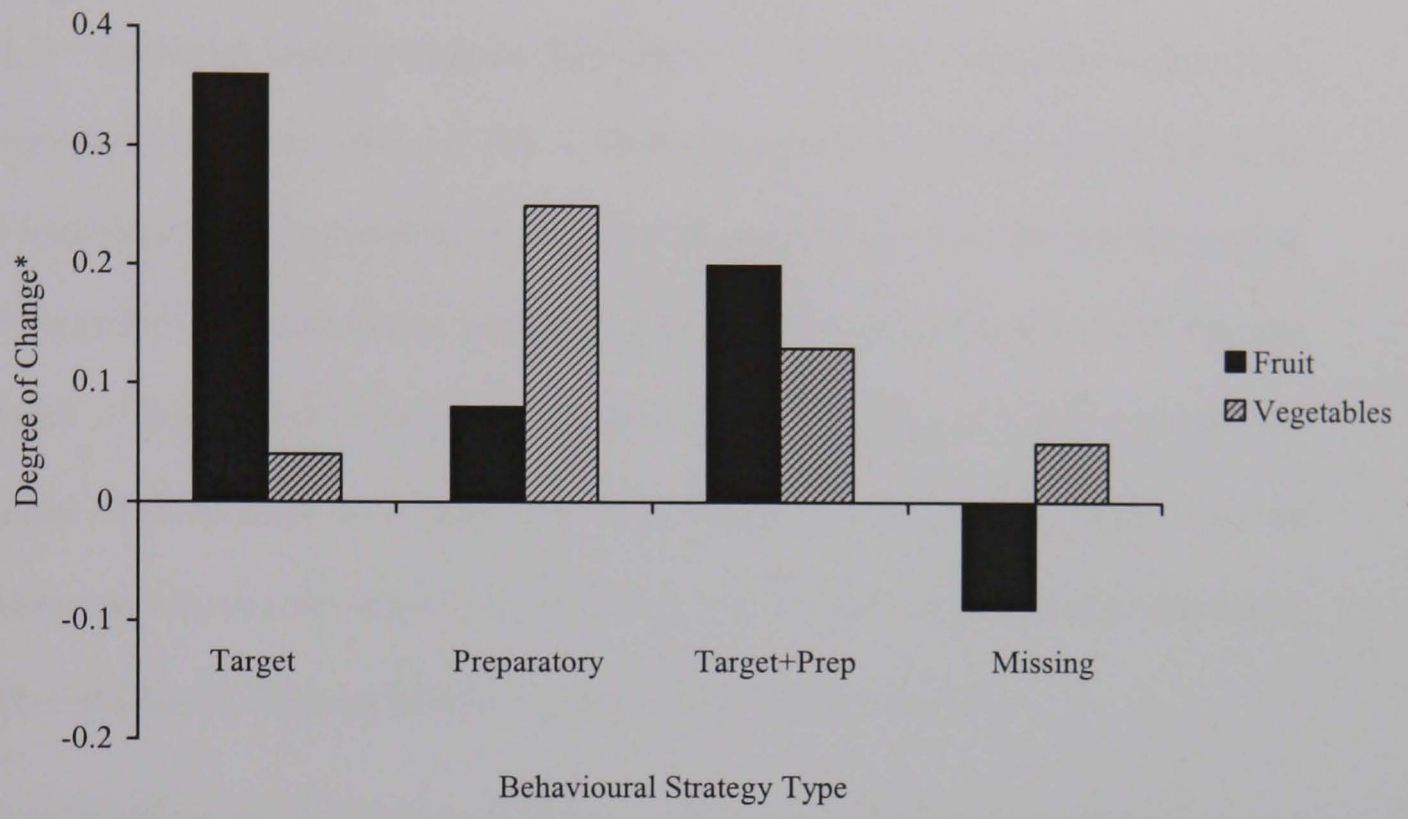
3.4.4.1.3.1 Fruit Intake

ANCOVA controlling for baseline fruit intake was used to examine the effect of behavioural strategy type (target, preparatory, target + preparatory, and missing) on fruit intake at follow-up. A significant difference between groups was revealed, $F(3, 199) = 3.13$, $p = .03$, $\eta_p^2 = .05$, and was broken down using planned contrasts. Participants who formed implementation intentions containing target strategies reported higher follow-up fruit intake than participants who formed implementation intentions using preparatory strategies ($p = .02$). Additionally, target strategies led to a higher follow-up fruit intake than missing implementation intentions ($p = .03$). No differences were found between the final fruit intakes of any other behavioural strategy type. Supporting the hypotheses, these analyses provide evidence that implementation intentions focusing on the target action of consumption had greater impact on actual fruit intake than those focusing on preparatory factors (Figure 3.4).

3.4.4.1.3.2 Vegetable Intake

The analyses were then repeated to examine the effect of behavioural strategy type (target, preparatory, target + preparatory, and missing) on vegetable intake at follow-up. However, although preparatory behavioural strategies had the greatest impact on behaviour, ANCOVA controlling for baseline showed that the difference in vegetable intake between groups at follow-up failed to reach significance, $F(3, 199) = 0.76$, $p = .52$, $\eta_p^2 = .01$ (Figure 3.4).

Figure 3.4: *Effects of Behavioural Strategy Type on Changes in Behaviour at Follow-up, Controlling for Baseline*



Note: *portions per day

3.4.4.2 What Type of Implementation Intentions were Generated by Participants in the Combined Implementation Intention Condition?

A third aim of the present study was to explore the type of implementation intention formed when participants were asked to increase fruit and vegetables as a combined food group. Specifically, it was hypothesised that participants would demonstrate a preference for generating implementation intentions to increase fruit intake over implementation intentions to increase vegetable intake. The remainder of the analyses were performed on participants randomised to the combined implementation intention condition only (n = 183).

3.4.4.2.1 Do Participants Follow Instructions to Increase both Fruit and Vegetables Combined?

To assess whether participants followed instructions to increase both fruit and vegetables together, the implementation intentions made in the combined condition were coded such that 1 = both (plan made to increase both fruit and vegetables, n = 70), 2 = fruit (plan made to increase fruit only, n = 66) and 3 = vegetables (plan made to increase vegetables only, n = 25). A further twenty two participants did not fill in the implementation intention manipulation. Chi-square tests revealed that the number of 'vegetable' implementation intentions generated were significantly lower than the number of 'both' plans to increase fruit and vegetables, $\chi^2(1) = 21.32$, $p < .01$ and the number of plans made to increase fruit only, $\chi^2(1) = 18.47$, $p < .01$. There were no differences between the number of 'both' and 'fruit' implementation intentions made, $\chi^2(1) = 0.12$, $p = .73$, therefore the hypothesis was partly supported.

3.4.4.2.2 Which Type of Implementation Intention is Most Effective for Increasing Intake?

The final set of analyses then assessed the impact of making fruit-only plans, vegetable-only plans, and plans to increase both fruit and vegetables on behaviour at follow-up.

3.4.4.2.2.1 Fruit Intake

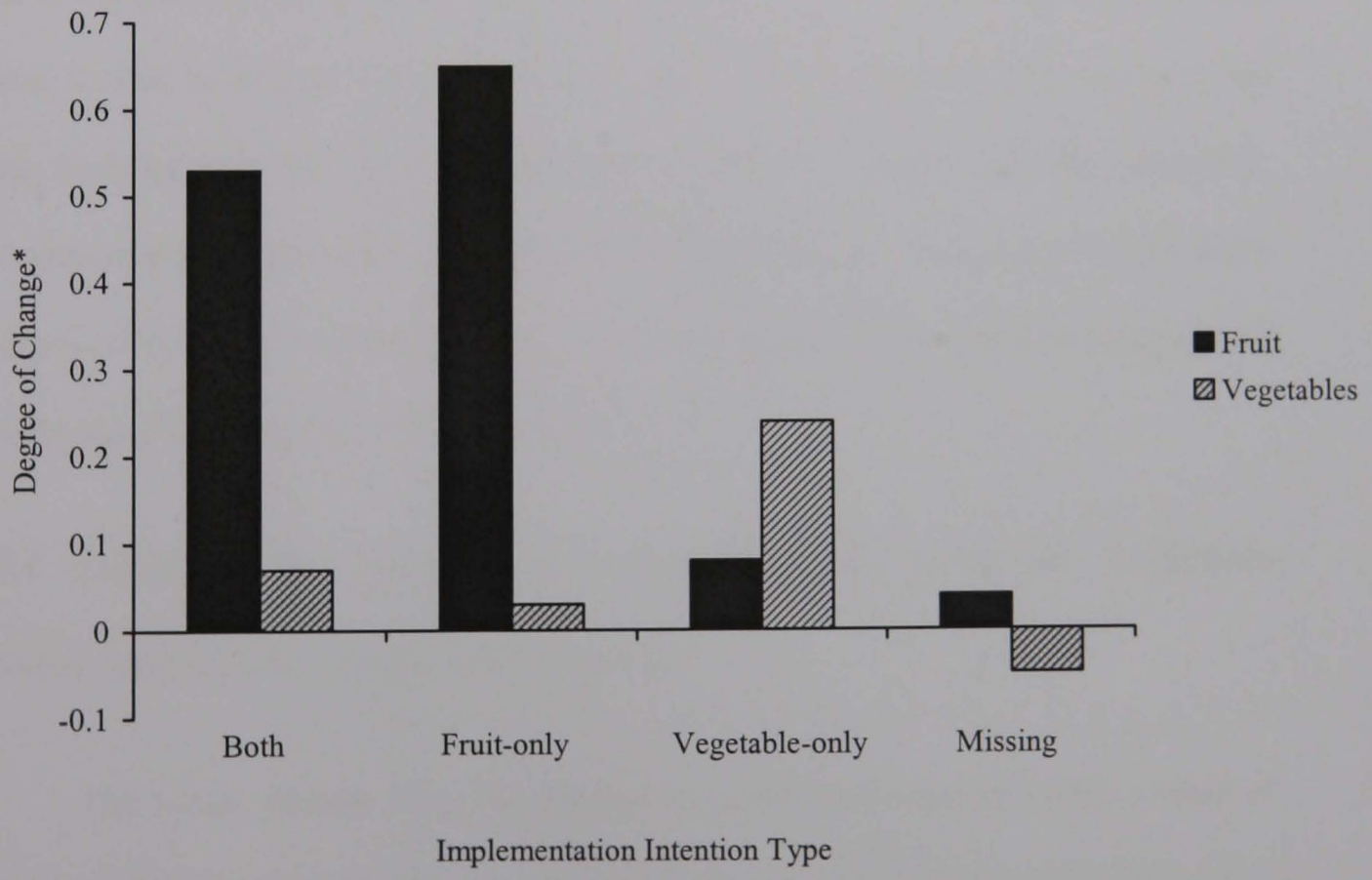
ANCOVA controlling for baseline fruit intake was used to examine the effect of implementation intention type (both, fruit, vegetables, and missing) on fruit intake. A significant difference was found between groups, $F(3, 182) = 3.79$, $p = .01$, $\eta_p^2 = .06$. Planned contrasts showed that participants who made plans to increase 'both' and 'fruit' ate significantly higher portions of fruit at follow-up than participants who did not fill in the implementation intention manipulation, (ps = .05 and .01, respectively). Participants who made 'fruit' plans also ate significantly higher portions of fruit at

follow-up than participants who made 'vegetable' plans (p = .01). No further differences between groups were found (ps > .11) (Figure 3.5).

3.4.4.2.2.2 Vegetable Intake

The analyses were then repeated to examine the effect of implementation intention type on vegetable intake at follow-up. However, although participants who generated implementation intentions to increase vegetables-only reported the highest intake at follow-up, ANCOVA controlling for baseline again revealed no significant difference between the groups, $F(3, 182) = 0.67$, $p = .57$, $\eta_p^2 = .01$ (Figure 3.5)[9].

Figure 3.5: *Effects of Implementation Intention Type on Changes in Behaviour at Follow-up, Controlling for Baseline*



Note: *portions per day

[9] Additional analyses were performed on the sub-group of participants in the combined implementation intention condition who made plans to increase both fruit and vegetables (n = 70), to assess which combination of implementation intention type worked best, e.g. 'target plan for fruit + preparatory plan for vegetables'. However no significant effects were found.

3.5 Discussion

The present study aimed to address the conceptual issue of changing both fruit and vegetable intake within a single intervention, by comparing the efficacy of an implementation intention combining the food groups with a manipulation containing two separate implementation intentions for each behaviour. The study also aimed to investigate the types of behavioural strategy used in the implementation intentions generated by participants to increase their intake, and their subsequent effect on fruit and vegetable intake. Finally, previous research suggests that consumers trying to change their fruit and vegetable intake as an aggregated food group show a marked preference for fruit (cf. Anderson et al., 1998). Therefore, the final aim of the study was to test whether participants followed implementation intention instructions when asked to plan to increase their combined intake. The following Section discusses the main findings from the single-item measure of behaviour and in line with Chapter 2, the contrasting findings from the FFQ. This is followed by a discussion of the content analysis of the implementation intentions and concludes with a general summary of results and directions for further research.

3.5.1 Effects of the Experimental Conditions on Fruit and Vegetable Intake, Assessed by Single-item Measure

The initial finding from the single-item measure is that the fruit intakes of participants randomised to both the combined and separate implementation intentions conditions were significantly higher than those of the control group after the two-month period. Participants in the combined implementation intention condition demonstrated a daily portion increase of 0.45 (d = .42) and participants in the separate

implementation intentions condition reported a 0.23 portion increase (d = .21). These are roughly comparable to the effect sizes found in previous work focusing on fruit (e.g. Armitage, 2007; Brug et al., 2006) and provide further evidence that implementation intentions are an effective means of increasing fruit intake. However, the hypothesis that the separate implementation intentions would result in a significantly higher increase than the combined implementation intention was not supported. Contrary to prediction, participants in the separate implementation intentions condition ate significantly less daily portions of fruit than the combined group at follow-up. This would suggest that for fruit consumption, asking participants to increase intake as a combined food group is a superior intervention strategy.

The findings from the single-item measure of vegetable intake showed a different pattern of results. Only participants in the separate implementation intentions condition reported eating a significantly higher amount of vegetables than the control group at follow-up, representing a small increase of 0.14 daily portions from baseline. Thus, some support is generated for the prediction that separate implementation intentions would be most successful in promoting vegetable consumption, although no differences were found between the vegetable intakes of the experimental groups at follow-up. It is noteworthy, however, that participants in the separate implementation intentions condition succeeded in increasing both fruit and vegetable intake over and above the control groups at follow-up, albeit by small amounts. In contrast, participants in the combined condition showed a high increase in fruit, but no change in vegetable intake. This is congruent with previous work suggesting that fruit is more amenable to change within a combined intervention (cf. Cox et al., 1998b), and speaks to the idea that being asked to plan the behaviours

separately is a promising means of prompting participants to think about the specific factors underpinning the consumption of both food groups.

However, the question remains as to why, contrary to prediction, the separate implementation intentions failed to increase fruit or vegetables over and above the combined intervention. First, it is possible that the length of the extra instructions introduced an element of response fatigue, suggesting that it would be advisable to reduce the length of the manipulation in future studies. Second, encouraging participants to form two implementation intentions in one sitting may have had some effect on the depth of encoding of each plan. Given that the degree of attention towards formulating one's plan is an important moderator of implementation intentions (cf. Sheeran et al., 2005a), it is feasible that forming multiple plans may inevitably lead to a reduction in the quality of attention afforded to each. The issue of encoding may also provide an alternative explanation of why participants in the separate condition showed a lesser effect for vegetables than fruit. As the instruction designed to promote vegetable intake came second, it could be that it was simply given less attention, and hence compromised the intervention effects. This is potentially important, as evidence for the ability of implementation intentions to increase vegetable intake is limited in comparison to fruit. Additional research is warranted to investigate these ideas further.

3.5.2 Null Findings of Effects of Implementation Intentions on Fruit and Vegetable Intake, Assessed by FFQ

In light of the findings from Chapter 2, the present study provided a second test of the FFQ that used a recall period of two months, which corresponded with the time frame of the follow-up. However, adjusting the recall period had no beneficial

impact, and as such, the findings from the single-item measure were not replicated when assessed by the FFQ. Again, the FFQ baseline intake of fruit and vegetables was higher than those of the single-item measure; by 16% for fruit intake and 54% for vegetable intake. This is directly comparable to previous research suggesting that FFQ results are likely to be considerably overestimated, particularly for vegetable intake (cf. Bingham et al., 1994; Krebs-Smith et al., 1995; see Chapter 2, Section 2.5.4). As the present Chapter rules out the possibility that the lack of findings could be related to a discrepancy between time intervals, it is likely that the overall FFQ results have been biased by a greater tendency to exaggerate intakes, as suggested by Cox et al. (1998b) and Gibson et al. (1998). The present findings are therefore equivalent to De Nooijer et al. (2006), who reported implementation intention effects for the single-item measure of behaviour only (see Section 1.6). As De Nooijer et al. did not report the mean values from their FFQ measure, comparison across studies cannot be made. However, given that the findings of both the current and preceding Chapters correspond with those reported by De Nooijer et al., it would appear that the FFQ may not be the optimal method for accurately measuring fruit and vegetable intake.

3.5.3 Content Analysis of Behavioural Strategies

As hypothesised, analysis of the written content of the plans in the separate implementation intentions condition showed that a significantly higher number of participants chose behavioural strategies aimed at the target action of consumption for increasing their fruit intake. This strategy was also found to be the most effective for increasing fruit intake, suggesting that preparatory factors such as acquisition and

meal planning did not feature highly as barriers to fruit consumption[10]. When making plans to increase vegetable intake however, a higher number of participants selected behavioural strategies focusing on preparatory actions, providing support for earlier work suggesting that these are instrumental in facilitating the consumption of vegetables in particular (e.g. Kellar & Abraham, 2005). However, actual vegetable consumption was not significantly improved by making implementation intentions containing preparatory strategies, although findings revealed a trend in this direction. One explanation for this may be that the overall increase in vegetable intake was small in comparison to fruit intake, making subtle differences between groups more difficult to determine. More research is required to extend these preliminary findings and generate more solid conclusions.

3.5.4 Content Analysis of Implementation Intention Choice in Combined Implementation Intention Condition

The final finding from the content analyses was that when asked to increase both fruit and vegetable intake in a combined implementation intention, only 38% of participants followed these instructions. A further 36% of participants chose to make implementation intentions to increase only their fruit intake; 14% made implementation intentions to increase their vegetable intake only, and 12% did not fill in the implementation intention. This partly supports the prediction that participants would favour fruit-only plans, and therefore fail to follow instructions (cf. Anderson et al., 1998). The subsequent analyses of behavioural impact showed that, perhaps

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[10] An additional point of interest that 'target' strategies were more beneficial for increasing fruit than either 'preparatory' *or* 'target + preparatory' strategies; the combination of two implementation intentions that included a target plan. This finding adds further weight to the suggestion that forming two implementation intentions in one sitting may introduce a fatiguing effect or compromise the depth of encoding (see Section 3.5.1).

unsurprisingly, 'both' and 'fruit' plans were more effective in increasing fruit intake than 'vegetable' or 'missing' plans. For vegetable intake, no significant difference was found between groups, although again the trend was towards a greater impact for participants who made implementation intentions to increase their vegetable intake only (see Section 3.5.3). Importantly, however, these findings demonstrate that participants who made implementation intentions to increase both behaviours showed an actual change in fruit intake, but not vegetable intake (see Figure 3.5). This provides further evidence that vegetable intake is less amenable to change (cf. Cox et al., 1998b), and suggests that combined implementation intention interventions may generate an increase in fruit intake only.

3.5.5 Motivation Manipulation Check

As in Chapter 2, TPB variables were used to control for the potential effects of motivation. However, no differences in motivation were found between groups at follow-up. Therefore, the reported changes in fruit and vegetable intake cannot be explained by a change in motivation as indexed by the TPB, which again offers support for the genuine effects of implementation intentions on behaviour (see Section 1.5.3.1).

3.5.6 Control Condition

Finally, Chapter 2 compared a passive control condition with an active control condition, which encouraged participants to increase their fruit and vegetable intake. The active control condition did not lead to a change in behaviour, and as such was used as the control condition in the present Chapter. Again, no change in either fruit or vegetable intake was demonstrated by the participants in this group, providing

further evidence that actively encouraging participants to make a behavioural change does not account for implementation intention effects (see Section 1.6.3.4 and Section 2.5.3.1).

3.6 Chapter Summary

In summary, the present Chapter provides a test of two implementation intention interventions to increase fruit and vegetable intake. The comparison of combined and separate implementation intentions showed that the combined intervention was successful in increasing fruit intake but not vegetable intake, whereas the separate intervention demonstrated a small but significant increase in both behaviours. This suggests that applying separate implementation intentions may be a promising means of simultaneously increasing intake. The present Chapter also generated preliminary empirical support for earlier suggestions that the cognitions underpinning fruit consumption may be different from those underpinning vegetable consumption (e.g. Armitage, 2007; Trudeau et al., 1998). Content analysis of the behavioural strategies made in implementation intentions to increase fruit show that target actions were most popular and most effective in changing behaviour, whilst preparatory strategies were preferred for vegetable intake, although these were not found to be significantly more effective than other strategies. In support of previous work, the current Chapter also found that generally, participants demonstrated a preference for targeting fruit when attempting to change their combined fruit and vegetable consumption, and also that implementation intentions made to increase fruit were the most effective.

3.7 The Next Step

Taken together, the summary of findings outlined above present an argument for a conceptual distinction between fruit and vegetables, which should be reflected in future implementation intention studies. Specifically, encouraging participants to consider separately the specific strategies that influence the consumption of both food groups may warrant further investigation. However, one possible limitation of the separate implementation intentions condition in the present study was that asking participants to form one implementation intention for fruit and one implementation intention for vegetables at the same time may have affected encoding, or been fatiguing in some way. The following Chapter therefore presents an additional test of implementation intentions on fruit intake and vegetable intake, extending the present study by assessing separate interventions rather than separate instructions within the same intervention.

Chapter 4 - A Comparison of Separate Implementation Intention Interventions to Increase Fruit and Vegetables

4.1 Abstract

The present study investigates whether the impact of implementation intentions on fruit and vegetable intake can be improved by applying separate interventions for each food group. Participants (N = 727) completed measures of motivation and behaviour at baseline before being randomised to one of four conditions (fruit control; fruit implementation intention; vegetable control; vegetable implementation intention) in a mixed design. At two months' follow-up, ITT analyses revealed that: (1) the fruit intake of participants randomised to the fruit implementation intention condition had increased significantly over the control groups; but (2) contrary to the hypothesis, no significant differences were detected between conditions for vegetable intake. Analysis of the written content of the implementation intentions generated by participants in the fruit and vegetable conditions confirmed that: (3) behavioural strategies focusing on the target action of consumption were the most popular and efficacious approach to increasing fruit intake, but (4) no differences were found in the types of behavioural strategies made by participants to increase vegetable intake, or in the subsequent impact on behaviour.

4.2 Introduction - Extending the Findings of Chapter 3

The focus of the present Chapter is to extend the findings of Chapter 3 and address the issues arising from this work. To reiterate, Chapter 3 presented results from a comparison of two interventions; an implementation intention to increase fruit and vegetables as a combined food group, and an intervention containing two implementation intention instructions to increase fruit and vegetables separately. Findings suggested that although separate implementation intentions may be a useful way to encourage simultaneous increases in both fruit intake and vegetable intake over and above controls, changes in behaviour were significantly smaller than expected in comparison with the combined intervention group. This may be due to an element of response fatigue or a reduction in the depth of encoding due to the additional length of the manipulations in the separate intervention. Given that the implementation intention instruction to promote vegetable intake was situated after fruit, it is also possible that less attention was given to plans to increase vegetable consumption. This is problematic, as evidence for the impact of implementation intentions on vegetable intake alone has been demonstrated in just one published study to date (Kellar & Abraham, 2005).

4.2.1 Aims and Hypotheses

The first aim of the present study was to address the limitations arising from the test of separate implementation intention instructions reported in Chapter 3. To reduce the potential for response fatigue and attentional bias, two separate tests of implementation intentions on fruit intake and vegetable intake are assessed. The second aim of the study was to replicate Chapter 3's content analyses of behavioural strategies, and compare findings across Chapters in order to further elucidate the underpinnings of successful plan formation.

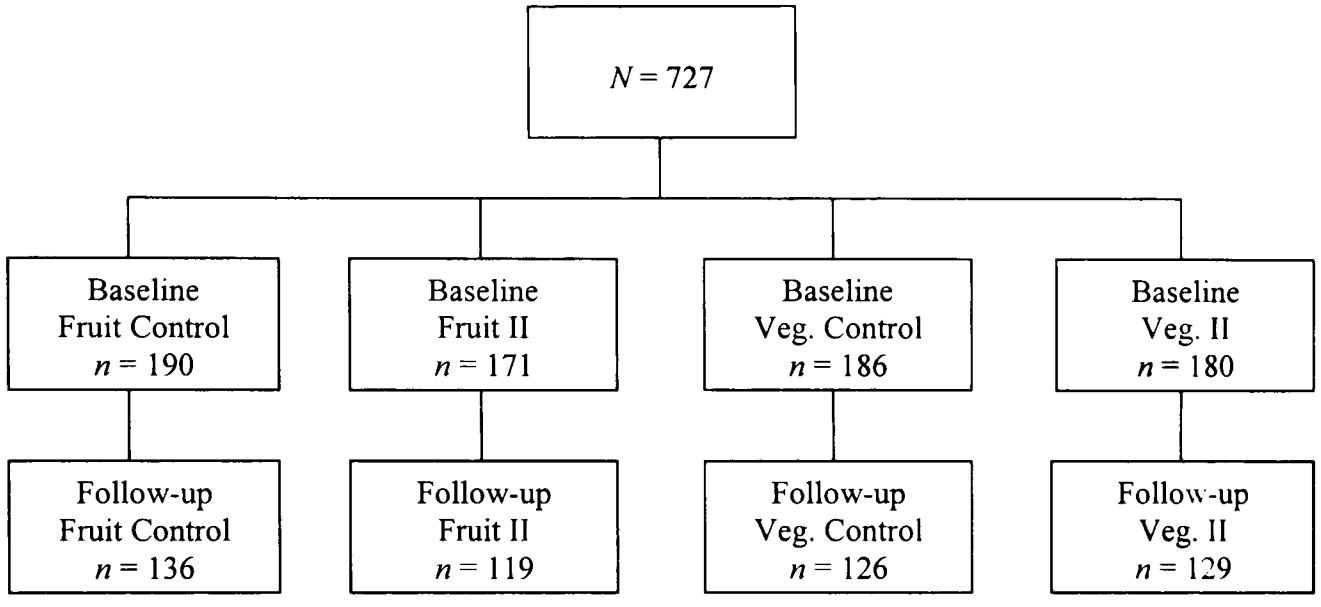
As in Chapter 3, the hypotheses were as follows: (1) the fruit implementation intention would engender a significantly higher increase in fruit intake than any other condition at follow-up; (2) the vegetable implementation intention would engender a significantly higher increase in vegetable intake than any other condition at follow-up; (3) a higher number of participants would generate target behavioural strategies than preparatory behavioural strategies to increase fruit intake, and these would be most effective; and (4) a higher number of participants would generate preparatory behavioural strategies than target behavioural strategies to increase vegetable intake, and these would be most effective in changing vegetable consumption.

4.3 Method

4.3.1 Participants

The sample comprised students from a UK university. Seven hundred and twenty seven online questionnaires were completed at baseline. Five hundred and ten participants completed a follow-up online questionnaire two months later, with a response rate of 70%. The age of the sample ranged from 18 - 37 years (M = 20.70, SD = 3.05), 73% were female (n = 531), and 86% were White (n = 625). The people who dropped out were treated as no-changers, and analysed on an ITT basis (Figure 4.1).

Figure 4.1: *Diagram of Participant Progress through the Phases of the Experiment*



Note: II = Implementation Intention

4.3.2 Design and Procedure

A randomised controlled design was used with one between-persons factor of *condition*, which had four levels: (1) fruit control; (2) fruit implementation intention; (3) vegetable control, and (4) vegetable implementation intention. All dependent measures (fruit intake, vegetable intake and TPB variables) were taken at baseline and two months' follow-up (Figure 4.1).

At baseline, undergraduate students were invited via group list email to participate voluntarily in a study of 'dietary habits'. The email contained a link to an online questionnaire, which randomly allocated participants to one of the four conditions. Participants were then contacted again for follow-up in two months' time via their individual email address, which they were asked to provide at baseline if they wished to continue with the study. In the follow-up email, a link was provided to a second online questionnaire. Although participants were asked to provide their university email address, confidentiality was preserved as the addresses consisted of a

series of letters and numbers (representing the course code, start year of degree, and initials), rather than the student's full name. Participants were informed that participation was voluntary and that they were free to withdraw their data at any point.

4.3.3 Questionnaire Content

Baseline and follow-up questionnaires began with a detailed section regarding what constitutes a portion of fruit and what constitutes a portion of vegetables. This was closely based on the UK DoH guide to the size of a portion of 5 A Day (DoH, 2008). Examples of fruit portions given were: 2 plums, 1 apple; examples of vegetable portions were: 2 broccoli spears, 3 heaped tablespoons of peas. This was followed by TPB items, a measure of fruit intake, a measure of vegetable intake, and the intervention manipulations where relevant. These are described in the following Sections.

4.3.4 Manipulations

4.3.4.1 Fruit Implementation Intention

The implementation intention manipulations were based closely on those used in previous two Chapters. Participants randomised to the fruit implementation intention condition were presented with the following phrase: "We would like you to increase your daily intake of fruit over the next two months. Research has shown that planning is more effective if you first identify a situation, then decide what you will do in that situation. For example, you might find it useful to state: "If it is lunchtime at university... then I will eat an apple instead of crisps!" Alternatively, you could choose to focus on planning where to buy fruit or when and how you will prepare it.

Take your time to think of strategies personal to you. Please write your plans in the space provided, following the format in the example ("if...then...")". This was followed by a space for the participants to formulate their own self-generated plans. These instructions were devised to encourage formation of plans in a specific if-then format (cf. Chapman et al., in press), and suggested the preparatory actions of acquisition and meal planning as ways to promote consumption (cf. Kellar and Abraham, 2005). The line "Take your time to think of strategies personal to you" was added to encourage thoughtful and personal plan formation.

4.3.4.2 Vegetable Implementation Intention

The instructions for the vegetable implementation intention condition were designed to be as similar as possible to the instructions outlined in Section 4.3.4.1, but with a different example given. The manipulation was as follows: "We would like you to increase your daily intake of vegetables over the next two months. Research has shown that planning is more effective if you first identify a situation, then decide what you will do in that situation. For example, you might find it useful to state: "If it is lunchtime at university... then I will choose a salad instead of chips!" Alternatively, you could choose to focus on planning where to buy vegetables or when and how you will prepare them. Take your time to think of strategies personal to you. Please write your plans in the space provided, following the format in the example ("if...then...")". This was followed by a space for the participants to formulate their own self-generated plans.

4.3.4.3 Fruit Control

Participants randomised to the fruit control condition received a brief statement designed to encourage them to increase their fruit consumption in the next

two months: "We would like you to increase your daily intake of fruit in the next two months." This is a similar phrase to those applied in the active control condition in Chapter 2 (see Section 2.3.5.1) and the control condition in Chapter 3 (see Section 3.3.5.1), and was used as a final check to assess the potential effect of encouraging participants to perform the behaviour.

4.3.4.4 Vegetable Control

Participants randomised to the vegetable control condition were presented with the same statement as the fruit control, but with the word 'fruit' substituted for 'vegetables'. The statement was: "We would like you to increase your daily intake of vegetables in the next two months."

4.3.5 Measures

4.3.5.1 Theory of Planned Behaviour

In line with previous implementation intention studies and the previous two Chapters, TPB variables were used to control for the effects of motivation (see Armitage, 2004), and because it has been shown to provide a good account of the factors underpinning motivation (Armitage & Conner, 2001). For the measure of attitude, participants were presented with the stem: "For me, increasing my daily intake of fruit and vegetables in the next two months is..." which was rated on two bipolar (-3 to +3) semantic difference scales, anchored by *bad-good*, and *negative-positive*. Reliability was good at baseline ($r = .74$, $p < .01$) and follow-up ($r = .73$, $p < .01$). PBC was measured using two items measured on bipolar (-3 to +3) scales: "How much personal control do you feel you have over increasing your daily intake of fruit and vegetables in the next two months? *no control-complete control*", and

"How confident are you that you will be able to increase your daily intake of fruit and vegetables in the next two months? *not very confident-very confident*" (r = .70, p < .01 at baseline, and r = .74, p < .01 at follow-up). Subjective norm was operationalised using two items: "Most people who are important to me think I should increase my daily intake of fruit and vegetables in the next two months", and "Most people in my social network would approve of my increasing my daily intake of fruit and vegetables in the next two months". These were measured by averaging responses made on unipolar (+1 to +7) scales, *strongly disagree-strongly agree* (baseline: r = .85, p < .01, and follow-up: r = .86, p < .01). Behavioural intention was measured on a bipolar (-3 to +3) scale using two items: "I *intend* to increase my daily intake of fruit and vegetables in the next two months *strongly disagree-strongly agree*", and "I *want* to increase my daily intake of fruit and vegetables in the next two months *strongly disagree-strongly agree*". Again, reliability was high at baseline (r = .77, p < .01) and follow-up (r = .79, p < .01).

4.3.5.2 Fruit and Vegetable Intake

Participants were required to report their daily fruit and vegetable intake using the following open-ended items: "Over the past week, how many portions of fruit have you eaten on average per day?" and "Over the past week, how many portions of vegetables have you eaten on average per day?" each followed by a blank space to write the answer[11].

4.4 Results

[11] Due to the null findings from the FFQ measure in Chapters 2 and 3, no further effects were anticipated. Therefore, only single-item measures of behaviour were used in the present Chapter and Chapter 5 (see Section 3.5.2 for discussion).

4.4.1 Representativeness Check and Attrition Bias

Means and standard deviations for all variables are presented in Table 4.1. The present sample had a mean total fruit and vegetable intake of 3.73 portions at baseline (1.82 portions of fruit and 1.91 portions of vegetables), which is comparable to data from the Health Survey of England (2001) who indicate a mean intake of 3.60 daily portions (Doyle & Horsfield, 2003).

To check attrition biases, the pretest responses (TPB variables, fruit intake, vegetable intake and age) of follow-up responders were compared with nonresponders using MANOVA. The multivariate test was nonsignificant, $F(7, 719) = 0.52$, $p = .82$, $\eta_p^2 = .01$, as were all univariate tests. Possible differences between responders and nonresponders on gender and ethnicity were tested using nonparametric tests, both of which were nonsignificant, $\chi^2(1) = 1.99$, $p = .16$ and $\chi^2(1) = 1.85$, $p = .17$, respectively. Additionally, no significant differences were found between drop-out rates by condition, $\chi^2(3) = 0.92$, $p = .82$, demonstrating there were no differences between responders and nonresponders.

4.4.2 Randomisation Check

The experimental and control conditions were then compared on fruit intake, vegetable intake, TPB variables and age to check whether randomisation was achieved. MANOVA was nonsignificant, $F(7, 719) = 0.95$, $p = .47$, $\eta_p^2 = .01$, as were all univariate ANOVAs. Gender and ethnicity were tested using nonparametric tests, and again no significant differences were found, $\chi^2(3) = 2.56$, $p = .46$, and $\chi^2(3) = 3.01$, $p = .39$, respectively. Together, these data suggest that prior to the implementation intention manipulations, participants in the experimental and control

groups ate similar portions of fruit and vegetables per day, and were equally motivated to increasing fruit and vegetable intake over two months (Table 4.1).

Table 4.1: *Means and Standard Deviations for all Variables at all Time Points*

Condition	Time	Fruit Intake (portions per day)	Vegetable Intake (portions per day)	Attitude	Subjective Norm	PBC	Intention
Fruit Control	**Baseline**	1.78	1.97	2.11	3.75	1.52	1.00
***M* (*SD*)**		(1.05)	(1.04)	(1.12)	(1.66)	(1.71)	(1.54)
	Follow-up	1.84	1.94	2.10	3.79	1.43	1.04
		(1.04)	(1.13)	(1.03)	(1.61)	(1.16)	(1.50)
Fruit II	**Baseline**	1.80	1.87	2.00	3.64	1.44	1.08
***M* (*SD*)**		(1.02)	(1.16)	(1.23)	(1.77)	(1.21)	(1.58)
	Follow-up	2.36	1.91	2.03	3.76	1.40	1.05
		(1.11)	(1.12)	(1.17)	(1.65)	(1.31)	(1.51)
Vegetable Control	**Baseline**	1.87	1.88	2.10	3.76	1.47	1.10
***M* (*SD*)**		(1.31)	(1.04)	(1.03)	(1.89)	(1.74)	(1.44)
	Follow-up	1.83	1.85	1.97	3.83	1.38	1.08
		(1.06)	(1.01)	(1.16)	(1.77)	(1.14)	(1.46)
Vegetable II	**Baseline**	1.82	1.93	2.20	3.82	1.48	1.13
***M* (*SD*)**		(0.98)	(1.05)	(1.04)	(1.75)	(1.15)	(1.55)
	Follow-up	1.93	2.07	2.12	3.85	1.58	1.21
		(1.09)	(1.24)	(1.13)	(1.58)	(1.09)	(1.50)

Note: II = Implementation Intention

4.4.3 Effects of the Implementation Intention Interventions

A series of between-persons ANCOVAs controlling for baseline measures were used to examine the effects of condition (fruit control, fruit implementation intention, vegetable control, and vegetable implementation intention) on the dependent variables at follow-up. Planned contrasts were then used to clarify where differences between the four levels of the between-persons factor lay.

4.4.3.1 Motivation Manipulation Check

The initial analysis examined whether the manipulations had any effect on participants' motivation to increase their daily intake of fruit or vegetables over the course of the study. ANCOVAs controlling for baseline revealed no significant effects of condition for attitude, $F(3, 726) = 1.17$, $p = .32$, $\eta_p^2 = .01$; PBC, $F(3, 726) = 1.76$, $p = .15$, $\eta_p^2 = .01$; subjective norm, $F(3, 726) = 0.07$, $p = .98$, $\eta_p^2 < .01$, or intention, $F(3, 726) = 0.52$, $p = .67$, $\eta_p^2 < .01$, suggesting that the manipulations did not affect motivation to perform the behaviour (Table 4.1).

4.4.3.2 Fruit Intake

The second analysis tested the effects of condition on fruit intake over the two-month period. ANCOVA controlling for baseline fruit intake showed significant differences between groups in fruit intake at follow-up, $F(3, 726) = 18.33$, $p < .01$, $\eta_p^2 < .07$. As predicted, planned contrasts revealed that participants in the fruit implementation intention condition ate significantly higher daily portions of fruit than in all the other groups at follow-up ($ps < .01$), and increased by 0.56 portions from baseline to follow-up. However, it was also demonstrated that participants in the vegetable implementation intention group reported marginally significantly higher

portions of fruit at follow-up than the vegetable control condition (p = .08), representing an increase of 0.11 daily portions[12]. No other differences between groups were found (Table 4.1 and Figure 4.2).

4.4.3.3 Vegetable Intake

The potential effects of the interventions on follow-up vegetable intake were then examined. ANCOVA controlling for baseline intake revealed no significant difference in vegetable between groups at follow-up, $F(3, 726) = 1.65$, $p = .18$, $\eta_p^2 = .01$, suggesting that vegetable intake had not changed significantly over the course of the study (Table 4.1 and Figure 4.2).

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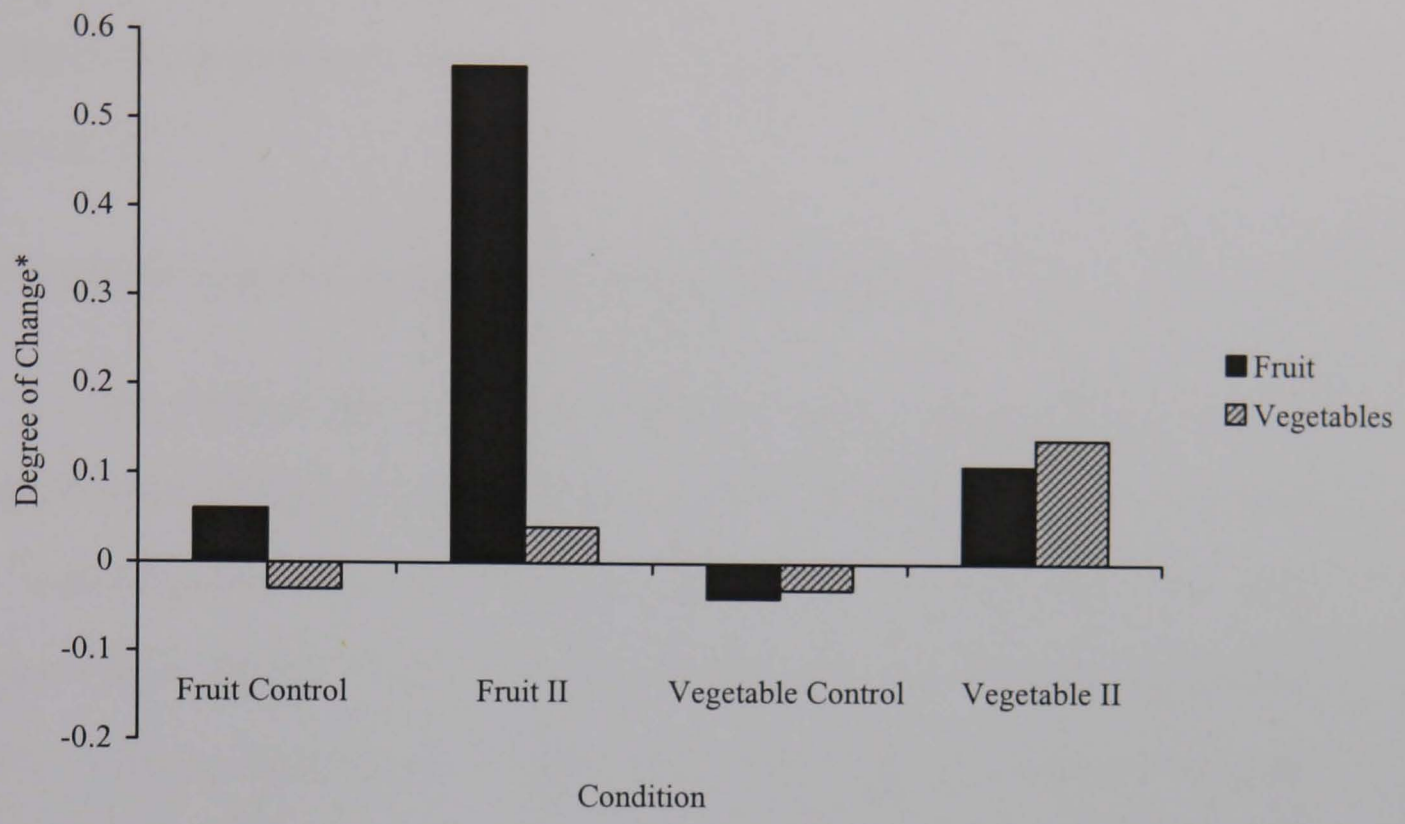
[12] Due to this finding, the implementation intentions of participants in the vegetable implementation intention condition were checked to determine whether plans had been made to increase fruit. However, only two plans to increase combined fruit and vegetables were found and the rest were targeted at vegetable intake as expected.

Figure 4.2: *Effects of Experimental Conditions on Changes in Behaviour at Follow-up, Controlling for Baseline*



Note: II = *portions per day, II = Implementation Intention

4.4.4 Content Analysis of Implementation Intentions

The following Section replicates the content analysis of behavioural strategies reported in Chapter 3 (Section 3.4.4.1). Congruent with Chapter 3, the present study hypothesised that a significantly higher number of participants would focus upon behavioural strategies geared towards the target goal of consumption to increase fruit intake, and strategies geared towards preparatory goals to increase vegetable intake. This was addressed by counting the number of participants who made implementation intentions containing target or preparatory strategies and comparing them within behaviours. A 'target strategy' was defined as one that focuses action on the actual consumption of the food (e.g. when, where or how the fruit would be consumed). An example of a target strategy is: "*If* it is breakfast time in the halls, *then* I will eat a

banana!" The definition of the 'preparatory strategy' was taken from Kellar and Abraham (2005) and focused action on behaviours required to prepare the food for consumption (e.g. when, where or how the fruit would be purchased or prepared). An example of a preparatory strategy is: "*If* it is Monday evening, *then* I will prepare a fruit salad!"

4.4.4.1 Behavioural Strategies used to Increase Fruit Intake

One hundred and seventeen participants were randomised to the fruit implementation intention condition. Three types of behavioural strategies were used in implementation intentions to increase fruit intake: target-focused (n = 87), preparatory-focused (n = 28) and a combination of target and preparatory strategies (n = 31). A further twenty five participants did not fill in the implementation intention manipulation. Chi-square revealed that the number of participants using target strategies was significantly higher than the number of participants using preparatory strategies, $\chi^2(1) = 30.27$, $p < .01$, or any other type of strategy, ($ps < .01$), again demonstrating that target-focused implementation intentions were the most popular choice for increasing fruit intake (Figure 4.3).

4.4.4.2 Behavioural Strategies used to Increase Vegetable Intake

The analysis was repeated on the one hundred and eighty participants who were randomised to the vegetable implementation intentions group. Target-focused behavioural strategies were used in the implementation intentions of sixty two participants; 73 used preparatory strategies, and 21 participants used a combination of target and preparatory strategies. A further twenty four participants did not fill in the implementation intention manipulation. Chi-square revealed that the number of

participants using preparatory strategies was significantly higher than the number of participants using target-and-preparatory strategies, $\chi^2(1) = 28.77$, $p < .01$, and those who did not fill in the manipulation, $\chi^2(1) = 24.75$, $p < .01$. However, contrary to the hypothesis, no difference was found between preparatory and target behavioural strategies, $\chi^2(1) = 0.90$, $p = .34$ (Figure 4.3).

Figure 4.3: *Behavioural Strategies used in Implementation Intentions to Increase Fruit Intake and Vegetable Intake*

4.4.4.3 Which Type of Behavioural Strategy is Most Effective for Increasing Intake?

The preceding Sections showed that a higher number of participants generated target-focused behavioural strategies to increase fruit intake, although there were no differences between the target and preparatory strategies made to increase vegetable

intake. Consistent with Chapter 3, the final Section then tests the efficacy of behavioural strategy type, first for fruit and then for vegetable intake.

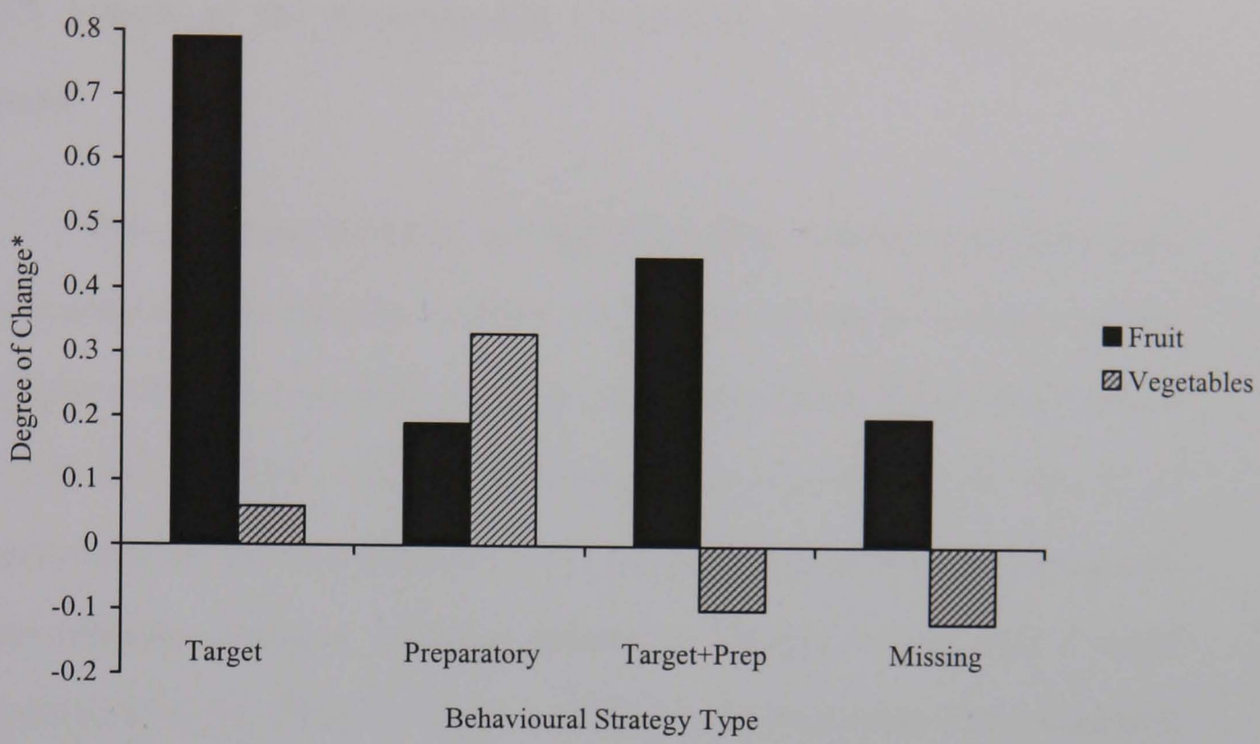
4.4.4.3.1 Fruit Intake

ANCOVA controlling for baseline fruit intake was used to examine the effect of behavioural strategy type (target, preparatory, target + preparatory, and missing) on fruit intake at follow-up. A significant difference between groups was revealed, $F(3, 170) = 3.26$, $p = .02$, $\eta_p^2 = .06$, and was broken down using planned contrasts. Participants who formed implementation intentions containing target strategies reported higher follow-up fruit intake than participants who formed implementation intentions using preparatory strategies ($p = .02$). Additionally, target strategies led to a higher follow-up fruit intake than missing implementation intentions ($p = .02$). No differences were found between the final fruit intakes of any other behavioural strategy type. Showing the same pattern of findings reported in Chapter 3, these analyses provide further evidence that implementation intentions focusing on the target action of consumption has greater impact on actual fruit intake, thus supporting the hypothesis (Figure 4.4).

4.4.4.3.2 Vegetable Intake

The analyses were then repeated to examine the effect of behavioural strategy type (target, preparatory, target + preparatory, and missing) on vegetable intake at follow-up. Although preparatory behavioural strategies had the greatest impact on behaviour, ANCOVA controlling for baseline again demonstrated that the difference in vegetable intake between groups at follow-up failed to reach significance, $F(3, 179) = 1.72$, $p = .17$, $\eta_p^2 = .03$ (Figure 4.4).

Figure 4.4: *Effects of Behavioural Strategy Type on Changes in Behaviour at Follow-up, Controlling for Baseline*



Note: *portions per day

4.5 Discussion

The present study was an attempt to extend the findings of Chapter 3, which generated partial support for applying separate implementation intention instructions to increase fruit and vegetable intake within one intervention. As the effects of the implementation intentions were small, particularly for vegetable intake, two interventions were compared to assess fruit and vegetables separately to reduce the potential for encoding difficulties and fatigue effects. Additionally, the present study aimed to replicate the content analyses of the behavioural strategies used in the implementation intentions in order to shed more light on possible differences in the ways fruit and vegetable intake can be promoted. The implications of the findings are

discussed in the following Sections, and the Chapter is concluded with directions for further research.

4.5.1 Effects of the Experimental Conditions on Fruit and Vegetable Intake

When addressed separately, the fruit intake of participants randomised to the fruit implementation intention condition was significantly higher at follow-up than any other condition. Fruit intake in this group had increased in the two month-period by 0.56 daily portions, which is a medium effect size of d = .48. This is an improvement on the small effect size of d = .21 found in fruit intake of the separate implementation intentions condition reported in Chapter 3, and also a slight improvement on the effect size of d = .42 found in the fruit intake of the combined condition of Chapter 3. Therefore, the hypothesis was supported. Rather more unexpectedly, the fruit intake of participants randomised to the vegetable implementation intention group was also found to be marginally significantly higher than one of the control groups, suggesting that receiving a vegetable implementation intention instruction was also slightly beneficial for increasing fruit.

In contrast to Chapter 3, however, no differences were found between groups for vegetable intake. Although the vegetable intake of the participants randomised to the vegetable implementation intention showed the highest degree of change over the study, this was not significant. Contrary to prediction, no effect was found for vegetable intake even after the potential for response fatigue or attentional bias was reduced. It would therefore seem that vegetable intake may be particularly resistant to change. In light of the findings of Kellar and Abraham (2005), implementation intention-based interventions may benefit from more structured, experimenter-

imposed planning focused specifically on preparatory behaviours, rather than employing the flexible, self-generated plans of the present study. Given that previous research suggests that vegetable intake is not only more complex but also a less popular target for change, future implementation intention-based interventions may need to develop novel ways to specifically target vegetable consumption as a distinct behaviour (cf. Anderson et al., 1998; Cox et al., 1998b; Naska et al., 2000).

4.5.2 Content Analysis of Behavioural Strategies

The analyses of fruit-increasing strategies in the present study revealed an identical pattern of results to those found in Chapter 3. A significantly higher number of participants chose target-focused behavioural strategies to increase their fruit consumption, and these were found to have the most beneficial impact on actual behaviour at follow-up. Therefore, confidence can be generated to some degree that implementation intentions focusing on the simple target action of consumption are successful for increasing fruit consumption. For vegetable intake, no differences were found between target and preparatory behavioural strategies, either in the number of participants choosing them or in their ability to increase behaviour. However, as in Chapter 3, a trend was revealed towards a higher increase in vegetable intake for those using preparatory strategies, although again this failed to reach significance. In line with the discussion in Section 4.5.1, this trend could be interpreted as further indication that experimenter-imposed preparatory planning should be employed to promote vegetable intake. Additionally, as the change in vegetable intake was very slight in the present study, differences in the efficacy of behavioural strategy types would again have been difficult to detect.

4.5.3 Motivation Manipulation Check

As in Chapters 2 and 3, TPB variables were used to control for the potential effects of motivation. Consistent with previous findings, no differences in TPB variables were demonstrated between conditions at follow-up, suggesting that the manipulations did not affect motivation to perform the behaviour. In contrast to the previous Chapters, however, the present study addressed fruit and vegetables separately, but motivation to increase intake was taken as a combined measure. Potentially, this is a limitation of the present study, as motivation to increase one's fruit consumption may not be the same as motivation to eat more vegetables, particularly in light of research indicating preferences for fruit (e.g. Cox et al., 1998b). However, given that no effects of motivation have been demonstrated in any of the previous Chapters, or in numerous prior implementation intention studies (e.g. Armitage, 2004, 2007), a degree of confidence can be generated from the present findings.

4.5.4 Control Condition

Finally, the present study provided a two further tests of the active control used in Chapter 2, which encouraged participants to increase their fruit and vegetable intake. In the present control conditions, participants were separately encouraged to increase their fruit intake and vegetable intake. No changes in behaviour were found, and as such it can be concluded that encouragement to make a behavioural change does not underlie implementation intention effects, as suggested by Jackson et al. (2005).

4.6 Chapter Summary

The present Chapter aimed to address the issues raised in Chapter 3, by comparing two implementation intention manipulations to increase fruit and vegetables separately. While findings suggest that implementation intentions are a consistent and robust means of promoting fruit intake, evidence for their ability to successfully increase vegetable intake was not demonstrated. This suggests that further investigation into ways to specifically target and promote vegetable intake is warranted. Similarly, analyses of the behavioural strategies used in implementation intentions to increase fruit intake again showed that target actions were the most popular and effective for changing behaviour. No differences were demonstrated for vegetable intake, although the trend was towards a more beneficial impact for preparatory strategies. However, the findings across Chapters 2 and 3 demonstrate that implementation intentions to increase vegetables do not appear to work in the same way as implementation intentions to increase fruit, providing additional evidence for a conceptual distinction and suggesting that the behaviours would benefit from being studied separately in future interventions.

4.7 The Next Step

The findings summarised above address the fourth main aim of the thesis, which was to investigate the potential problems surrounding attempts to change fruit and vegetables as a combined food group. The following Chapter will now revisit and extend the concept of booster implementation intentions introduced in Chapter 2, in an attempt to further improve the long-term effects of implementation intentions on behaviour. In light of the findings from the present Chapter, however, the following study will differ from Chapter 2 by moving away from targeting fruit and vegetables

as an aggregated food group, and will instead focus the intervention on promoting fruit consumption only.

Chapter 5- Improving the Long-term Impact of Implementation Intentions on Fruit Intake: An Investigation of Booster, Action and Coping Plans

5.1 Abstract

The present study draws upon a distinction between action and coping implementation intentions to extend the findings of Chapter 2. The efficacy of separate action and coping implementation intentions are tested as both shorter-term interventions over three months and as boosters for longer-term maintenance over six months. Participants (N = 1275) completed measures of fruit intake and motivation at baseline before being randomised to one of six conditions in a between-persons design. Contrary to prediction, ITT analysis revealed that: (1) at three months' follow-up, participants in both action and coping implementation intention conditions ate significantly more fruit than those in the active control groups, but no differences were found between the experimental groups, and (2) at six months' follow-up, the action implementation intention + action booster (AII + AII) and the action implementation + coping booster (AII + CII) conditions were most successful in increasing intake, but no differences were found between the AII + AII and the AII + CII groups. Secondary analysis on low and high baseline fruit intake revealed a different pattern of results, showing that: (3) at three months, action implementation intentions were most successful for low baseline consumers, but coping implementation intentions were more successful for high baseline consumers; and (4) at six months, the action implementation intention + the coping booster combination

generated the highest total portion increase in low baseline fruit consumers, but no main effect of condition was demonstrated for high baseline consumers at the end of the study.

5.2 Introduction

Chapter 2 provided evidence that a single implementation intention is sufficient to increase fruit and vegetable intake over three months, but this effect was not sustained over a six-month period. However, it was demonstrated that the long-term impact of the intervention can be improved by administering a booster implementation intention at three months. The present Chapter aims to extend these findings by drawing upon a distinction between action and coping planning, and testing these in relation to the booster concept.

5.2.1 Action and Coping Planning

As outlined in Chapter 1, planning can be defined as a prospective self-regulatory strategy to implement an intended change in behaviour. To reiterate, implementation intentions facilitate the translation of intention into behaviour by linking situational cues to goal-directed behaviours, triggering the desired outcome when the environmental cues are encountered. Implementation intentions are therefore planning strategies that assist in initiating immediate action, and have been demonstrated to promote goal-directed behaviour more successfully than goal intention alone (see Section 1.5.4; Gollwitzer & Sheeran, 2006 for review).

However, a further body of literature has argued that successful behaviour change is a process that requires detailed planning of both the initiation and the maintenance of the goal. Sniehotta, Schwarzer, Scholz and Schüz (2005) propose two

subconstructs of planning that serve different purposes. The first subconstruct is 'action' planning, which can be considered synonymous with implementation intentions in that it involves specifying the when, where and how of what one will do to initiate the behaviour. Congruent with Koestner et al. (2006), Sniehotta et al. (2005) suggest that action plans may be vulnerable to interference from competing obstacles and distractions over time, particularly in relation to complex, lifestyle behaviours such as dietary goals and physical exercise (See Chapter 2, Section 2.2.2; also Scholz, Schüz, Zeigelmann, Lippke & Schwarzer, 2008). To address this, the second subconstruct proposed by Sniehotta et al. (2005) is 'coping' planning; a barrier-focused self-regulation strategy. As action planning links concrete responses to future situations, coping planning represents a mental link between anticipated risk situations and suitable coping strategies. By predetermining potential pitfalls, individuals can continue to act on their intentions even in situations where barriers to the goal are presented. Coping planning can therefore protect against future distractions because a clear procedure is at hand when a risk situation is encountered. To summarise, action planning is a task-facilitating strategy used to initiate the desired behaviour, whereas coping planning is a distraction-inhibiting strategy that enhances the likelihood of the initiated behaviour being maintained. Thus, both of these constructs are considered highly valuable for promoting sustained behaviour change (Sniehotta et al., 2005).

A number of studies have provided evidence for the theoretical assumptions outlined above. For example, Sniehotta, Scholz and Schwarzer (2006) conducted an intervention designed to encourage cardiac patients to engage in regular physical activity following discharge from rehabilitation. Patients at baseline were randomised to one of three conditions: an action planning group; a combined action and coping

planning group; or a standard care control group. At two months post-discharge, patients randomised to the combined planning group engaged in significantly higher levels of regular physical exercise than any other condition, suggesting that interventions consisting of both action and coping strategies may be particularly beneficial in promoting behaviour change. However, because the action and coping planning components of the intervention were combined, it is not possible to fully tease apart the independent effects of each intervention.

Empirical support has also been generated for the differential effects of action and coping planning on the initiation and maintenance of behaviour. In a RCT with orthopaedic rehabilitation patients, Ziegelmann, Lippke and Schwarzer (2006) demonstrated that action plans formed at baseline predicted levels of physical activity at the beginning of the behaviour change process, whereas coping plans formed at baseline resulted in a delayed effect and did not significantly predict behaviour until later follow-ups including six months post-rehabilitation. This would suggest that in contrast to action planning, coping planning is an important strategy for maintaining, rather than initiating complex behaviour. Similarly, a recent non-experimental study of physical activity in the general population demonstrated that reported levels of spontaneously-generated coping planning mediated the intention-behaviour relationship in formerly active, but not formerly inactive, participants (Scholz et al., 2008). The authors therefore conclude that coping planning represents a critical self-regulatory strategy to enable actors to maintain physical activity levels; however, experimental support for these preliminary findings is required in order to draw more solid conclusions.

5.2.2 How Could Action and Coping Plans be Usefully Combined with Boosters?

The content and purpose of the action versus coping planning constructs are considered conceptually distinct, and it is argued that the information required for successful plan formation will differ accordingly. For instance, Sniehotta et al. (2005) state that for action planning, the knowledge needed to form a plan in terms of when, where and how can be relatively easily accessed and defined by one's present and immediate circumstances. For an individual to define and generate efficient coping plans, however, prior experience of personal risk situations (i.e. habits, temptations and distractions) is a prerequisite. In line with the literature reviewed above, coping plans are therefore assumed to have limited worth at the onset of behaviour change because the anticipated barriers to action may as yet be unclear (Sniehotta et al., 2005; 2006). Despite this, intervention studies to date have tested coping plans only in combination with action plans administered at baseline. From a theoretical perspective, however, coping plans would be more usefully deployed at mid-point, when initiation of the behaviour is underway and participants have gained experience of their personal barriers to health. The present study therefore aims to combine the plan components with the booster technique reported in Chapter 2, in an attempt to further enhance the long-term effects.

5.2.3 Additional Considerations

The present Chapter also aims to address further gaps in the action and coping plan literature to date. First, research into the efficacy of action and coping planning has been tested in the domain of physical activity promotion only. Second, the majority of interventions in the area have been conducted on clinical populations,

specifically cardiac and orthopaedic patients in rehabilitation settings (e.g. Sniehotta et al., 2006; Zeigelmann et al., 2006). While these samples represent an important focus for health promotion, the interventions are conducted with close involvement from health professionals including physicians, therapists or trained consultants (see also Lippke, Zeigelmann & Schwarzer, 2004; Scholz, Knoll, Sniehotta & Schwarzer, 2006). Therefore, to improve generalisability, it would be valuable to extend these findings to the promotion of other complex health behaviours in generally healthy populations.

Third, the explanatory processes of the action and coping planning are assumed to be synonymous with those governing implementation intentions (see Sniehotta et al., 2005). That is, in forming both action and coping plans, automatic activation of the desired outcome (specified in the 'then' section of the plan) is triggered when the critical cue (specified in the 'if' section of the plan) is encountered. Therefore, the accessibility of cues and the strength of the cue-response association are understood to be the underlying mechanisms (cf. Webb & Sheeran, 2008). As discussed in the systematic review in Chapter 1, however, implementation intention intervention studies (including action and coping planning) do not experimentally manipulate the formation of the plans using an 'if-then' structure, which may compromise the overall impact (see Chapter 1, Section 1.6.3.5). In line with previous Chapters, the present study will therefore test the concept of action and coping plans in a specific if-then format, and to make this distinction the plans will be relabelled 'action implementation intentions', and 'coping implementation intentions'.

5.2.4 Revisiting Demand Characteristics

The studies reported in Chapters 2, 3 and 4 test an active control condition in which participants are encouraged to make a behavioural change. No effects were found, generating support for the genuine impact of the interventions. However, this active control condition has limitations in that it does not control for the time taken to complete the intervention, or the level of engagement with the health-related materials (see Chapter 2, Section 2.5.3.1). To address this, the present study will extend the previous active control conditions by asking participants to plan to change their behaviour, in order to tease apart the general effects of planning from those generated by the specific cue-response link formed by an implementation intention. This method was recently tested in implementation intention-based smoking cessation interventions and showed no behavioural effects (see Armitage, 2008; Armitage & Arden, 2008), but it has not been applied to other health behaviours to date. The present study will therefore provide a more exacting test of demand characteristics by testing the active control in relation to fruit consumption.

5.2.5 Aims and Hypotheses

In light of the above, the aims of the present study were threefold. The first study aim was to investigate and compare the initial impact of action implementation intentions and coping implementation intentions on fruit intake over a three-month period. The second aim of the study was to extend the findings reported in Chapter 2 by assessing the long-term efficacy of deploying action and coping implementation intentions as boosters at three months. The third study aim was to employ a more rigorous active control condition than previous Chapters, to ensure that both encouragement to perform the behaviour and the level of engagement with materials was adequately controlled.

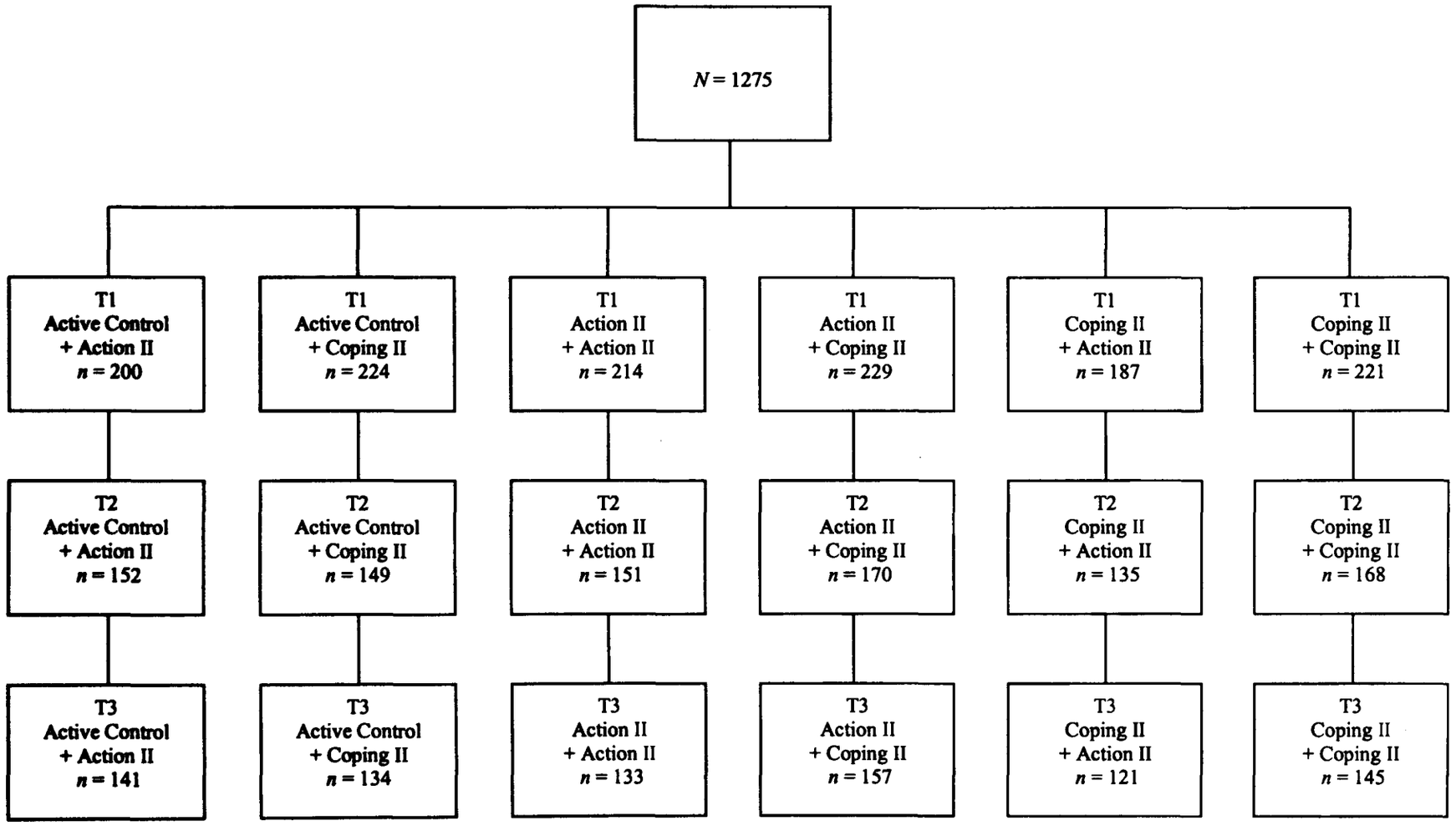
The hypotheses were as follows. As action implementation intentions are proposed to be more effective at initiating behaviour, it was predicted that action implementation intentions would have a greater impact on behaviour than coping implementation intentions over the shorter-term from baseline to three months. As coping implementation intentions are associated with the efficient maintenance of behaviour, the second prediction was that an action implementation intention at baseline followed by a coping booster implementation intention at three months would be the most successful combination for increasing fruit intake over a six-month period. The final hypothesis relates to the test of demand characteristics. In line with Armitage (2008) and Armitage and Arden (2008), it was predicted that no changes would be demonstrated in the behaviour of participants randomised to the active control conditions.

5.3 Method

5.3.1 Participants

The sample comprised students from a UK university. One thousand, two hundred and seventy five online questionnaires were completed at baseline. Nine hundred and twenty five participants completed a follow-up at three months, with a response rate of 73%. Eight hundred and thirty one participants completed a second follow-up at six months, giving a total response rate of 65% from participants at baseline, and 90% of the responses from three months. The age of the sample ranged from 18 - 40 years (M = 20.19, SD = 3.10), 70% were female (n = 888), and 83% were White (n = 1057). The people who dropped out at both time points were treated as no-changers, and analysed on an ITT basis (Figure 5.1).

Figure 5.1: *Diagram of Participant Progress through the Phases of the Experiment*



Note: T1 = Baseline, T2 = 3 months' follow-up, T3 = 6 months' follow-up, II = Implementation Intention

5.3.2 Design

A randomised controlled design was used with the between-persons factor of *condition*, which had six levels: (1) active control plus an action implementation intention at 3 months (AC + AII); (2) active control plus a coping implementation intention at 3 months (AC + CII); (3) action implementation intention plus an action implementation intention at 3 months (AII + AII); (4) action implementation intention plus a coping implementation intention at 3 months (AII + CII); (5) coping implementation intention plus an action implementation intention at 3 months (CII + AII), and (6) coping implementation intention plus a coping implementation intention at 3 months (CII + CII). All dependent measures (fruit intake and TPB variables) were taken at baseline, three months and six months' follow-ups (Figure 5.1).

5.3.3 Procedure

Data were collected from students who were invited via group list email to participate in a study of 'dietary habits'. The email contained a link to an online questionnaire, which randomly allocated participants to one of the six conditions. Participants were contacted again at three months via their individual email address, which they were asked to provide at baseline if they wished to continue with the study. In the follow-up email, a link was provided to the second online questionnaire. To ensure minimum drop-out, participants were sent two generic reminder emails in the ten day period following the three months' follow-up email. This procedure was repeated at the six-month follow-up. Although participants were asked to provide their university email addresses, confidentiality was preserved as the addresses consist of a series of letters and numbers (representing the course code, start year of

degree, and initials), rather than the student's full name. Participants were informed that participation was voluntary and that they were free to withdraw their data at any point.

5.3.4 Questionnaire Content

All questionnaires began with a detailed section regarding what constitutes a portion of fruit, which was closely based on the fruit section of the UK DoH guide to the size of a portion of 5 A Day (DoH, 2008). Examples of fruit portions given were: 2 plums, 1 apple, and half a grapefruit. This was followed by TPB items, the measure of fruit intake, and the intervention manipulations where relevant. All of these are described in the following Sections.

5.3.5 Manipulations

5.3.5.1 Baseline

5.3.5.1.1 Action Implementation Intention

Participants randomised to the AII + AII and AII + CII conditions were presented with the following phrase: "We would like you to plan to increase your daily intake of fruit and vegetables over the next 6 months. Research has shown that planning is more effective if you first identify a good situation to act, and then decide what action you will take in that situation. For example, you might find it useful to state: "If it is lunchtime at university, then I will eat at least one portion of fruit with my meal!" Please write your plans in the space provided, following the format in the example ("if...then..."). Take your time to think of strategies personal to you and repeat your plans to yourself when you have finished". This was followed by a page

of blank lines for the participants to formulate their own self-generated plans. These instructions were based on those of Chapman et al. (in press) in light of evidence that forming plans in a specific ("if...then...") format is superior in engendering behaviour change (see Chapter 1, Section 1.5.3.1). The line "Take your time to think of strategies personal to you and repeat your plans to yourself when you have finished" was added to encourage thoughtful and personal plan formation and to enhance the depth of encoding of the plan.

5.3.5.1.2 Coping Implementation Intention

Participants randomised to the CII + AII and CII + CII conditions were presented with the following phrase: "We would like you to plan to increase your daily intake of fruit and vegetables over the next 6 months. Research has shown that planning is more effective if you first anticipate potential barriers that may interfere with your goal, and then decide what strategies you will take to overcome them. For example, you might find it useful to state: "If I forget to eat fruit at lunchtime, then I will eat at least one portion of fruit at home with my evening meal!" Please write your plans in the space provided, following the format in the example ("if...then...") Take your time to think of strategies personal to you and repeat your plans to yourself when you have finished". This was followed by a page of blank lines for the participants to formulate their own self-generated plans. These instructions were designed to be as similar as possible to the active implementation intention manipulation while ensuring the formation of a link between anticipated risk situations and suitable coping responses.

5.3.5.1.3 Active Control

Participants randomised to the AC + AII and AC + CII conditions were presented with the following brief statement designed to encourage them to plan to increase their fruit intake over the duration of the study: "We would like you to plan to increase your daily intake of fruit and vegetables over the next 6 months. Take your time to think of strategies personal to you and repeat your plans to yourself when you have finished". This was followed by a page of blank lines for the participants to write their plans. This was designed to be as similar as possible to the opening instructions used in the experimental groups, and is comparable to the methods applied in previous implementation intention studies applying active control conditions (see Armitage, 2008; Armitage & Arden, 2008).

5.3.5.2 Three Months

Participants in the AC + AII, AII + AII, and CII + AII conditions were presented with the action implementation intention phrase described above in Section 5.3.5.1.1. Participants in the AC + CII, AII + CII, and CII + CII conditions were presented with the coping implementation intention phrase described in Section 5.3.5.1.2.

5.3.6 Measures

5.3.6.1 Theory of Planned Behaviour

In line with previous implementation intention studies and the previous three Chapters, TPB variables were used to control for the effects of motivation (see Armitage, 2004), and because it has been shown to provide a good account of the factors underpinning motivation (Armitage & Conner, 2001). For the measure of attitude, participants were presented with the stem: "For me, increasing my daily

intake of fruit in the next six months is..." which they were asked to rate on three bipolar (-3 to +3) semantic difference scales, anchored by *bad-good*, *negative-positive*, and *foolish-wise*. Cronbach's α indicated that the attitude scale possessed good internal reliability at baseline (α = .86), 3-month follow-up (α = .83) and 6-month follow-up (α = .84). PBC was measured using items measured on three bipolar (-3 to +3) scales: "Increasing my daily intake of fruit in the next six months would be *difficult-easy*", "How much personal control do you feel you have over increasing your daily intake of fruit in the next six months? *no control-complete control*", and "How confident are you that you will be able to increase your daily intake of fruit in the next six months? *not very confident-very confident*". The internal reliability of the scale was good at baseline (α = .78), at 3-month follow-up (α = .78), and 6-month follow-up (α = .80). Subjective norm was operationalised using three items: "Most people who are important to me think I should increase my daily intake of fruit in the next six months", "Most people who are important to me would want me to increase my daily intake of fruit in the next six months", and "Most people in my social network would approve of my increasing my daily intake of fruit in the next six months". These were measured by averaging responses made on unipolar (+1 to +7) scales, *strongly disagree-strongly agree*. The items formed an internally reliable scale at baseline (α = .76), 3-month follow-up (α = .78) and 6-month follow-up (α = .72). Behavioural intention was measured on a bipolar (-3 to +3) scale using three items: "I *intend* to increase my daily intake of fruit in the next six months *strongly disagree-strongly agree*", "I *want* to increase my daily intake of fruit in the next six months *strongly disagree-strongly agree*", and "How likely is it that you will increase your daily intake of fruit in the next six months? *very unlikely-very likely*". Again,

reliability was high at baseline (α = .88), 3-month follow-up (α = .89) and 6-month follow-up (α = .88).

5.3.6.2 Fruit Intake

Participants were required to report their daily fruit intake using the following open-ended item: "Over the past week, how many portions of fruit have you eaten on average per day?" followed by a blank space to write the answer.

5.4 Results

5.4.1 Descriptive Statistics and Attrition Biases

Means and standard deviations for all variables are presented in Table 5.1. The present sample had a mean baseline fruit intake of 1.57 (*SD* = 1.14) portions per day, which was slightly lower than the daily fruit portions reported in Chapter 3 (*M* = 1.72, *SD* = 1.01) and Chapter 4 (*M* = 1.82, *SD* = 1.04). MANOVA showed there were no significant differences between responders and non-responders on their fruit intake, TPB variables or age, regardless of whether they dropped out at three months, $F(6, 1260) = 1.03$, $p = .41$, $\eta_p^2 = .01$, or 6 months, $F(6, 1260) = 0.81$, $p = .56$, $\eta_p^2 < .01$. No statistically significant univariate tests were found. Chi-square showed no differences between responders and non-responders for gender at three months, χ^2 (1) = 0.21, $p = .65$, or at 6 months, χ^2 (1) = 0.02, $p = .89$; or ethnicity at 3 months, χ^2 (1) = 1.05, $p = .31$, or at 6 months, χ^2 (1) = 2.69, $p = .10$. Finally, no significant differences were found between drop-out rates for condition at three months, χ^2 (5) = 7.29, $p = .20$, or at 6 months, χ^2 (1) = 7.38, $p = .19$.

5.4.2 Randomisation Check

The experimental and control conditions were compared on baseline fruit intake, TPB variables and age to check whether randomisation was achieved. The MANOVA was nonsignificant, $F(6, 1260) = 1.41$, $p = .21$, $\eta_p^2 = .01$, as were all univariate ANOVAs. Gender and ethnicity were tested using nonparametric tests, and again no significant differences were found, $\chi^2 (5) = 8.61$, $p = .13$, and $\chi^2 (5) = 7.40$, $p = .19$, respectively. Together, these data suggest that prior to the implementation intention manipulations, participants in the experimental and control groups ate similar portions of fruit per day, and were equally motivated to increasing their daily portions (see Table 5.1).

Table 5.1: *Means and Standard Deviations for all Variables at all Time Points*

Variable	Time	Active Control With Action II at 3 months *M* (*SD*)	Active Control With Coping II at 3 months *M* (*SD*)	Action II With Action II at 3 months *M* (*SD*)	Action II With Coping II at 3 months *M* (*SD*)	Coping II With Action II at 3 months *M* (*SD*)	Coping II With Coping II at 3 months *M* (*SD*)
Fruit Intake (portions per day)	Baseline	1.55	1.63	1.58	1.66	1.53	1.46
		(1.21)	(1.24)	(1.13)	(1.08)	(1.17)	(1.02)
	3 Months	1.54	1.66	1.79	1.90	1.67	1.65
		(1.19)	(1.20)	(1.14)	(1.06)	(1.20)	(1.13)
	6 Months	1.71	1.77	1.88	2.06	1.63	1.56
		(1.28)	(1.30)	(1.19)	(1.17)	(1.23)	(1.16)
Attitude	Baseline	1.69	1.79	1.83	1.84	1.87	1.80
		(1.10)	(1.10)	(1.06)	(0.97)	(0.98)	(1.16)
	3 Months	1.68	1.72	1.78	1.84	1.94	1.84
		(0.99)	(1.05)	(1.09)	(0.97)	(0.87)	(1.06)
	6 Months	1.72	1.71	1.82	1.79	1.88	1.89
		(1.00)	(1.08)	(1.00)	(0.97)	(0.82)	(1.01)
Subjective Norm	Baseline	4.42	4.36	4.60	4.43	4.60	4.58
		(1.40)	(1.27)	(1.40)	(1.32)	(1.40)	(1.27)
	3 Months	4.39	4.41	4.54	4.46	4.48	4.60
		(1.38)	(1.29)	(1.38)	(1.27)	(1.36)	(1.23)
	6 Months	4.32	4.46	4.53	4.45	4.52	4.60
		(1.37)	(1.31)	(1.28)	(1.35)	(1.32)	(1.25)
PBC	Baseline	1.14	1.19	1.15	1.16	1.21	1.26
		(1.28)	(1.21)	(1.35)	(1.26)	(1.17)	(1.30)
	3 Months	1.18	1.21	1.16	1.14	1.26	1.20
		(1.28)	(1.20)	(1.30)	(1.20)	(1.11)	(1.26)
	6 Months	1.25	1.17	1.13	1.17	1.30	1.26
		(1.24)	(1.27)	(1.35)	(1.14)	(1.18)	(1.24)
Intention	Baseline	1.17	1.19	1.22	1.16	1.23	1.31
		(1.55)	(1.36)	(1.39)	(1.43)	(1.41)	(1.32)
	3 Months	1.15	1.25	1.19	1.22	1.22	1.32
		(1.43)	(1.32)	(1.31)	(1.33)	(1.37)	(1.27)
	6 Months	1.20	1.27	1.26	1.18	1.21	1.40
		(1.34)	(1.34)	(1.29)	(1.39)	(1.35)	(1.21)

Note: II = Implementation Intention

5.4.3 Effects of the Implementation Intention Interventions

The data were analysed according to ITT. A series of between-persons ANCOVAs controlling for baseline measures were used to examine the effects of the six conditions (AC + AII, AC + CII, AII + AII, AII + CII, CII + AII and CII + CII) on the dependent variables at 3 months' follow-up and 6 months' follow-up. For the results at both time points, planned contrasts were used to clarify where any differences between the levels of the between-persons factor lay.

5.4.3.1 Motivation Manipulation Check

The initial analyses examined whether the manipulations had any effect on participants' motivation to increase their daily intake of fruit over the course of the study. At three months follow-up, ANCOVAs controlling for baseline revealed no significant effects of condition for attitude, PBC, subjective norm, or intention, Fs(5, 1274) = 0.37 to 1.96, ps = .87 to .08, η_p^2s < .02. Similarly, at six months follow-up, ANCOVAs controlling for baseline revealed no significant effects of condition for attitude, PBC, subjective norm, or intention, Fs(5, 1274) = 0.69 to 1.55, ps = .63 to .17, η_p^2s < .02. This provides evidence that motivation was unaffected by the manipulations, and no changes in any of the TPB variables were demonstrated (Table 5.1).

5.4.3.2 Fruit Intake at Three Months

The second analyses tested the effect of the active controls, action implementation intentions and coping implementation intentions on fruit intake at three months.

ANCOVA controlling for baseline fruit intake revealed a significant difference among conditions at three months, $F(5, 1274) = 6.47$, $p < .01$, $\eta_p^2 = .03$. Planned contrasts were performed to test the hypothesis that participants randomised to the action implementation intention groups would demonstrate the highest increase in fruit intake from baseline to three months. As expected, significant differences were found between the action implementation intention groups and the active control groups at three months, with higher levels reported in the action implementation intention conditions (*p*s < .01) (Table 5.1 and Figure 5.2). However, no significant differences were found between the fruit intakes of the action implementation intention and the coping implementation intention conditions at three months (*p*s > .10). This finding suggests that the coping manipulations were equally effective for increasing fruit over the shorter-term and hence the initial hypothesis was not supported (Table 5.1 and Figure 5.2).

Further planned contrasts assessing potential differences between the fruit intakes of the coping implementation intention groups and the active controls at three months revealed that significantly more fruit was consumed in the coping conditions (*p*s < .04) (Table 5.1 and Figure 5.2). Therefore, participants in all four experimental conditions (AII + AII, AII + CII, CII + AII, and CII + CII) reported eating significantly more portions of fruit than the controls, lending support to the prediction that general planning would not impact behaviour (Figure 5.2).

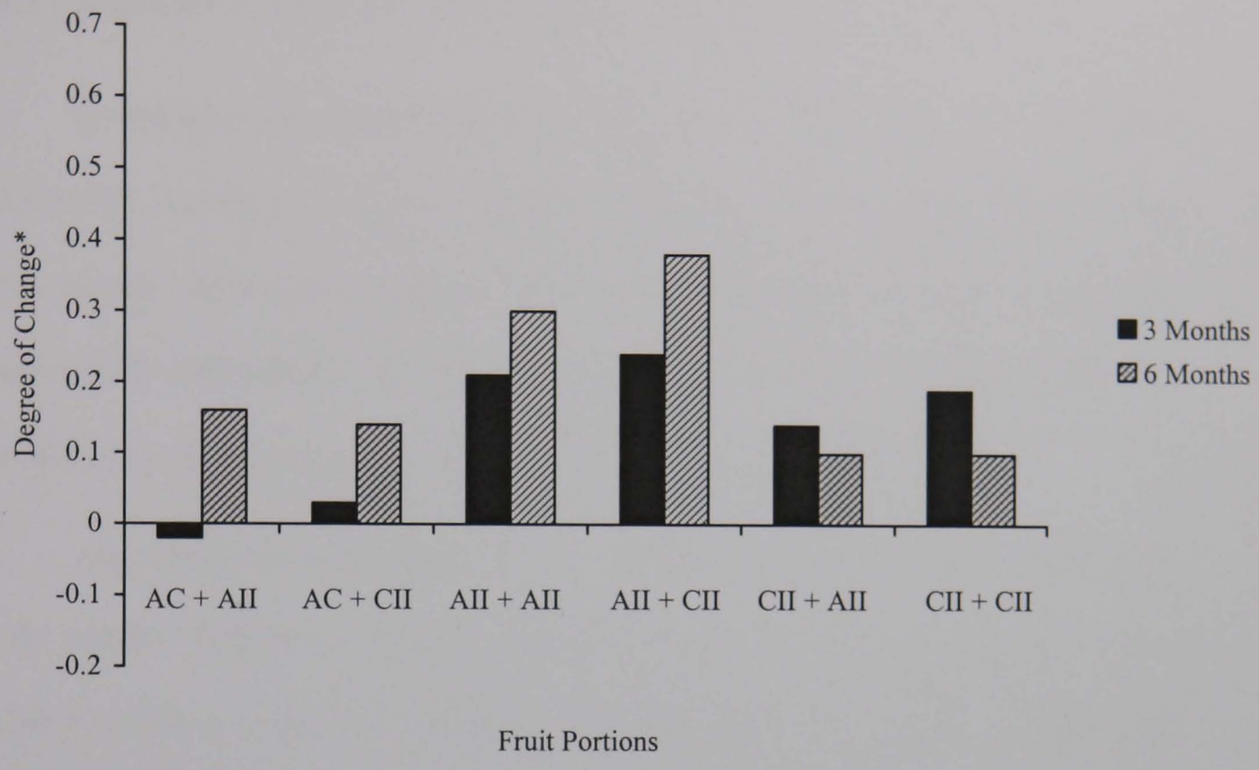
5.4.3.3 Fruit Intake at Six Months

The third set of analyses tested the booster effect of the action implementation intentions and coping implementation intentions on fruit intake at six months' follow-up.

ANCOVA controlling for baseline fruit intake revealed a significant difference among conditions, $F(5, 1274) = 6.87$, $p < .01$, $\eta_p^2 = .03$. Planned contrasts were then applied to test the hypothesis that participants who received an action implementation intention at baseline followed by a coping booster implementation intention at three months (AII + CII) would lead to the greatest change in behaviour at the end of the study. It was revealed that the AII + CII condition reported eating significantly higher portions of fruit at six months than four of the remaining groups (AC + AII, AC + CII, CII + AII, and CII + CII), $ps < .01$, representing a total increase of 0.40 daily portions. However, no difference was found between the AII + CII and the AII + AII conditions at six months follow-up ($p = .12$), suggesting that an action implementation intention followed by an action booster has a similar long-term impact to combining the action and coping manipulations[13] (Table 5.1 and Figure 5.2). Therefore, the hypothesis was only partly supported.

[13] Further planned contrasts also revealed that similar to the AII + CII condition, the AII + AII group ate significantly higher portions of fruit at six months than any of the four remaining conditions (AC + AII, AC + CII, CII + AII, CII + CII), $ps \leq .04$. No other significant differences were found (see Table 5.1 and Figure 5.2).

Figure 5.2: *Effects of Condition on Fruit Intake at Three Months and Six Months' Follow-up, Controlling for Baseline*



Note: *portions per day

5.4.4 Effects of the Implementation Intention Interventions on Low and High Baseline Fruit Intake

The results presented in Sections 5.4.3.2 and 5.4.3.3 were unexpected given that action and coping manipulations are proposed to exert differential effects on the initiation and maintenance of behaviour. However, exploratory findings from Scholz et al. (2008) have previously suggested that coping planning seems particularly beneficial for those already engaging in the behaviour at the beginning of the study (see Section 5.2.1). The following Section therefore re-assessed the impact of the interventions on those consuming different amounts of fruit at baseline. A median split of baseline portions was dummy-coded so that participants consuming low intake ($\leq$ 1 daily portion, n = 727) = 1, and participants consuming high intake ($\geq$ 2

daily portions, n = 548) = 2. The analyses in Sections 5.4.3.2 and 5.4.3.3 were then repeated with the variable 'baseline intake' as a second IV.

5.4.4.1 Repeated Analyses at Three Months' and Six Months' Follow-up

In addition to the significant difference among conditions reported in Section 5.4.3.2 (F[5, 1274], $p < .01$, $\eta_p^2 = .03$), the ANCOVA performed on fruit intake at three months' follow-up revealed a significant difference between low and high baseline fruit consumption, $F(1, 1274) = 12.70$, $p < .01$, $\eta_p^2 = .01$, and a significant condition x consumption interaction, $F(5, 1274) = 2.94$, $p = .01$, $\eta_p^2 = .01$.

Also consistent with Section 5.4.3.3, the ANCOVA performed on fruit intake at six months' follow-up revealed a significant difference among conditions, $F(1, 1274) = 12.70$, $p < .01$, $\eta_p^2 = .01$; a significant difference between low and high baseline fruit consumers, $F(1, 1274) = 12.70$, $p < .01$, $\eta_p^2 = .01$, and a significant condition x consumption interaction, $F(1, 1274) = 12.70$, $p < .01$, $\eta_p^2 = .01$.

The interactions were then decomposed by analysing the effect of condition for low and high baseline consumers separately; first at three months, and then at 6 months' follow-up.

5.4.4.1.1 Low Baseline Fruit Intake at Three Months

ANCOVA controlling for baseline fruit intake showed a significant difference among conditions at three months for low fruit consumers, $F(5, 726) = 6.57$, $p < .01$, $\eta_p^2 = .04$. Planned contrasts again revealed significant differences between the action implementation intention groups and the active control groups at three months, with higher levels reported in the action implementation intention conditions (ps < .01) (Table 5.2). However, significant differences were also demonstrated between the

fruit intakes of the action implementation intention and the coping implementation intention conditions (*p*s < .05), demonstrating that for low baseline consumers, the action manipulations were most effective for increasing fruit over three months (see Table 5.2 and Figure 5.3). No differences were found between any other condition, suggesting that the active control and coping implementation intention groups had a similar impact on behaviour[14].

Table 5.2: *Means and Standard Deviations for Low and High Baseline Fruit Intake at all Time Points*

Variable	Time	Active Control With Action II at 3 months *M* (*SD*)	Active Control With Coping II at 3 months *M* (*SD*)	Action II With Action II at 3 months *M* (*SD*)	Action II With Coping II at 3 months *M* (*SD*)	Coping II With Action II at 3 months *M* (*SD*)	Coping II With Coping II at 3 months *M* (*SD*)
Low baseline Fruit Intake	Baseline	0.74 (0.44)	0.75 (0.43)	0.76 (0.43)	0.83 (0.38)	0.77 (0.42)	0.79 (0.41)
(portions per day)	3 Months	0.81 (0.58)	0.86 (0.58)	1.09 (0.77)	1.23 (0.77)	0.93 (0.65)	0.98 (0.67)
	6 Months	1.00 (0.78)	0.90 (0.69)	1.21 (0.90)	1.46 (1.01)	0.91 (0.85)	0.85 (0.67)
High baseline Fruit Intake	Baseline	2.75 (0.97)	2.68 (1.06)	2.57 (0.89)	2.61 (0.81)	2.67 (0.99)	2.48 (0.79)
(portions per day)	3 Months	2.64 (1.01)	2.62 (1.03)	2.65 (0.93)	2.65 (0.81)	2.80 (0.93)	2.68 (0.91)
	6 Months	2.77 (1.15)	2.81 (1.08)	2.69 (0.97)	2.75 (0.95)	2.71 (1.10)	2.64 (0.88)

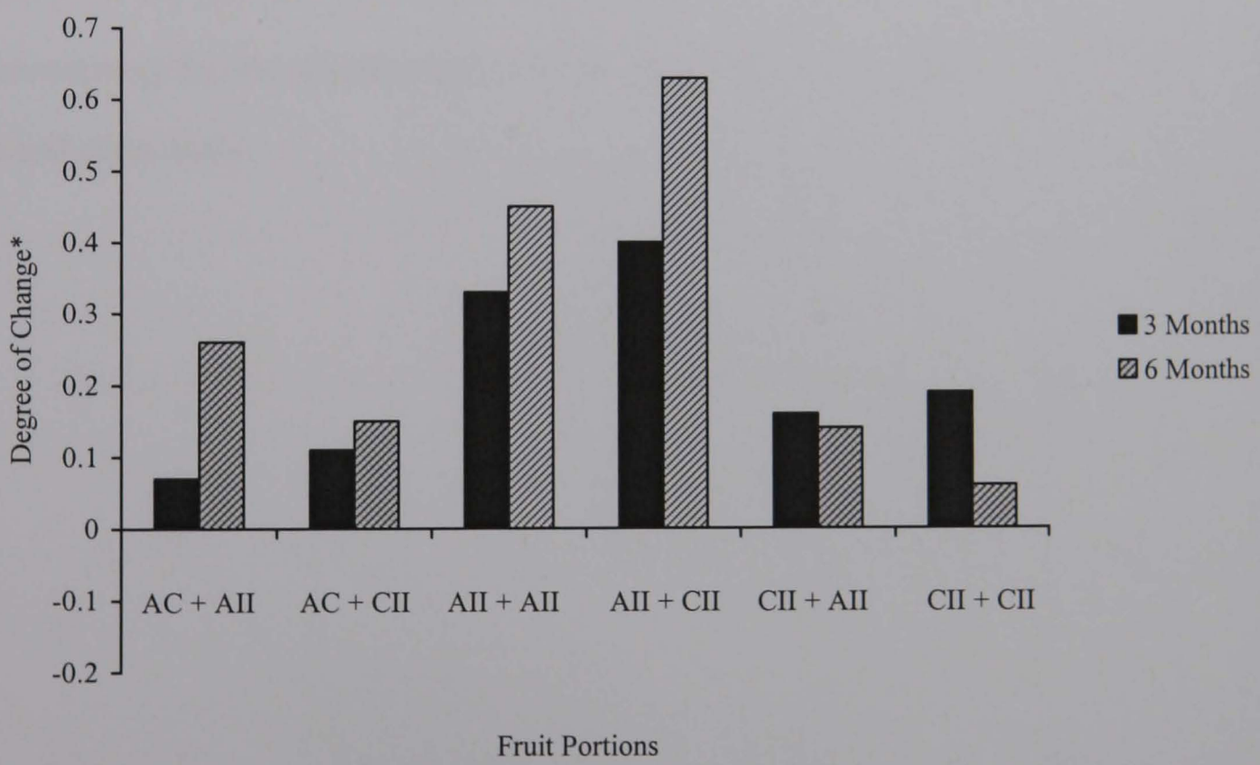
Note: II = Implementation Intention

5.4.4.1.2 Low Baseline Fruit Intake at Six Months

[14] However, the difference between AC + AII and CII + CII was approaching significance, $p = .08$ (Figure 5.3).

A significant difference between conditions was also demonstrated at six months, $F(5, 726) = 11.78$, $p < .01$, $\eta_p^2 = .08$. In contrast to Section 5.4.3.3, planned contrasts showed that low baseline consumers randomised to the AII + CII condition reported significantly higher portions of fruit at six months than any other condition including the AII + AII group (*p*s < .04) (Table 5.2 and Figure 5.3). Differences between all other groups were nonsignificant at six months with the exception of AC + AII and CII + CII; with AC + AII eating significantly higher portions of fruit at follow-up ($p = .03$) (Table 5.2 and Figure 5.3).

Figure 5.3: *Effects of Condition on Low Baseline Fruit Intake at Three Months and Six Months' Follow-up, Controlling for Baseline*



Note: *portions per day

5.4.4.1.3 High Baseline Fruit Intake at Three Months

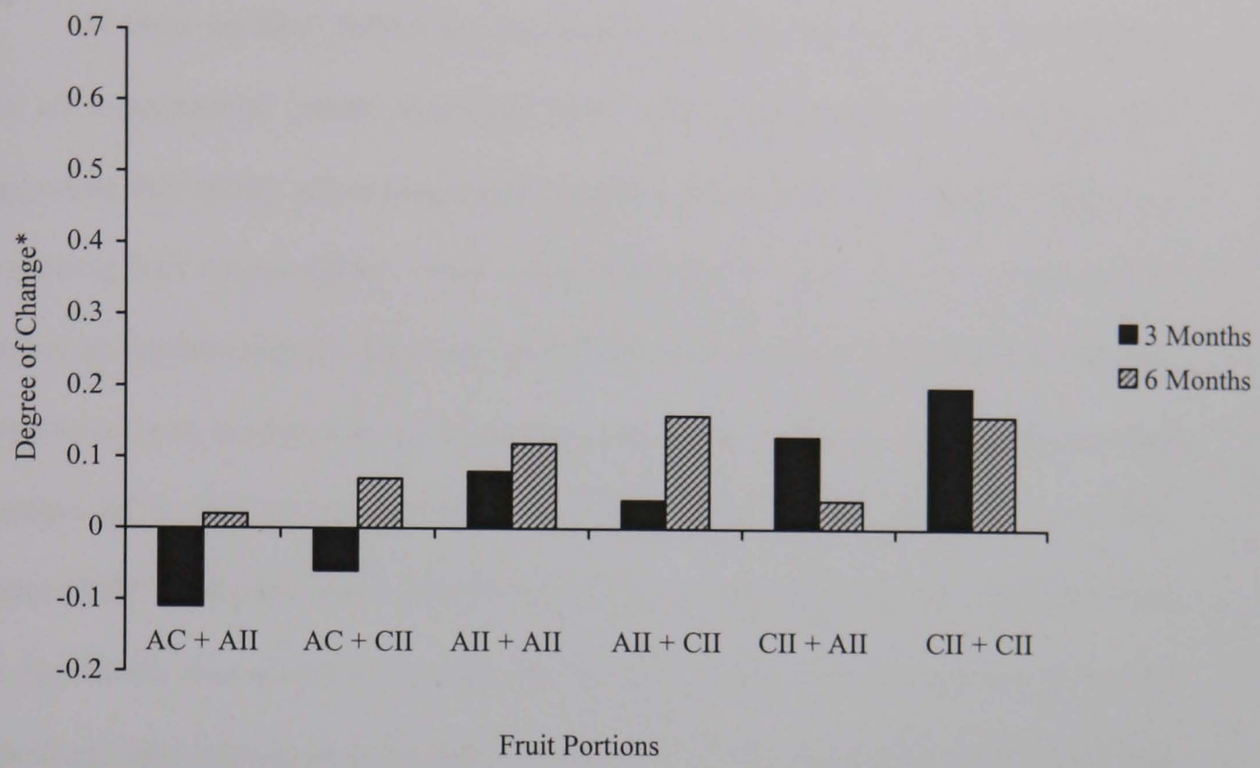
The analyses were then repeated on high consumers. ANCOVA controlling for baseline intake again demonstrated a significant difference among conditions at

three months, $F(5, 547) = 2.61$, $p = .02$, $\eta_p^2 = .02$, however, the planned contrasts revealed a different pattern of results to the low baseline intake participants. Significant differences were found between both coping implementation intention groups and the active control groups at three months, with higher fruit intakes reported in the coping implementation intention conditions ($ps < .02$) (Table 5.2 and Figure 5.4). In contrast, only one of the action implementation intention conditions (AII + AII) was significantly higher than the active control (AC + AII), $p = .05$. No significant differences were found between any other conditions.

5.4.4.1.4 High Baseline Fruit Intake at Six Months

For participants consuming high fruit intake, the ANCOVA controlling for baseline at six months was nonsignificant, $F(5,547) = 0.30$, $p = .91$, $\eta_p^2 < .01$, demonstrating that the booster implementation intentions had no differential effect at the end of the study.

Figure 5.4: *Effects of Condition on High Baseline Fruit Intake at Three Months and Six Months' Follow-up, Controlling for Baseline*



Note: *portions per day

5.5 Discussion

The present study compared the efficacy of action and coping implementation intentions to increase fruit intake over a three-month period, and aimed to extend the findings of Chapter 2 by investigating the long-term impact of action and coping booster combinations. The study also tested the use of a general planning control condition, in an attempt to tease apart the specific effects generated by implementation intention formation. The following discussion begins with the main effects on fruit intake at both time points, and considers the differing pattern of results shown in the secondary analyses performed on low and high baseline consumers. This is followed by a discussion of the findings from the control conditions, and concludes with a general summary of results.

5.5.1 Effects of Action and Coping Implementation Intentions on Fruit Intake at Three Months' Follow-up

At three months' follow-up, the results presented in Section 5.4.3.2 showed that all experimental groups increased fruit intake significantly over controls, thus suggesting that action and coping implementation intentions were equally effective at increasing fruit consumption. Mean scores indicated that participants randomised to the action implementation intentions groups did increase their fruit intake by slightly more than those randomised to the coping conditions, averaging a 0.23 daily portion increase (d = .21) in comparison with a 0.17 daily portion increase (d = .16), respectively. However, these differences failed to reach significance, and therefore the hypothesis that action implementation intentions would have a greater impact on behaviour than coping implementation intentions at the shorter-term follow-up was not initially supported. This finding is in contrast to previous literature that proposes a behavioural distinction between the initiating role of action planning and the subsequent maintenance-enhancing properties of coping planning (Sniehotta et al., 2005; 2006; see Section 5.2.1).

However, the secondary analyses performed on median-split low and high baseline fruit consumers revealed a different pattern of results. For low baseline consumers, only action implementation intentions increased intake significantly over the control groups at three months, lending support to the first hypothesis. For high baseline consumers, participants in both coping implementation intention conditions, but only one of the action implementation intention conditions, ate significantly more fruit than the controls at three months. These findings therefore provide experimental support for the findings of Scholz et al. (2008), who suggest that the effects of coping

planning are exerted more readily in participants already engaging in the behaviour to some extent. Equally, participants who ate one or fewer portions of fruit per day at the start of the study may have been less equipped to successfully pre-empt personal risk strategies, and thus the task-facilitating planning had greater impact. The findings from the median-split analysis from baseline to three months therefore speak to the initial idea that action implementation intentions are of more value at the onset of behaviour change interventions, although these may be better targeted to those with low levels of baseline behaviour.

5.5.2 Effects of Action and Coping Booster Implementation Intentions on Fruit Intake at Six Months' Follow-up

The second main finding relates to the long-term effects of the action and coping booster implementation intentions administered at three months. It was revealed that participants who formed an action implementation intention at baseline followed by either a coping booster at three months or an action booster at three months ate significantly more fruit than any other combination of manipulations across the duration of the study. The action implementation intention + coping booster generated slightly higher portions of fruit at six months than the action implementation intention + action booster, representing total increases of 0.40 daily portions (d = .36) and 0.30 daily portions (d = .26) respectively, although this difference again failed to reach significance. However, support for the booster hypothesis was revealed for a second time by the median-split analyses at six months, which showed that the added effect of the action implementation intention + coping booster was most successful for participants eating one or fewer portions of fruit at the beginning of the study. In contrast, no differences between conditions were found

for the high baseline consumers, demonstrating that the long-term booster effect had no additional impact for those already eating two or more portions at baseline. This finding therefore provides some evidence for the suggestion that action and coping planning can be usefully combined with the booster technique to enhance longer-term behaviour change, particularly when aimed at participants with little experience of performing the target behaviour. It is also interesting to note that the overall long-term effect was not reciprocated in the coping implementation intention + action booster condition, which provides additional evidence that the presenting order of the manipulations was important in this instance, as opposed to the combined baseline effect of action and coping planning seen in previous research.

5.5.3 Demand Characteristics Revisited

The third hypothesis of the present study relates to the test of a more thorough active control condition, in which participants were encouraged to make general plans to increase their fruit intake. In accordance with previous Chapters, the active control was not effective in encouraging participants to increase fruit intake, despite providing behavioural encouragement and comparable engagement with the health-related materials. Although participants in the present active control condition were asked to plan to change their behaviour, crucially they were not asked to specify the cue-response link underpinning implementation intention formation. This supports findings from previous implementation intention interventions (e.g. Armitage, 2008; Armitage & Arden, 2008), and in combination with previous Chapters provides robust evidence for the genuine effects of implementation intentions.

5.5.4 Motivation Manipulation Check

The final point for discussion relates to the use of TPB variables to control for the effects of motivation. Consistent with previous findings, no differences in TPB variables were demonstrated between conditions at either three or six months' follow-up, once again suggesting that the changes in fruit intake cannot be explained by changes in motivation and thus offering additional support for the volitional effects of implementation intentions on behaviour (see Section 1.5.3.1).

5.6 Chapter Summary

In conclusion, the present Chapter provides partial evidence that action implementation intentions are most efficient in promoting fruit intake over the short-term, and that an action implementation intention at baseline followed by a coping booster implementation intention at three months may be particularly beneficial for long-term maintenance. However, this pattern was only demonstrated in participants consuming low baseline fruit intake, appearing to suggest that action implementation intentions and coping boosters may be usefully targeted at samples intending to initiate behaviour change. These findings lend empirical support to the theoretical underpinnings of action and coping implementation intentions (cf. Scholz et al., 2008; Sniehotta et al., 2005), and additionally extend the current literature by demonstrating that the planning subconstructs can be usefully applied to the domain of dietary behaviour without the presence of a health professional.

5.7 The Next Step

The preceding Chapter therefore aimed to build upon Chapter 2 and further address the third aim of the thesis, which was to investigate ways in which to improve

long-term behaviour change by implementation intentions. Chapter 6 will now summarise, compare and evaluate the research presented here and in previous empirical Chapters, in addition to discussing the conceptual and theoretical implications arising from this work. To conclude, ways in which these findings may be taken forward will be presented with suggestions for future research.

Chapter 6- Summary, Implications and Limitations

6.1 Introduction

The present Chapter provides an evaluation of the empirical work of the thesis. More specifically, Chapter 6 will revisit the main themes generated by the systematic review of previous literature, and assesses the extent to which the thesis aims have been met. Briefly, Chapter 1 highlighted four main aims. First, to provide a further overall assessment of the efficacy of implementation intentions to increase fruit and vegetable intake, while addressing potential methodological difficulties associated with attrition rates (Chapters 2 to 5). Second, to investigate the potential role of demand characteristics that have been suggested to underlie the effects of implementation intentions (Chapters 2 to 5). Third, to design and assess methods of extending the long-term efficacy of implementation intentions to increase fruit and vegetables (Chapters 2 and 5); and fourth, to investigate whether the effects of the interventions could be improved by targeting fruit and vegetables separately instead of combining the food groups (Chapters 3 and 4). In line with previous studies, the empirical Chapters of the thesis continued to control for TPB variables in order to provide further clarification regarding the potential mediating role of motivation (Chapters 2 to 5). A summary and comparison of the findings related to the thesis aims are presented, followed by a discussion of the potential limitations of this work and suggestions for future research.

6.2 The Efficacy of Implementation Intentions to Increase Fruit and Vegetable Intake

Section 6.2 compares the results of the present thesis with those of the systematic review in Chapter 1 to provide an overall assessment of implementation intentions in relation to fruit and vegetable intake. The results from fruit and vegetables combined, fruit intake only, and vegetable intake only will be considered. For clarity, this Section focuses on the thesis findings generated by a single implementation intention only (for discussion of booster implementation intentions, see Section 6.4).

6.2.1 Fruit and Vegetable Intake Combined

6.2.1.1 Short-term Findings up to Three Months

The systematic review in Chapter 1 revealed that to date, implementation intention-based interventions to increase both fruit and vegetables combined had small-to-medium and medium-to-large effect sizes of d = .34 and d = .71 over one week (Kellar & Abraham, 2005; Gratton et al., 2007; see Chapter 1, Table 1.3). In comparison, single implementation intentions to increase fruit and vegetables administered over the shortest follow-up of three months in Chapter 2 yielded small effect sizes of d = .20 and .24, which are somewhat smaller than those reported by Kellar and Abraham and Gratton et al. However, the effect sizes in previous research were based on the sub-groups of the sample for whom all data were available, therefore potentially leading to reduced generalisability and inflation of type 1 error (see Chapter 1, Section 1.6.3.3). The ITT analysis used in the thesis may therefore represent a more practical interpretation of the effects (cf. Fergusson et al., 2002).

6.2.1.2 Long-term Findings up to Six Months

Lusczcynska et al. (2007) found a medium effect size for their combined self-efficacy and implementation intention intervention over six months, $d = .53$, however no differences were found between the combined intervention and a self-efficacy only intervention ($d = .62$; Chapter 1, Table 1.3). This suggests that the planning component in Lusczcynska et al.'s study had no additional impact on fruit and vegetable intake over and above motivational variables, providing only partial support for long-term implementation intention effects in this area. The findings reported in Chapter 2 similarly suggest that a single implementation intention manipulation is insufficient to engender a lasting effect on fruit and vegetable intake over a six-month period. Interestingly, Chapter 2 demonstrated that a single implementation intention administered at baseline resulted in a significant increase in fruit and vegetable intake at three months, but not at six months. This finding is important in that it provides theoretical support for the proposition that implementation intentions are subject to cognitive interference over time (cf. Koestner et al., 2006; Sniehotta et al., 2005). The implication is that long-term implementation intention-based behaviour change may require top-up interventions in order to maintain the initial effects (see Section 6.4.1). As this line of research is in its infancy, it is as yet unclear whether this is the case for other health behaviours. It may be that the 'drop off' effect demonstrated in Chapter 2 is more prevalent in complex lifestyle health behaviours such as dietary goals; however, previous research has also reported a temporal decline in goal achievement for BSE, which is a single performance task (see Prestwich et al., 2005, Study 1). Further research is required to determine the length of time taken for the effects of implementation intentions to become habitual in dietary intake and other health behaviours.

6.2.2 Fruit Intake

For the four tests of fruit intake alone, the systematic review revealed small (d = .27; De Nooijer et al., 2006) and medium-to-large effect sizes (d = .61; Armitage, 2007) across one and two weeks (mean d = .44; see Chapter 1, Table 1.3). The five tests of single fruit-only implementation intentions in Chapters 3, 4 and 5 of the present thesis ranged from d = .21 to d = .48, yielding an average effect size of d = .30. This is comparable to previous research despite using ITT analysis and being performed over longer time frames of two and three months (see Section 6.2.1.1). The present findings therefore demonstrate that implementation intentions are an efficacious and robust means of increasing fruit and vegetable intake for up to three months.

6.2.3 Vegetable Intake

Kellar and Abraham (2006) conducted the only study to date that tested implementation intentions in relation to vegetable intake alone, and reported a small effect size of d = .22 over one week (Chapter 1, Table 1.3). Chapter 3 hypothesised that this effect could be improved by administering separate implementation intentions for fruit and vegetables, to promote behaviour-specific formation of vegetable-increasing strategies. However, despite showing a significant increase over the control group after two months, the vegetable intake of the experimental condition revealed a very small effect size of d = .13. The two possible explanations for this finding were that: (1) the act of forming two implementation intentions in one sitting resulted in a fatiguing effect or a reduction in the encoding of the plans, or (2) vegetable intake is particularly resistant to change. Chapter 4 tested the former proposition by comparing separate implementation intentions for fruit and vegetables, however no increase in vegetable intake was found after two months. Taken together,

these findings suggest that implementation intentions appear to be of limited value for increasing vegetable intake. This is congruent with previous research indicating vegetable intake to be less amenable to change than fruit intake (cf. Anderson et al., 1998; Cox et al., 1998b), and confirms the authors' proposition that greater efforts are required to specifically target vegetable consumption.

6.2.4 Summary

Regarding the first general aim of the thesis, the four intervention studies in Chapters 2 to 5 revealed that a single implementation intention manipulation at baseline appears to be a useful and consistent means of increasing a combined measure of fruit and vegetable intake, and fruit intake only, for up to three months; generating small to medium effect sizes. However, it was found that the beneficial effect of a single implementation intention could not be sustained for six months. Additionally, little evidence was found in the present thesis to generate support for the efficacy of implementation intentions on vegetable intake alone. The content analysis performed on written implementation intentions in Chapters 3 and 4 shed further light on potential reasons for this finding, and are discussed in more detail in Section 6.5.

6.3 The Role of Demand Characteristics

The second aim of the thesis was to investigate the potential role of demand characteristics in relation to the effects of implementation intentions, particularly in relation to the use of passive control conditions and the awareness of study aims. The findings across the empirical Chapters are summarised and discussed as follows.

6.3.1 Passive Controls Versus Active Controls

The genuine effects of implementation intentions were called into question by Jackson et al. (2005), who suggested that providing participants with active encouragement to increase their daily intake of fruit and vegetables may engender similar effects to those generated by the planning manipulation (see Chapter 1, Section 1.6.3.4). Chapter 2 provided a direct test of this by comparing the effects of a standard passive control group with an active control group synonymous with that of Jackson et al., in which participants were explicitly asked to increase their intake of fruit and vegetables. However, no changes in fruit and vegetable intake were found for either the passive or active control group, suggesting that the active control condition had no benefit on behaviour. Chapters 3 and 4 provided a further three tests of the same active control condition for fruit intake and vegetable intake separately, and again no change in behaviour was demonstrated across studies.

However, it could be argued that although the active control conditions tested in Chapters 2 to 4 controlled for encouragement to perform the behaviour, they still differed from the experimental manipulations in content and duration. Chapter 5 therefore encouraged participants in the control group to not only increase their behaviour, but also to plan to do so. Thus, implementation intentions were tested against a more equivalently active control group, which was similar to the intervention in terms of exposure and the level of engagement with the health-related materials. Again, no changes in behaviour were demonstrated.

6.3.2 Awareness of Study Aims

A further test of demand characteristics was provided by assessing the level of participant awareness of the general aims of the study. In addition to highlighting the potential problems with passive control conditions, Jackson et al. (2005) argue that implementation intention research may be biased by a heavy reliance on student samples. This may lead to a higher rate of socially desirable responding as students may be more aware of the study aims. Chapter 1 therefore tested this directly, and found that participants who completed implementation intentions were no more likely to correctly anticipate the aims of the study than those randomised to the control groups. Furthermore, whether or not participants were aware of the study aims did not seem to affect reported fruit and vegetable intake.

The clear implication is that experimenter demand does not appear to underlie implementation intention effects. Conceptually, the present findings provide support for previous applied research suggesting that the 'active ingredient' within an implementation intention is the linking of a critical situation with a goal-directed response (see Armitage & Arden, 2008). By controlling for the effects of a general planning manipulation, is was possible to distinguish implementation intentions from other related planning exercises such as goal setting or action planning. Congruent with laboratory based studies, the current findings therefore strongly suggest that the unique effects of implementation intentions can be attributed to the specific formation of the cue-response link (cf. Webb & Sheeran, 2008). This in turn has implications for future implementation intention studies. To reiterate the argument presented in Chapter 1 (Section 1.6.3.4), it is important that continued steps are taken to employ a more stringent application of the 'if-then' format in the instructions issued to participants, in order to strengthen the underlying mechanisms and maximise the effects.

6.3.3 Summary

The present thesis ruled out the possibility of bias from differences in expectancies and attentional demands between conditions. It is therefore concluded that the effects of implementation intentions on fruit and vegetable intake are genuine.

6.4 Extending the Long-term Impact of Implementation Intentions

The third aim of the thesis was to investigate ways to extend the long-term efficacy of implementation intentions on fruit and vegetable intake. This was a particularly important goal, as the evidence for sustained implementation intention effects in this area is limited. The following Section reviews the findings of Chapters 2 and 5 and considers the resulting implications.

6.4.1 Booster Implementation Intentions

Chapter 2 established that a single implementation intention was insufficient to increase fruit and vegetable intake over six months, supporting the suggestion that implementation intentions are subject to deterioration over time (see Section 6.2.1.2). However, when the implementation intention deployed at baseline was supplemented by a repeated implementation intention at three months, the effect size of the change in fruit and vegetable intake increased from d = .24 to d = .38. The repeated implementation intention instruction therefore served as a booster to further promote fruit and vegetable intake over and above the initial benefits demonstrated at three months.

This finding is important in a number of ways. On a practical level, the findings suggest that booster implementation intentions may represent an extremely time and cost-effective means of both maintaining and augmenting behaviour change over a long period of time. As previous longitudinal interventions have typically employed interview-assisted or tailored designs, the present findings in comparison offer a promising and inexpensive means of promoting sustained behaviour change without the requirement of a health professional (cf. De Vet, 2007). Furthermore, these findings add to the growing body of literature suggesting that health interventions can be successfully administered online (see Vallejo, Jordán, Díaz, Comeche & Ortega, 2007, for detailed discussion). Internet research has advantages over traditional pencil-and-paper methods of collecting data in that it can quickly and easily access large populations and achieve rapid returns that are time and cost saving. Therefore, it is very encouraging that beneficial changes in fruit and vegetable intake can be instigated and maintained over six months via a web-based intervention. From a pubic health perspective, the 0.57 daily fruit and vegetable portion increase from baseline to six months is of considerable importance, as evidence indicates an increase in just one half serving per day could, if maintained, result in an 8% lower cancer incidence rate (WCRF, 1997). The preliminary test of booster implementation intentions in Chapter 2 therefore represents a worthy starting point from which to develop future long-term interventions.

6.4.2 Action and Coping Implementation Intentions

Chapter 5 aimed to extend the booster findings of Chapter 2 by testing the impact of an action implementation intention at baseline followed by a coping booster implementation intention at three months. This was in response to indications from

previous literature that action planning may be useful for facilitating behaviour change, whereas coping planning may be helpful for maintaining the change by anticipating and protecting against potential barriers to action (cf. Sniehotta et al., 2005; see Chapter 5, Section 5.2). To recap briefly, findings at three months revealed that both action and coping implementation intentions had significantly increased fruit intake, but no differences were found between them. At six months, the greatest change in fruit intake was demonstrated by participants who received an action implementation intention followed by a coping booster, however this did not differ significantly from the action implementation intention + action booster condition. Analysis on the subsample of low baseline fruit consumers showed that action implementation intentions were more effective than coping implementation intentions over three months, and the action implementation intention + coping booster was the most successful combination of interventions at the end of the study. Conversely, analysis on the subgroup of high baseline consumers showed that coping implementation intentions were more useful than action implementation intentions from baseline to three months, but no differences between groups were found after six months.

These findings are important for a number of reasons. First, they extend the previous action and coping planning literature by providing an attempt to experimentally tease apart the unique effects of action and coping planning. Studies to date have tested interventions consisting of combined action and planning instructions deployed at baseline only, therefore the independent effects of the planning components on behaviour have previously remained unclear (see Sniehotta et al., 2006). Second, Chapter 5 of the present thesis represents the first study to demonstrate empirical evidence for order effects associated with action and coping

implementation intentions. For example, the effects generated from an action implementation intention + coping booster were not reciprocated in the coping implementation intention + action booster group, supporting the theoretical hypothesis that coping planning is of little value to those who have limited experience of their personal barriers to health (e.g. Sniehotta et al., 2005; 2006; Scholz et al., 2008). The findings from the high baseline fruit consumers further support this idea, by showing a greater overall effect for coping planning from baseline to three months. However, this initial change in fruit intake for high baseline consumers was not enhanced at six months, and as such no differences between the booster conditions were found at the end of the study. As the mean of the high baseline fruit consumers at three months was 2.67 daily portions (Chapter 5, Table 5.2), a likely explanation of this finding is that the impact of the boosters were lost to ceiling effects in this subgroup. Additional research is required in order to speculate further.

The initial implication of Chapter 5 is that while action implementation intentions and coping boosters show promise in extending long-term behaviour change, it may be more usefully tailored towards individuals with low fruit intake. However, it is important to note that although the intervention failed to generate a significant main effect over six months on the fruit intake of high baseline consumers, neither did it demonstrate harmful effects; with slight increases reported from baseline in all conditions (see Chapter 5, Figure 5.4). Additionally, the overall effects of the significant booster interventions at six months were very similar to those reported in Chapter 2 (*d*s = .36 and *d* = .38, respectively), despite failing to generate support for the original hypothesis regarding expected differences between action and coping manipulations. Therefore, the value of screening and targeting the intervention at low or high baseline consumers is questionable in terms of the added time and

expense. Rather, research efforts may be more usefully directed towards extending the current preliminary findings to benefit as broad a range of participants as possible (see Section 6.8.2 for further suggestions).

6.4.3 Summary

Chapter 2 provided preliminary evidence that the long-term efficacy of implementation intentions can be extended and improved by administering a booster implementation intention after three months. Chapter 5 attempted to build on these findings by drawing upon a distinction between action and coping implementation intentions and testing them in relation to boosters. Supporting the theoretical background of action and coping planning, an action implementation intention followed by a coping booster was found to be the most efficacious over six months, but this effect was only demonstrated in the subsample of participants who had a low intake of fruit at the beginning of the study. Thus, although Chapter 5 revealed important insights into the underlying processes of the action and coping concepts, the long-term efficacy of the intervention was not improved over and above Chapter 2 as anticipated. Overall, the significant long-term impact of booster implementation intentions across studies were similar, demonstrating an average small-to-medium effect size of $d = .37$ in comparison with an average of $d = .23$ from baseline to three months.

6.5 Fruit and Vegetables as a Combined Food Group

The fourth aim of the thesis was to investigate whether the effects of implementation intentions could be improved by targeting fruit and vegetables separately, rather than combined within the same intervention. Section 6.2 discussed

the main findings from Chapters 3 and 4, which indicated that although fruit intake was successfully changed by both combined and separate interventions; little support was generated overall for vegetable intake. The following Section considers the findings from the content analyses of Chapters 3 and 4, which give insight into the processes and consumer preferences underlying attempts to change fruit and vegetable intake. The conceptual implications of these findings are discussed in relation to future intervention efforts and clarification for national recommendations.

6.5.1 Differences in Behavioural Strategies

Chapters 3 and 4 provided evidence that the content of implementation intentions differed according to whether participants were planning to change their fruit intake or their vegetable intake. When attempting to increase fruit intake, a significant majority of participants made behavioural strategies that focused on the target action of consumption. Furthermore, these strategies were demonstrated to be the most beneficial for behaviour change. When attempting to increase vegetable intake, however, Chapter 3 showed that most participants chose to focus on preparatory strategies, concerning the acquisition and preparation of meals. Despite this, neither Chapter 3 nor Chapter 4 demonstrated that any particular behavioural strategy type was superior for increasing vegetable intake. The implications of this are twofold. First, the findings provide evidence that the psychological processes governing fruit and vegetable consumption are distinct. Future studies should therefore avoid study designs that attempt to change both behaviours within a single implementation intention. Second, the present findings also reveal that, as predicted, changing vegetable consumption appears to be less straightforward than fruit. Even though consumers in Chapter 3 made implementation intentions containing

preparatory strategies to facilitate their vegetable intake, these strategies had little impact on their actual consumption. Given the dearth of research directed solely at promoting vegetable intake, further investigation into the complex culinary strategies associated with vegetable consumption is required. However, one potential explanation for the lack of association between preparatory behavioural strategies and subsequent change in vegetable intake could be related to the use of a student sample. For example, many students live in catered halls, and therefore may not get the opportunity to acquire and prepare their own meals as often as members of the general population. Thus, the analyses should be repeated in other populations before firm conclusions can be drawn. Also, it is worth noting that the manipulations in the present study used examples of implementation intentions for both fruit and vegetables that contained target strategies only; therefore it is possible the examples skewed the formation of the responses. However, given that the examples were designed to be as similar as possible across conditions; and that a higher number of preparatory strategies were generated to increase vegetable intake, it seems unlikely that participants simply copied the target examples given. Again, further research is warranted.

6.5.2 Findings from Analysis of Combined Implementation Intention

Chapter 3 additionally performed content analysis of written plans formed in response to the combined implementation intention manipulation, to determine whether participants followed instructions to plan for both fruit and vegetables. However, only 38% of participants formed implementation intentions to increase both food groups, and over a third generated plans to increase their fruit intake only. Furthermore, implementation intentions aimed at increasing fruit and vegetables

combined, and implementation intentions aimed at increasing fruit only, generated successful changes in fruit intake; but implementation intention type did not have a behavioural effect on vegetable consumption. This is a particularly salient finding in that it demonstrates that participants do not target fruit and vegetables equally when asked to increase intake. This finding is congruent with previous research revealing a marked preference for fruit amongst consumers (e.g. Anderson et al., 1998; see Chapter 3, Section 3.2.2). Therefore, it is unclear whether the effects of combined interventions from previous studies, including those reported in Chapter 2, are generated by an increase in fruit and vegetables as intended, or by a change in fruit only. This is an important issue given the distinct health benefits associated with individual vegetables and fruits (see Chapter 1, Section 1.2).

In addition to differences in the tastes, culinary uses and practices of fruits and vegetables, the present thesis has also indicated that the psychological processes underlying their consumption are distinct. The efficacy of fruit and vegetable promoting strategies may be enhanced if fruit and vegetables are addressed separately; furthermore, interventions that specifically focus on vegetables require particular attention. However, the more wide-reaching implication is that the current '5 A Day' message is clearly open to different interpretations. In line with the national programmes of countries including Greece, Australia and the US, specific guidelines on the separate recommendations for each food group should be issued to highlight the health benefits of consuming a diet high in both vegetables and fruit (see also Chapter 1, Section 1.3). Consequently, the term 'vegetables and fruit' should be used interchangeably with 'fruit and vegetables', to prevent fruit taking priority.

6.5.3 Summary

The present thesis has demonstrated that the promotion of fruits and vegetables may require different behavioural strategies for optimum benefits. Additionally, fruit and vegetables are not targeted equally by combined interventions. Both intervention efforts and national recommendations would benefit from a clear definition of fruit and vegetables as separate food groups. Interventions that focus specifically on vegetables require particular attention, as it is with regard to vegetables that the deficit is more substantial.

6.6 The Role of Motivation

A secondary aim of the thesis was to continue to control for potential effects of motivation to perform the behaviour. With the exception of Gratton et al. (2007), no previous implementation intention-based interventions to increase fruit and / or vegetable intake have demonstrated support for the idea that implementation intention effects can be explained in terms of motivational processes (see Chapter 1, Section 1.6.3.2). Similarly, the present empirical Chapters found no changes between experimental and control conditions for measures of attitude, intention, social norm or PBC across studies. There were other motivational variables that were not assessed, such as perceived past behaviour and anticipated regret. However, given Webb and Sheeran's (2008) recent meta-analysis reported effect sizes of *d*s < .10 for the association between implementation intentions and motivational variables, it seems unlikely that the inclusion of additional measures would have impacted the findings (Chapter 1, Section 1.5.3.1). Thus, consistent with previous research and Gollwitzer's (1993) MAP, the implication is that the changes in behaviour cannot be explained by changes in motivation, offering support for the genuine volitional mechanisms of implementation intentions.

6.7 Potential Limitations

Potential limitations of the present thesis should be noted before solid conclusions can be drawn. The main issues across Chapters centre on the use of a student sample and the measures of behaviour. The following Section will discuss these issues in more depth.

6.7.1 Student Sample

As highlighted in Chapter 1 (Section 1.3), students represent an important target for fruit and vegetable interventions, as young adults aged 16 – 24 years are the lowest fruit and vegetable consumers of all age groups. However, the fruit and vegetable intake of the present student samples were surprisingly consistent with those found in the UK population as a whole. Conversely, the sample was over-representative of the general population in terms of a higher proportion of female participants, and a higher level of education. The latter point raises the issue of whether the use of self-administered questionnaires with minimal experimenter contact would generate comparable effects in groups who have a lower level of education, or who are less literate than the current sample. Further, the web-based design of the studies reported in the thesis require both access to a computer and a degree of computer literacy. Therefore, caution is warranted before generalising the results of the present research.

6.7.2 Measures of Behaviour

A second potential problem across Chapters relates to the measures of behaviour. As these were self-reported, they may be susceptible to potential sources

of bias from social desirability responding to unreliable recall of diet. Objective measures, such as biomarkers or direct observation of dietary behaviour were impractical for the present thesis due to the size and length of the studies being conducted. Nonetheless, a more objective measure of behaviour would have been desirable to improve reliability. However, support for the present findings can be generated to some extent from previous studies that have successfully applied implementation intentions to change objectively verifiable behaviour (e.g. Sheeran & Orbell, 2000; see also Gollwitzer & Sheeran, 2006). Furthermore, it is worth noting that in contrast to self-reported behaviour, self-reports of cognition did not change as a result of the interventions. If the present findings were associated with reporting biases, one would expect a general shift in responses to both behavioural and psychological outcomes (see also Armitage, 2008; Armitage & Arden, 2008). In light of this, there are grounds for a degree of confidence in present findings.

6.8 Extending the Work Reported in the Thesis: Directions for Future Research

The final Section considers the way in which the findings of the thesis may be taken forward. In addition to recommendations for the separation of fruit and vegetables in future interventions (see Section 6.2.5), the two main issues arising from the empirical Chapters are regarding the lack of change for vegetable intake and attempts to extend the preliminary findings from booster implementation intentions. These are discussed below, followed by a general point of interest arising from the thesis regarding the use of control conditions.

6.8.1 Targeting Vegetable Intake

Sections 6.2 and 6.5 highlighted the problems associated with increasing vegetable intake. Despite demonstrating that planning strategies focusing on the acquisition and preparation of vegetables were more popular than those focusing on the target action of consumption, little behavioural impact was made. This is in contrast to Kellar and Abraham (2006), who found a small effect size for their combined motivational and preparatory-structured implementation intention manipulation. This would suggest that a worthy avenue for future research would be to test a more stringent enforcement of preparatory behavioural strategies to promote vegetable intake, in the form of pre-formatted implementation intentions. The research in the present thesis steered away from researcher-imposed implementation intentions due to suggestions that the reduced flexibility could potentially discourage participants and even result in an adverse effect (cf. Sheeran et al., 2005). Elsewhere it has been suggested that individuals are the experts on their own lifestyle, and are therefore better placed to generate a personal and meaningful strategy for change (Sniehotta et al., 2005). However, given that vegetable intake may require a particularly specific approach, it is recommended that future studies aim to experimentally manipulate target and preparatory strategies to gain a greater insight into the determinants of increased vegetable consumption. Also, as very few studies to date have considered vegetable intake as a separate food group, further research into the potential barriers to change is warranted to inform intervention efforts.

An additional point relates to motivation to increase vegetable intake. The TPB measures taken across the Chapters in the present thesis showed that overall, participants were highly motivated to change their behaviour throughout the duration of the studies. However, a potential flaw of the TPB measures was that while Chapters 3 and 4 addressed fruit and vegetables separately, motivation to increase

intake was taken as a combined measure (see Chapter 4, Section 4.5.3). Therefore, it is somewhat unclear whether one's motivation to increase vegetable intake is comparable with motivation to increase fruit. From this standpoint, the possibility that an undetected lack of motivation underpins the disappointing effects on vegetable intake cannot be overruled. Future research should aim to clarify this issue, and also consider employing implementation intention interventions with an added motivational component, congruent with Kellar and Abraham (2006).

6.8.2 Extending the Booster Concept

The second important area for future research relates to the initial long-term findings from booster implementation intentions. Chapters 2 and 5 represent an exciting base on which to build further interventions, as preliminary results suggest that booster implementation intentions are an extremely cost and time efficient means of sustaining long-term behaviour change. Useful avenues for research would be to investigate the mechanisms responsible for the temporal decline of implementation intentions on fruit and vegetable intake, in order to further develop methods to maximise their impact. It is interesting that both Koester et al. (2006) and Sniehotta et al. (2005) agree that implementation intentions are subject to deterioration over time, yet present alternative explanations for this. For example, Koestner et al. highlight memory decay as the mediating factor, along with the role of spontaneous distractions that cannot be anticipated at the initial formation of the plan. This speaks to the idea that the plan may need to be refreshed in memory at a later date, or continually amended to meet ever-evolving challenges. In contrast, Sniehotta and colleagues highlight the role of competing obstacles that may interfere with the original action plan. As such, coping plans are suggested to overcome potential interference from the

start of behaviour change. In light of the findings from Chapters 2 and 5, it may be that a combination of both rationales would benefit long-term behaviour change. That is, the effects of an action implementation intention + a coping booster may work particularly well if participants are also given the opportunity to refresh or change their original plans over time, as suggested by Koestner et al. Future work may provide a more detailed examination of these ideas in order to shed more light on ways to assist people in initiating and maintaining positive behaviour patterns over a prolonged period of time.

6.8.3 Control Conditions

Finally, an additional point of interest regards the general use of passive controls. The findings of the empirical Chapters generate support for the genuine impact of previous implementation intention studies employing passive control conditions, which implies that future studies could reduce the overall length of the questionnaire without deleterious effects. Alternatively, it could be suggested that the worth of enrolling participants to passive control groups is somewhat questionable. For example, research with clinical populations such as Jackson et al. (2005) is subject to strict ethical guidelines that require participants across the study to receive full information about the research design, and usually a form of standard care. However, it is argued that while not an ethical requirement, participants from all populations taking part in health intervention studies should get the opportunity to glean some benefit from the experience. Therefore, future implementation intention research on non-clinical populations should aim to employ active control groups as standard; to further reduce the potential for inconsistencies in demand characteristics

but more importantly, to offer more detailed and potentially beneficial information to control participants.

6.9 Conclusion

Overall, implementation intentions are a useful and robust intervention tool for increasing fruit. Some evidence was generated to support the potential of implementation intentions to promote vegetable intake; however, further research in this area is required. Part of the problem may rest in the targeting of fruit and vegetables as an aggregated food group, as consumers show a preference for fruit consumption. Recommendations are geared towards a separation of fruit and vegetables in future studies. The long-term efficacy of implementation intentions may be improved by administering boosters, and the potential of action and coping planning constructs may represent a useful addition to the booster concept. The present thesis provides a useful basis for building further research programmes.

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