Promoting Fruit and Vegetable Consumption: Modeling Behaviour Change Using the Theory of Planned Behaviour

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Abstract

Despite fruit and vegetable consumption’s substantial health benefits for physical health and the reduction of disease risk (World Health Organisation, 2002), many young adults fail to consume recommended quantities of fruit and vegetables (Australian Bureau of Statistics, 1997). This design and evaluation of an intervention intended to increase fruit and vegetable consumption in Australian young adults is reported in the present thesis. The intervention was guided by the theory of planned behaviour (Ajzen, 1991; Fishbein & Ajzen, 2010) and focused on increasing fruit and vegetable consumption through change in attitude, subjective norms, and perceived behavioural control. The intervention was designed on the basis of extensive preliminary work which guided the selection of a theoretical framework and identified salient beliefs that should be targeted in intervention materials. Intervention content was based on findings from preliminary quantitative and qualitative research presented. Analyses showed that the intervention was highly acceptable to participants but did not lead to significant changes in fruit and vegetable consumption relative to the control condition. Despite the fact that the theory of planned behaviour provided a good model for the prediction of fruit and vegetable consumption across multiple studies, results indicate that the theory could not be meaningfully be applied to the modelling of change in fruit and vegetable consumption in this population. This finding adds to the growing body of research suggesting that models that can be reliably applied to the prediction of behaviour are not necessarily applicable to behaviour change (Hardeman, Kinmonth, Michie, & Sutton, 2011). Researchers who wish to use theories such as the theory of planned behaviour in health research should consider the implications of this research for both intervention design and behaviour change theory more broadly. Specifically, researchers should consider the evidence
that the TPB may not be an effective means to develop interventions designed to increase fruit and vegetable intake.
Publications relating to this thesis

The following publications are related to this thesis and are included in the Appendices.


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Chapter 1

Introduction

Fruit and vegetable consumption is linked to increased risk of serious disease and illness (Begg et al., 2007; International Agency for Research on Cancer, 2003; World Health Organisation, 2002). It has been estimated that inadequate fruit and vegetable intake is the cause of 31% of ischemic heart disease, 11% of stroke (World Health Organisation, 2002), and 5–12% of cancers (International Agency for Research on Cancer, 2003). In Australia, inadequate fruit and vegetable consumption is estimated to contribute to 9% of the total burden of disease (Begg, et al., 2007). The health implications of inadequate fruit and vegetable consumption suggest a need for in-depth understanding of the factors underlying low fruit and vegetable consumption and improved methods to increase consumption. Indeed, decreasing the incidence of chronic noncommunicable diseases which have been linked to inadequate fruit and vegetable consumption is a major goal of public health policy in Australia and around the world (The National Priority Action Council, 2005; World Health Organisation; World Health Organisation).

As I will argue in this thesis, one of the primary challenges for researchers working in the area of fruit and vegetable consumption is to develop effective interventions that target factors likely to influence intake. One of the principal ways in which researchers have tackled the challenge of effective intervention design is through the use of psychological theory. Major reviews of behaviour change and methods of intervention design recognise this approach in the development and evaluation of interventions (e.g. Bartholomew, Parcel, Kok, & Gottlieb, 2001; House of Lords;...
Science and Technology Committee, 2011). A number of meta-analytic reviews of the use of theory in intervention design have concluded that more extensive use of theory was associated with larger intervention effects (Brug, Debie, van Assema, & Weijts, 1995; Webb, Joseph, Yardley, & Michie, 2010). Consistent with these findings – a recent review of the science of behaviour change argued that improvements in the link between behavioural intervention to specified behaviour change techniques and theoretical mechanisms of change are areas where advances are urgently needed in order to improve scientific standards within the field of health-related behaviour change (Michie & Johnston, 2012).

**Aims and Scope of the Thesis**

Within this context, the aim of this thesis is to investigate whether a social cognition model of behaviour can be used to design and evaluate an intervention to increase fruit and vegetable consumption in the Australian context.

Due to the research context of the present thesis (i.e., resource constraints of the PhD project), the focus of this project has the individual as the unit of analysis.

**Overview of the Thesis**

There is a large body of literature relating to best practices for the design and evaluation of behaviour change interventions (e.g., Bartholomew, et al., 2001; Glanz, Rimer, Lewis, & Jossey-Bass, 2008a). Research suggests that there are a number of qualitatively separate stages of intervention design that may occur in an iterative process (Bartholomew, et al., 2001).

In light of this body of research, the research problem was divided into four stages described in Figure 1. The rationale for the design of each stage is presented below.
Figure 1. Outline of the research conducted in this thesis
Establishing the need for the intervention. Most major theories of intervention design recognise the importance of establishing the need for an intervention to change a given behaviour before the design and evaluation of interventions designed to modify that behaviour (Bartholomew, et al., 2001; Glanz, et al., 2008a). This stage of intervention design is intended to provide a rationale for intervention development and should provide a comprehensive assessment of health problems and their causes (Bartholomew, et al., 2001). Providing a rationale for the need to intervene in a given population can take the form of a review of existing literature, the conduct of original research, or a combination of both (Bartholomew, et al., 2001). Given the time constraints of a PhD thesis as well as the large body of research investigating patterns of fruit and vegetable intake in the Australian population and the health consequences of low consumption of fruit and vegetables, the first stage of research takes the form of a review of relevant literature. This review is presented in Chapter 2.

Selection of a theoretical framework. The selection of a theoretical framework is central to theory-based intervention design practice and evaluation (Bartholomew, et al., 2001). Effective program design is dependent on the selection of relevant theories of behaviour to inform both content selection and program evaluation (Bartholomew, et al., 2001; Glanz, et al., 2008a). The second stage of research presented in this thesis relates to the selection of a theoretical framework for use in all subsequent stages of intervention design, implementation, and evaluation. The selection of a theoretical framework for use in the design of the intervention presented in this thesis was conducted in two steps.

The first step is a critical review of the literature that describes the current state of research in this area and provides a critique of the literature linking major theories of
behaviour to the prediction and modification of fruit and vegetable consumption. The review will be used to identify a theory of behaviour likely to be useful in the design of the current intervention. The review of major theories is presented in Chapter 3.

The second step is a prospective predictive study that applies the selected model to the prediction of fruit and vegetable intake in the target population. Several theories of intervention design—for example, intervention mapping—argue that preliminary testing of the selected theory is required in order to verify that the hypothesised determinants of behaviour are relevant to the target population and to explore population specific expressions of those determinants (Bartholomew, et al., 2001). The second study reported in this thesis is designed to establish whether the assumptions from the selected model about the prediction of behaviour hold true in the target population. The design, methods, and results of this prospective study are presented in Chapter 4.

**Intervention design and piloting.** The development of intervention content is integral to all intervention design (Bartholomew, et al., 2001; Campbell et al., 2000; Glanz, et al., 2008a). The intervention design and piloting stage of this project ensured that the intervention developed during this research project reflected the needs and preference of the target population. This was likely to increase the perceived relevance of the intervention and ensure that the intervention is appropriate to the target group (Lutz et al., 1999; Oenema, Tan, & Brug, 2005; Smeets, Kremers, de Vries, & Brug, 2007).

These issues were addressed in two steps. Using a focus-group design, the first step addressed idiosyncratic expressions of theory-relevant constructs, intervention preferences, and needs. The study, presented in Chapter 5, was designed to elicit beliefs about fruit and vegetable intake held by the target population in order to help develop a
detailed understanding of perceived needs and intervention preferences within the target population.

The second stage of intervention design and piloting was the preliminary evaluation of the intervention in order to determine the feasibility and acceptability of the proposed intervention. Intervention components that targeted salient beliefs were identified and included in the intervention materials using an intervention mapping approach. This process, presented in Chapter 6, was a vital step in ensuring that the final intervention was suitable for the selected target population.

**Intervention implementation and evaluation.** The final stage of research presented in this thesis was the implementation and evaluation of the intervention developed through the earlier stages. It was essential that any newly developed intervention be tested according to change in participant’s behaviour. Because the intervention was theory based, it was also important to evaluate the extent to which the intervention led to intended changes in theory-relevant constructs. In particular, the extent to which the effect of the intervention is mediated by change in theory-relevant constructs is an important part of assessing theory-based interventions. The results of studies investigating the short-term efficacy of the intervention are presented in Chapter 7. Whilst there are other aspects of intervention evaluation, such as longer term testing of intervention effects, the research presented in the current thesis was limited to the evaluation of the immediate postintervention change.
Chapter 2

Fruit and Vegetable Consumption and Physical Health: The Need for Intervention in the Australian Context

The Epidemiological Transition

Over the past century, causes of disease and death have shifted dramatically. Where infectious diseases were once amongst the leading causes of morbidity and mortality, the most common causes of death are now noncommunicable chronic diseases (Armstrong, Conn, & Pinner, 1999; Taylor, Lewis, & Powles, 2008). This shift, known as the epidemiologic transition (Mackenbach, 1994; Omran, 1971), has been led in large part by improvements to living conditions, sanitation, and medical care (Armstrong, et al., 1999; Mackenbach, 1994; Taylor, et al., 2008). Consistent with epidemiologic transition theory, the decreasing impact of infectious disease on mortality has been observed in high-, middle-, and low-income countries (Mackenbach, 1994; Taylor, et al., 2008; World Health Organisation, 2008). In Australia, with the exception of the peak in mortality related to the 1918 Spanish flu epidemic, mortality attributable to infectious disease fell steadily between 1907 and 1990 (Taylor, et al., 2008). According to the most recent data, infectious diseases are now responsible for only 1.3% of Australian mortality (Australian Bureau of Statistics, 2010).

However, even as rates of infectious disease mortality have fallen, the mortality and morbidity associated with noncommunicable chronic disease has risen. In 2008 the World Health Organisation estimated that 48% of the global disease burden is now due to noncommunicable disease (World Health Organisation, 2008). This was expected to reach 66% of the global disease burden by 2030 (World Health Organisation, 2008).
Indeed, almost 60% of Australian mortality is now caused by circulatory diseases and cancer (Australian Bureau of Statistics, 2010). These diseases are also responsible for a significant proportion of the burden of disease in Australia. Cardiovascular diseases alone accounted for 18% of the overall disease burden in 2003 and $5.5 billion dollars in health expenditure from 2000 to 2001 (Begg, et al., 2007). In addition to being major causes of morbidity and health expenditure, chronic noncommunicable illnesses are also associated with high levels of disability, low quality of life, and high levels of distress (Ayis, Gooberman-Hill, & Ebrahim, 2003; Cott, Gignac, & Badley, 1999; Derogatis, Morrow, & Fetting, 1983; Frasure-Smith, 1991; Johnson & Wolinsky, 1993; Sellick & Crooks, 1999).

**Fruit and Vegetable Consumption and Noncommunicable Disease Morbidity and Mortality**

Unsurprisingly, decreasing the incidence of chronic noncommunicable disease is a major goal of public health policy in Australia and around the world (The National Priority Action Council, 2005; World Health Organisation). In 1996, the Australian Institute of Health and Welfare developed the National Health Priority Areas initiative (The National Priority Action Council, 2005). The National Health Priority Areas initiative is a collaborative public-health effort focusing on those aspects of health that contribute significantly to the burden of illness and injury and that have the potential for health gains in relation to the burden of disease (The National Priority Action Council, 2005). At present, the Australian Institute of Health and Welfare and the National Health Priority Action Council recognise seven priority areas:
• arthritis and musculoskeletal conditions
• asthma
• cancer control
• cardiovascular health
• diabetes mellitus
• injury prevention and control
• mental health (The National Priority Action Council, 2005)

Together these health areas account for over 80% of the total burden of injury and disease in Australia (The National Priority Action Council, 2005). The initiative also focuses on risk factors that are shared across two or more National Health Priority Areas, including physical inactivity, excess body weight, tobacco smoking, and poor diet and nutrition. This thesis focuses on one of these risk factors: poor diet and nutrition.

The majority of the burden of disease related to poor diet and nutrition is associated with just two dietary risk factors—inadequate fruit and vegetable consumption and high intake of saturated fat (World Health Organisation, 2004). Of these, low fruit and vegetable intake appears to be the larger contributor to the burden of disease. A study of the influence of diet-related factors on burden of disease in the European Union found that low fruit and vegetable consumption accounted for 3.5% of the European Union burden of disease, whereas saturated fat intake accounted for just 1.1% of the burden of disease (National Institute of Public Health, 1997).

**Cardiovascular diseases and fruit and vegetable consumption.** The World Health Organisation has estimated that inadequate fruit and vegetable intake is the cause of 31% of ischemic heart disease and 11% of stroke (World Health Organisation,
It has further been estimated that 85% of the global burden of disease attributable to low fruit and vegetable intake is related to cardiovascular diseases (World Health Organisation, 2002). According to quantification of global burdens of disease associated with fruit and vegetable consumption conducted by the World Health Organisation (2004), a 80g increase in daily fruit and vegetable consumption was related to a relative risk ratio of .90 for ischaemic heart disease, and 0.94 for ischaemic stroke. According to these estimates, increasing average worldwide consumption of fruit and vegetable to 600g a day would reduce the burden of disease attributable to ischaemic heart disease by 31% and the burden of disease associated with ischaemic stroke by 19% (World Health Organisation, 2004).

Overall, the research linking fruit and vegetable consumption to diseases of the heart and blood vessels is still in its early stages, with most evidence for a protective effect of fruit and vegetables coming from cohort and case-control studies (e.g. Dauchet, Amouyel, & Dallongeville, 2009; Dauchet, Amouyel, Hercberg, & Dallongeville, 2006a; He, Nowson, & MacGregor, 2006). An inverse relationship between fruit and vegetable consumption and cardiovascular events, both coronary heart disease and stroke, has been found in a number of observational studies (see: Dauchet, et al., 2006a). Meta-analysis of cohort studies of coronary heart disease incidence has suggested that the risk of coronary heart disease is reduced by 4% for each additional portion of fruit and by 7% for each additional portion of fruit and vegetables (Dauchet, et al., 2006a). Similarly, a meta-analysis of stroke events suggested that individuals who consumed five or more servings of fruit and vegetables each day were 26% less likely to suffer from a stroke than individuals who consumed less than three servings of fruit and vegetables each day (He, et al., 2006).
Interpretation of observational data of this kind tends to be controversial. Many have argued (e.g. Dauchet, et al., 2009; Dauchet, et al., 2006a) that frequent consumers of fruit and vegetables are likely to engage in other behaviours that influence cardiovascular-disease risk and that these lifestyle factors may represent a major confound. Research tends to support this argument. For example, high fruit and vegetable intake has been associated with higher levels of physical activity, lower levels of alcohol intake, and never-smoking status across a number of large international studies (Boffetta et al., 2010; Joshipura et al., 1999).

While a series of randomised controlled trials of fruit- and vegetable-based diets would be an ideal method of assessing the effect of fruit and vegetable consumption in the absence of such confounds, such studies tend to be extremely difficult to perform (Brunner, Rees, Ward, Burke, & Thorogood, 2007). In particular, as a recent Cochrane review of dietary advice to reduce cardiovascular disease risk shows, researchers have experienced difficulties in achieving large changes in fruit and vegetable consumption that can be maintained over the course of suitably long follow-up periods to allow for evaluation of cardiovascular disease outcomes (Brunner, et al., 2007). These results highlight the problem of achieving and maintaining adequate increases in fruit and vegetable consumption in order to investigate the link between fruit and vegetable intake and cardiovascular disease incidence (Dauchet, et al., 2009). These problems are partially resolved by trials investigating the effect of fruit and vegetable intake on cardiovascular-disease risk factors, because these surrogate endpoints can be evaluated using a much shorter follow-up period. Such studies also have an important role in establishing the biological plausibility of a causal relationship between inadequate fruit and vegetable intake and cardiovascular disease.
There have been a number of short-term randomised controlled trials that indicate that consumption of fruit and vegetables has an effect on risk factors associated with coronary heart disease (Dauchet et al., 2006b; Rankins, Sampson, Brown, & Jenkins-Salley, 2005). In particular, increases in fruit and vegetable consumption under controlled conditions have been shown to result in drops in both systolic and diastolic blood pressure in a number of randomised controlled trials studies (Dauchet, et al., 2006b; Rankins, et al., 2005). Results from short-term randomised controlled trials on the effect of fruit and vegetable consumption on cholesterol also provide support for the biological plausibility of cardioprotective effects of fruit and vegetable consumption. For example, one recent study conducted with hyperlipidemic individuals showed that increased consumption of a diet high in vegetable proteins leads to lower levels of LDL-C in the blood (Jenkins et al., 2009). Together these studies provide convincing evidence for a link between fruit and vegetable consumption and both blood-pressure regulation and cholesterol levels; they also strengthen the body of evidence linking fruit and vegetable intake to circulatory diseases.

**Cancer and fruit and vegetable consumption.** International research has estimated that low fruit and vegetable consumption is responsible for 5–12% of cancers (International Agency for Research on Cancer, 2003). It appears that the majority of this cancer burden related to fruit and vegetable consumption is seen in lung, oesophageal, gastric, and colorectal cancers (World Health Organisation, 2004). According to quantification of global burdens of disease associated with fruit and vegetable consumption conducted by the World Health Organisation, a 80g increase in daily fruit and vegetable consumption is related to a relative risk ratio of .96 for cancers of both the lung and colorectum, and 0.94 for oesophageal and gastric cancers (World Health Organisation, 2004). According to these estimates, increasing average
worldwide consumption of fruit and vegetable to 600g per day would reduce the burden of disease attributable to cancers of the lung, oesophagus, colorectum, and stomach by 12%, 19%, 2%, and 19%, respectively (World Health Organisation, 2004). Importantly, research also suggests that a significant reduction in cancer risk can be achieved from small increases in fruit and vegetable intake. An increase in fruit and vegetable intake of just 50g per day, for example, has been associated with a 15% reduction in cancer mortality (Khaw et al., 2001).

The link between fruit and vegetable consumption and various cancers has been considered in a large number of case-control and cohort studies and has been reviewed extensively in reports of the literature jointly conducted by the World Cancer Research Fund and the American Cancer Research Institute in 2007 and 1997. The evidence for a link between fruit or vegetable consumption—or both—and cancers of the colorectum, lung, oesophagus and stomach is outlined in Table 1 and Table 2.

**Table 1**

*Evidence Linking Fruit Intake with Risk of Cancer at Various Sites*

<table>
<thead>
<tr>
<th>Cancer site</th>
<th>Level of evidence</th>
<th>Dose-response relationship</th>
<th>Evidence for plausible mechanisms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lung</td>
<td>Probable</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Colorectum</td>
<td>Limited</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Stomach</td>
<td>Probable</td>
<td>Yes*</td>
<td>Yes</td>
</tr>
<tr>
<td>Oesophagus</td>
<td>Probable</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

*More consistent evidence from case-control than cohort data*

Table 2

Evidence Linking Vegetable Intake with Risk of Cancer at Various Sites

<table>
<thead>
<tr>
<th>Cancer site</th>
<th>Level of evidence</th>
<th>Dose-response relationship</th>
<th>Evidence for plausible mechanisms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lung</td>
<td>Limited</td>
<td>Yes</td>
<td>-</td>
</tr>
<tr>
<td>Colorectum</td>
<td>Limited</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Stomach</td>
<td>Probable</td>
<td>Yes#</td>
<td>Yes</td>
</tr>
<tr>
<td>Oesophagus</td>
<td>Probable</td>
<td>Some evidence</td>
<td>Yes</td>
</tr>
</tbody>
</table>

# Evidence from case-control but not cohort data


In addition to the evidence linking fruit and vegetable consumption with reduced risk of cancer mentioned in Table 1 and Table 2, the World Cancer Research Fund and American Cancer Research Institute (2007) also noted that there is evidence of a probable link between fruit and vegetable consumption and lower risk of cancers of the mouth, pharynx, and larynx. There is also limited evidence that nonstarchy vegetables may also protect against cancers of the ovary, endometrium, and nasopharynx—and that fruits may also protect against cancers of the liver, pancreas, and nasopharynx (World Cancer Research Fund and American Institute for Cancer Research, 2007).

As reported in Table 1 and Table 2, there is also evidence for plausible pathways for the cancer protective effects of both fruit and vegetables. In particular, there is evidence suggesting that folate, beta-carotene, lycopene, vitamin C, quercetin, and dietary fibre protect against cancer at various sites (World Cancer Research Fund and American Institute for Cancer Research, 2007).
**Other diseases.** Research suggests that a diet high in fruit and vegetables is linked to decreased risk of cataract formation, asthma, and bronchitis (Van Duyn & Pivonka, 2000) and that fruit and vegetable consumption plays an important role in weight management and obesity risk (FAO/WHO, 2003). In particular, it appears that consumption of fruit and vegetables is likely to be an important factor in weight regulation because, in comparison to other foods, most fruits and vegetables are energy dilute and have high fibre content (FAO/WHO, 2003). This has lead the World Health Organisation to recommend increased consumption as a means of reducing obesity at a population level (FAO/WHO, 2003).

While decreasing obesity is an important public health goal in its own right, it is particularly important in this context, given the relationship of body weight to risk of both cardiovascular diseases and certain cancers. The link between body weight and heart disease is long established (Hubert, Feinleib, McNamara, & Castelli, 1983). There is a substantial body of evidence showing that increases in body weight have a significant impact on heart disease risk and management (Eckel & Krauss, 1998; Hubert, et al., 1983; Poirier et al., 2006). Obesity is also a known risk factor for a range of cancers, including postmenopausal breast cancer, and cancers of the colon, kidney, oesophagus, and endometrium (International Agency for Research on Cancer, 2002). Given these links, fruit and vegetables may also indirectly reduce cardiovascular disease and cancer risks through the link between fruit and vegetable consumption and weight management.

**Dietary Guidelines for Fruit and Vegetable Consumption**

In light of the links between fruit and vegetable consumption and the risk of cardiovascular disease, cancer, and other life-limiting diseases, governments around the world have recommended that individuals regularly consume a range of fruit and
vegetables. The Australian government, for example, recommends that Australian adults consume two pieces of fruit and five servings of vegetables each day in order to achieve and maintain optimal health (National Health and Medical Research Council, 2003). Table 3 shows dietary guidelines from a number of different countries as they relate to fruit and vegetables.

**Table 3**

*Recommended Daily Intake of Fruit and Vegetables for Adults by Country*

<table>
<thead>
<tr>
<th>Country</th>
<th>Recommended daily intake of fruit and vegetables</th>
<th>Serving size</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>2 servings of fruit and 5 servings of vegetables</td>
<td>Fruit: 150g</td>
<td>Dietary Guidelines for Australian Adults</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vegetables: 75g</td>
<td></td>
</tr>
<tr>
<td>UK</td>
<td>5 servings of fruit and vegetables</td>
<td>Fruit: 80g</td>
<td>5 A DAY</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vegetables: 80g</td>
<td></td>
</tr>
<tr>
<td>USA</td>
<td>4 to 13 servings of fruit and vegetables*</td>
<td>Fruit: ½ cup</td>
<td>Dietary Guidelines for Americans</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vegetables: ½ cup</td>
<td></td>
</tr>
<tr>
<td>New Zealand</td>
<td>At least 5 servings per day, 3 servings of vegetables and 2 servings of fruit</td>
<td>About a handful</td>
<td>Food and Nutrition Guidelines for Healthy Adults</td>
</tr>
</tbody>
</table>

*Recommendations vary depending on age, gender and level of physical activity*

Adapted from *Food and Nutrition Guidelines for Healthy Adults: A Background Paper*, by the Ministry of Health, copyright 2003 by Ministry of Health; *Dietary Guidelines for Australian Adults*, by the National Health and Medical Research Council; copyright 2003 by the National Health and Medical Research Council; and *Dietary Guidelines for Americans 2010*, by the U.S. Department of Agriculture and the U.S. Department of Health and Human Services, copyright 2010 by U.S. Government Printing Office.

Unlike many other countries (e.g., UK, USA, NZ), Australia uses a serving-size measurement for fruit that is different from the standard for vegetables. According to
the *Australian Guide to Healthy Eating* (*The Australian Guide to Healthy Eating*, 1998), a serving of vegetables is 75g. This equates to one cup of salad vegetables, one medium potato, or half cup of cooked vegetables, beans, or pulses. A serving of fruit is 150g, which is equivalent to 125ml of fruit juice, one cup of diced fruit, one medium-sized piece of fruit, such as an apple, or one and a half tablespoons of dried fruit (*The Australian Guide to Healthy Eating*, 1998). The fruits and vegetables included under the Australian guidelines are broadly consistent with those foods included under international recommendations, with the notable exception of the inclusion of potato, which is excluded from World Health Organisation recommendations. World Health Organisation (World Health Organisation) guidelines for fruit and vegetable consumption call for the consumption of 400g of fruit and vegetables, excluding roots and tubers such as potatoes, cassavas, and yams.

**Rates of Fruit and Vegetable Consumption**

The most recent data on consumption of fruit and vegetables in the Australian population was collected as part of the 2007–2008 National Health Survey (Australian Bureau of Statistics, 2009a). The survey included a nationally representative sample of 20,800 Australians. According to that survey, only 6.2% of all Australians aged 15 and above met dietary guidelines for fruit and vegetable consumption (Australian Bureau of Statistics, 2009a). Table 4 reports the proportion of individuals surveyed who reported consuming fruit and vegetables at different levels of consumption (categorised by servings per day).
As can be seen in Table 4, 6.2% of Australians aged over 15 years report consuming no fruit and 0.7% report consuming no vegetables during the day before the survey. According to the National Health Survey, the majority of individuals reported eating less than half of the recommended intake of fruit and vegetables each day (Australian Bureau of Statistics, 2009a).

These results are consistent with results from earlier Australian data sets. For example, data collected in New South Wales in 2006 indicated that only 51% of adults ate two or more servings of fruit and only 7% of adults ate five or more servings of vegetables each day (Population Health Division, 2006). Earlier National Health Surveys also found similar patterns, with more than 47% of Australian adults reporting eating fewer than two servings of fruit each day, and almost 70% reporting eating fewer than four servings of vegetables (Australian Institute of Health and Welfare, 2001). High rates of inadequate fruit and vegetable consumption observed in Australia are broadly consistent with consumption patterns around the world. For example, in the
USA, 80% of all American adults consumed fewer than five servings of fruit and vegetables each day in 2005 (Blanck, Gillespie, Kimmons, Seymour, & Serdula, 2008).

**Demographic Correlates of Inadequate Fruit and Vegetable Consumption**

Analyses of fruit and vegetable consumption patterns in Australia and around the world indicate a large degree of variability in fruit and vegetable consumption in different population subgroups. In particular, fruit and vegetable consumption appears to vary as a function of age and socioeconomic status (Blanck, et al., 2008; Hall, Moore, Harper, & Lynch, 2009).

**Age.** The World Health Organisation calculated age-stratified mean fruit- and vegetable-consumption rates by region in 2004 (World Health Organisation, 2004). According to those estimates, fruit and vegetable consumption was lowest amongst 15–29-year-olds across six of 14 regions; in all other regions young adults had the second lowest consumption of fruit and vegetables of any age group. Regions where fruit and vegetable consumption was low amongst young adults included America-A, which included USA, Canada, and Cuba; America-B, which included Mexico and much of South America; Europe-A, which included most of western Europe, including France, Germany, the UK, and the Netherlands; and the Western Pacific Region-A, which consisted of Australia, Japan, New Zealand, and Singapore (World Health Organisation, 2004). This is consistent with age-stratified results from a number of national surveys of fruit and vegetable consumption in Australia, where young adults have consistently been found to be less likely than older adults to consume adequate quantities of fruit and vegetables (e.g. Australian Bureau of Statistics, 1997).

Patterns of low fruit and vegetable consumption in young adults across most western industrialised countries is of particular interest the known trajectory of dietary patterns over time. Analyses of changes in individuals’ dietary habits over time show
that whilst dietary patterns are likely to change over time only 17% of individuals will improve their dietary pattern over a 10 year period (Pachucki, 2011). Instead, the majority of individuals will stay in entrenched in poor dietary practices or will decrease the quality of their dietary practices over time (Pachucki, 2011). As such, low consumption of fruit and vegetables currently observed amongst young adults might reasonably be assumed to predict poor dietary habits that will continue or worsen across the lifespan. Importantly, individuals who do engage in healthy patterns of dietary consumption are the group most likely to maintain dietary patterns over time (Pachucki, 2011), suggesting that if individuals can improve their fruit and vegetable consumption this increased consumption may be maintained over the long term.

Young adults have the lowest life time exposure to poor diet of any adult age group (World Health Organisation, 2004), which would suggest that the reversibility of the health risks associated with their dietary practices is likely to be higher than in other groups, especially if improved diet can be maintained. As such, increases in fruit and vegetable consumption in young adulthood have the potential for large impacts on both an individual’s lifetime risk of disease and for global burden of disease.

**Socioeconomic status.** The relationship between fruit and vegetable consumption and socioeconomic status has been investigated in a large number of cross-sectional studies in Australia and elsewhere. Australian studies have found that gross annual household income, occupation, and education—all common measures of socioeconomic status—are all positively correlated with fruit and vegetable consumption and purchasing (Hamer & Chida, 2007; Jenkins, et al., 2009; Kritharides & Stocker, 2002; Rissanen et al., 2003). This relationship is such that those with higher household incomes, higher levels of education, or occupations that require a greater number of skills consume the greatest quantities and variety of fruit and vegetables.
This pattern is consistent with data from the UK and USA (Hertog, Feskens, Kromhout, Hollman, & Katan, 1993; Katsiki & Manes, 2009).

These three factors—education, income, and occupation—may co-vary substantially (Hamer & Chida, 2007). However, studies suggest that income has a relationship with fruit and vegetable consumption that is not accounted for by variations in occupation or education and that the influence of income may attenuate the relationship between fruit and vegetable consumption and the other two factors (Hamer & Chida, 2007). This finding has led some researchers to argue that the link between socioeconomic status and fruit and vegetable consumption is likely to reflect, at least in part, structural and financial barriers to consumption in low-income groups (Hamer & Chida, 2007; Jenkins, et al., 2009). In particular, it has been suggested that fruit and vegetable consumption may be a function of the cost of fruit and vegetables as a proportion of discretionary income, and that low consumption may reflect the limited availability of affordable, high-quality produce in relatively impoverished environments (Hamer & Chida, 2007; Jenkins, et al., 2009; Katsiki & Manes, 2009; Kris-Etherton, Lichtenstein, Howard, Steinberg, & Witztum, 2004).

**Selection of a Target Group**

There is considerable evidence linking both socioeconomic status and age to variation in fruit and vegetable consumption. Based on this evidence, there is substantial justification to intervene to increase fruit and vegetable consumption in either Australian young adults or individuals of low socioeconomic position. However, whilst there may be strong justification to intervene in either group, the capacity for improvement should also be considered when seeking to select a target group for any intervention (Bartholomew, et al., 2001). The present thesis focuses on achieving change in fruit and vegetable consumption through intervention strategies that centre on
change at an individual level. As such, it is important to consider the extent to which there is capacity to improve fruit and vegetable consumption through approaches that target individual change for each of these potential target groups.

One issue that may limit capacity for improvement through interventions targeted at the individual is the extent to which low fruit and vegetable consumption reflects structural barriers to intake in a given population. There is little evidence to suggest that low fruit and vegetable consumption in young adults is a result of entrenched disadvantage or structural constraints; however, this does not appear to be the case when considering groups with low socioeconomic status. Instead, as already discussed, the evidence suggests that low fruit and vegetable consumption in low-socioeconomic-status groups may reflect low availability of affordable fruit and vegetables in relatively impoverished environments. These kinds of structural constraints may limit the capacity to increase fruit and vegetable consumption in groups with low socioeconomic status through purely psychosocial interventions. Instead, large gains in fruit and vegetable consumption are likely to require changes at the community or societal level that may require substantial changes in public health policy. Indeed, most interventions to increase fruit and vegetable consumption in low-income groups have supported the suggestion that increasing fruit and vegetable consumption in these groups requires intervention at multiple levels (Feldman et al., 2000; Havas et al., 2003; Herman, Harrison, Afifi, & Jenks, 2008). Unfortunately, such research is outside the scope of this thesis. As such, the intervention presented in this thesis focuses on increasing fruit and vegetable consumption in Australian young adults, because the existing research in this area suggests that this group is likely to be amenable to increasing fruit and vegetable consumption through psychosocial interventions that focus on bringing about change at the individual level.
Young adults can also be difficult to access through traditional intervention channels. In particular, the majority of fruit and vegetable interventions have been implemented in workplaces or schools (Ammerman, Lindquist, Lohr, & Hersey, 2002 & Hersey, 2002; Knai, Pomerleau, Lock, & McKee, 2006; Pomerleau, Lock, Knai, & McKee, 2005). However, a large number of young adults are not currently enrolled in secondary schooling or working in paid employment (Australian Bureau of Statistics, 2009b), meaning that interventions delivered through these channels have a limited capacity to reach young adults. However, over 40% of Australian 18–25-year-olds are currently enrolled in tertiary education (Australian Bureau of Statistics, 2009b); making higher-education settings, such as universities, one possible type of venue for increasing intervention reach for this age group. As such, the research presented in this thesis makes use of university-based samples of young adults.

**Conclusion**

This chapter has outlined the body of evidence linking fruit and vegetable consumption with increased risk of serious noncommunicable diseases. The balance of evidence clearly suggests that inadequate fruit and vegetable consumption is a major risk factor for cardiovascular disease and some types of cancer. On the basis of this evidence, the NHMRC recommends that Australian adults consume at least two servings of fruit and five servings of vegetables each day. However, data from national surveys of Australian dietary practices show that few Australians consume the recommended quantities of fruit and vegetables. Consistent with data from a range of western industrialised countries, consumption of fruit and vegetables is especially low in young adults and individuals from relatively impoverished environments.

Together, the link between low fruit and vegetable intake and increased disease burden, represents a compelling case for intervention in order to increase fruit and
vegetable intake within the Australian population. In particular, there is substantial
evidence suggesting a need to intervene to increase fruit and vegetable consumption in
Australian young adults.

The development of strategies to address low fruit and vegetable intake requires
an in-depth understanding of the factors underlying low fruit and vegetable
consumption. Chapter 3 reviews research on factors underlying low fruit and vegetable
consumption in the context of major theories of health psychology. The way in which
each theory has been used to understand fruit and vegetable consumption is discussed
in order to identify the theory most appropriate for use in an intervention to increase
fruit and vegetable consumption of Australian young adults in the university setting.
Chapter 3

Selection of a Theoretical Framework for Use in Intervention Design: A Critical Review of the Literature

Psychosocial Predictors of Fruit and Vegetable Consumption

Extensive research has investigated psychosocial correlates of fruit and vegetable consumption. A recent review of cross-sectional and prospective studies which have examined predictors of fruit and vegetable consumption identified twelve constructs for which there is strong or sufficient evidence for a link between that construct and fruit and vegetable consumption in adults (Shaikh, Yaroch, Nebeling, Yeh, & Resnicow, 2008). These variables were:

- knowledge
- self-efficacy / perceived control / perceived behavioural control
- social support/encouragement/influence
- anticipated regret
- barriers
- enabling factors
- intentions
- autonomous motivation
- attitudes/beliefs
- benefits
- predisposing factors
- stages of change (Shaikh et al., 2008)
This is broadly consistent with studies in cohorts of young adults, which have linked many of these factors to the prediction of fruit and vegetable consumption (Beresford, Klesges, & Rockett, 2008; French & Hankins, 2003; Michie & Johnston, 2012; Peterson et al., 2008). However, as the final part of this chapter shows, very few studies have systematically applied these constructs to the design and evaluation of interventions to increase fruit and vegetable consumption in this age group. Because of the lack of studies specifically investigating factors underlying fruit and vegetable consumption in the target population, this chapter will include evidence from studies investigating the fruit and vegetable consumption of the broader population of healthy adults.

While many studies have provided evidence of a link between fruit and vegetable consumption and a number of individual constructs, each of these constructs has limited predictive validity in isolation, and it is difficult to integrate these varied constructs into a single conceptual framework that is suitable for use in intervention design. This is arguably the primary weakness of a single-predictor approach to modelling of behaviour. Such an approach also does not take into account the influence of each of these constructs in combination, meaning that interactions between constructs which may be useful in the prediction and modification of fruit and vegetable consumption are ignored, as is the possibility of multicollinearity of some effects. This means that the predictive utility of an approach that combines all of these variables is unknown. The final consideration when seeking to apply findings from this approach to the prediction and modification of fruit and vegetable consumption is the issue of parsimony. While these constructs may provide a useful starting point for understanding fruit and vegetable consumption, they probably do not represent the smallest, most efficient set of variables required. Rather than attempting to apply all of
these constructs to the issue of fruit and vegetable consumption simultaneously, it is likely that it may be more productive to make use of conceptual and theoretical frameworks that include a subsection of these constructs.

**Applying Social Cognition Models to the Prediction of Behaviour**

A number of theoretical frameworks have been used to attempt to predict and change health behaviours. According to a review of the use of theory in health promotion between 2000 and 2005 (Painter, Borba, Hynes, Mays, & Glanz, 2008), the most commonly applied theories are the transtheoretical stages of change model (Prochaska, Redding, & Evers, 2002), social cognitive theory (Bandura, 1986; Smith, 1998), the health belief model (Becker, 1976; Rosenstock, 1990), and the theory of planned behaviour (Ajzen, 1991). These theories focus on the social and cognitive factors underlying behaviour. All four theories use cognitive processes to analyse and evaluate behaviours and outcomes; the process of evaluation is thought to occur unconsciously and leads to a motivational state in which a decision is made to carry out a given course of behaviour (Bermudez, 1999). Each of these theories includes variables identified by Shaikh et al.’s (2008) review of psychosocial predictors of fruit and vegetable consumption. These models represent an improvement over the use of single psychosocial constructs because they address issues of parsimony and the relationships between constructs. The following sections provide a description of each of these major theories and consider the evidence linking each theory to the successful prediction of fruit and vegetable consumption amongst healthy individuals.

**Transtheoretical stages of change model.** *Description.* The transtheoretical stages of change model (Prochaska, 1984; Prochaska, et al., 2002) is a stage model of behaviour that considers individuals as being at discrete ordered stages of readiness for
behavioural change (Rutter & Quine, 2002). The model includes four major constructs: stage of change, processes of change, decisional balance, and self-efficacy.

Stage of change is the primary construct of the transtheoretical stages of change model and is the focus of the majority of the research using this model (Prochaska, et al., 2002). The model proposes five ordered stages of behaviour. The stages are considered ordered because each stage implies a greater inclination to perform the desired behaviour than proceeding stages; however, the model asserts that individuals can progress from one stage to another in a nonlinear fashion, for example by moving backwards from later stages to earlier ones, or by skipping one or more stages (Prochaska, et al., 2002). The stages of change proposed by the transtheoretical stages of change model are outlined below using fruit and vegetable consumption as an illustration (see Table 5).
### Table 5

**Stages of Change with Illustrative Examples**

<table>
<thead>
<tr>
<th>Stage</th>
<th>Definition</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precontemplation</td>
<td>Has no intention of changing within the next six months</td>
<td>An individual who is not currently thinking of increasing fruit and vegetable consumption and may not realise that current intake of fruit and vegetables is inadequate</td>
</tr>
<tr>
<td>Contemplation</td>
<td>Intends to take action within the next six months</td>
<td>An individual who recognises the need to increase fruit and vegetable consumption but does not plan to change their diet immediately</td>
</tr>
<tr>
<td>Preparation</td>
<td>Intends to take action within the next 30 days and has taken some preparatory behavioural steps</td>
<td>An individual who has concrete plans to increase fruit and vegetable consumption and has begun to implement a plan, for example by purchasing fruit and vegetables or creating a menu plan</td>
</tr>
<tr>
<td>Action</td>
<td>Has changed their overt behaviour for less than six months</td>
<td>An individual who has recently increased fruit and vegetable consumption</td>
</tr>
<tr>
<td>Maintenance</td>
<td>Has changed overt behaviour for more than six months</td>
<td>An individual who changed diet some time ago and is now maintaining increased levels of fruit and vegetable consumption</td>
</tr>
</tbody>
</table>

Adapted from *Health Behavior and Health Education: Theory, Research, and Practice*, by Glanz, K., Rimer, B. K., & Lewis, F. M. Copyright 2008 by Jossey-Bass.

Each of the stages of change included in the model is assumed to be qualitatively distinct. In particular, each of the stages is argued to be associated with different processes of change (Prochaska, et al., 2002). According to the
transtheoretical stages of change model (Prochaska & Prochaska, 1999; Prochaska, et al., 2002), processes of change can be divided into two broad categories: experiential processes and behavioural processes (see Table 6). Use of both categories of processes of change is thought be lower in earlier stages and to increase as the individual progresses through to later stages (Prochaska, et al., 2002). Processes-of-change use is thought be stage related such that experiential processes are used primarily in preparation and action, while behavioural processes are primarily used in action and maintenance (Rosen, 2000).
Table 6

*Process of Change with Illustrative Examples*

<table>
<thead>
<tr>
<th>Process of change</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Experiential</strong></td>
<td></td>
</tr>
<tr>
<td>Consciousness raising</td>
<td>Raising awareness about inadequate fruit and vegetable consumption</td>
</tr>
<tr>
<td>Dramatic relief</td>
<td>Using affect to help motivate increased fruit and vegetable consumption</td>
</tr>
<tr>
<td>Self-reevaluation</td>
<td>Reassessing thought, feelings and knowledge about inadequate fruit and</td>
</tr>
<tr>
<td></td>
<td>vegetable consumption in relation to oneself</td>
</tr>
<tr>
<td>Self-liberation</td>
<td>Recognising choices, using will power, and making a commitment to</td>
</tr>
<tr>
<td></td>
<td>increase fruit and vegetable consumption</td>
</tr>
<tr>
<td>Social liberation</td>
<td>Becoming aware of changes in the environment that influence fruit and</td>
</tr>
<tr>
<td></td>
<td>vegetable consumption</td>
</tr>
<tr>
<td>Environmental reevaluation</td>
<td>Assessing the impact one’s fruit and vegetable consumption has on others</td>
</tr>
<tr>
<td><strong>Behavioural</strong></td>
<td></td>
</tr>
<tr>
<td>Helping relationships</td>
<td>Seeking and accepting support from others to increase fruit and</td>
</tr>
<tr>
<td></td>
<td>vegetable consumption</td>
</tr>
<tr>
<td>Reinforcement management</td>
<td>Rewarding oneself, or being rewarded by others, for increasing fruit</td>
</tr>
<tr>
<td></td>
<td>and vegetable consumption</td>
</tr>
<tr>
<td>Interpersonal systems</td>
<td>Avoiding individuals who act as barriers to fruit and vegetable</td>
</tr>
<tr>
<td>control</td>
<td>consumption</td>
</tr>
<tr>
<td>Counterconditioning</td>
<td>Substituting healthy thoughts or behaviours in place of unhealthful</td>
</tr>
<tr>
<td></td>
<td>dietary practices</td>
</tr>
<tr>
<td>Stimulus control</td>
<td>Avoiding situations, places, and things that trigger low consumption of</td>
</tr>
<tr>
<td></td>
<td>fruit and vegetables</td>
</tr>
</tbody>
</table>

Adapted from *Health Behavior and Health Education: Theory, Research, and Practice*, by Glanz, K., Rimer, B. K., & Lewis, F. M. Copyright 2008 by Jossey-Bass.
*Decisional balance* refers to a process by which the costs of the behaviour are weighed against the benefits of the behaviour (Prochaska, et al., 2002). Decisional balance is operationalised in the individual’s relative weighting of the pros and cons of changing his or her behaviour. This weighting, as well as the raw number of pros and cons, is thought to be central to stage progression (Prochaska, et al., 2002). Researchers have suggested that, in order for an individual to progress from precontemplation to contemplation, the number of pros must increase; to progress to preparation, the number of cons must decrease; and, to progress to action, the number of pros must be higher than the cons (Prochaska, et al., 2002).

The construct of self-efficacy was derived from Bandura’s work, which has defined self-efficacy as “beliefs in one’s capabilities to organize and execute the courses of action to produce given attainments” (Bandura, 1997, p. 3). This construct was identified by Shaikh et al. (2008) as being associated with fruit and vegetable consumption and, as described below, is included in some form in all of the theories reviewed in this thesis. Self-efficacy is thought to increase across stages in a linear fashion, such that individuals in each stage have higher behaviour-specific self-efficacy than individuals in the proceeding stage (Prochaska, et al., 2002). However, it is unclear whether this relationship is the cause of behaviour change; perhaps increases in self-efficacy are related to mastery experiences as individuals progress through the stages.

*Empirical support.* The transtheoretical stages of change model has been widely applied to the challenge of understanding and modifying fruit and vegetable consumption (Shaikh, et al., 2008). The model has been used to successfully categorise young adults and adolescents into distinct stages of change. For example, a study conducted by Ma, Betts, Horacek, Georgiou, and White (2003) applied the model to the fruit and vegetable consumption of 18–24 year olds living in 10 American states.
According to that study, individuals were split between precontemplation (23%), contemplation (21%), preparation (27%), action (3%), and maintenance (26%) stages. Consistent with the predictions of the model, self-efficacy was positively related to stage of change, so individuals in maintenance had higher self-efficacy than individuals in the action stage. The decisional balance construct was also supported, with the relative weighting of pros and cons more favourable in the later stages than in earlier stages (Ma, et al., 2003).

Studies which have applied the processes of change construct to fruit and vegetable consumption have provided mixed support for the model. For example, while some studies have reported patterns of process-of-change use that is consistent with the model (i.e., greater overall process use in action and maintenance; e.g., Di Noia, Schinke, Prochaska, & Contento, 2006), other studies have found that the use of experiential and behavioural change processes does not differ between stages (de Oliveira, Anderson, Auld, & Kendall, 2005; Di Noia, et al., 2006).

Overall, the balance of evidence linking the transtheoretical stages of change model to prediction of fruit and vegetable consumption was rated by Shaikh et al. as providing sufficient evidence for a link between the theory and fruit and vegetable intake. The review identified 14 studies which had investigated the association between stage of change and fruit and vegetable intake. Of these, five studies found a significant correlation between stage of change and consumption of fruit and vegetables. This provides limited evidence that the stage of change construct is a meaningful predictor of fruit and vegetable consumption. Further, as the authors of that review noted, there are some conceptual issues that should also be taken into account when interpreting these findings. First, it has been argued that the stage-of-change construct is tautological (Sutton, 1996, 2000; Sutton, 2001). Staging algorithms often include
measures of the outcome of interest so that reported fruit and vegetable consumption is used to both stage an individual and as the outcome measure (Shaikh, et al., 2008). This would inflate the association between stage of change and an outcome measure (Shaikh, et al., 2008; Sutton, 2000).

It is also important to note that the review conducted by Shaikh did not consider the whole transtheoretical stage of change model. Most studies using this model, like the review conducted by Shaikh, consider the stage-of-change construct without considering the rest of the theoretical constructs specified by the model (Shaikh, et al., 2008). It has been argued that the focus on stages of change within the research literature may have diverted attention away from more fruitful lines of inquiry, such as the processes of change (Armitage, 2009). The relative paucity of studies that have investigated the entire model should be considered when evaluating the predictive utility of the model; in the absence of studies testing the whole model, it is difficult to determine its value in predicting fruit and vegetable consumption.

Health belief model. Description. The health belief model (Becker, 1976; Rosenstock, 1990) is a value-expectancy model of health behaviour (Glanz, et al., 2008a). The model proposes that people are motivated to carry out preventative health behaviours in response to perceived threats to their health. According to this model, individuals engage in behaviour because of a desire to reduce disease risk (or to improve health) and a belief that specific health behaviours will prevent (or ameliorate) disease (Becker, 1976; Rosenstock, 1990).

As shown in Figure 2, the health belief model posits five factors that determine an individual’s specific health-related behaviour (Becker, 1976; Rosenstock, 1990; Rosenstock, Strecher, & Becker, 1988). These are perceived susceptibility, severity, benefits, barriers, and cues to action. These factors are defined in detail in
Table 7. In addition to these five variables, later formulations of the model have included two other main constructs: health motivation and self-efficacy (Glanz, et al., 2008a).

Figure 2. The health belief model.
### Table 7

**Health Belief Model Variables with Illustrative Examples**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Perceived Severity</strong></td>
<td>The individual’s perception of the seriousness of negative consequences of not performing the behaviour, including the physical, social, and psychological consequences of nonperformance</td>
<td>The belief that cancer is serious and life threatening</td>
</tr>
<tr>
<td><strong>Perceived Susceptibility</strong></td>
<td>The individual’s subjective perception of his or her own risk of encountering negative consequences of behavioural non-performance</td>
<td>The individual’s belief that he/she is likely to be diagnosed with cancer</td>
</tr>
<tr>
<td><strong>Perceived Benefits</strong></td>
<td>The social, physical, and psychological benefits of taking an action that could effectively negate negative consequences of behavioural non-performance</td>
<td>The belief that eating fruit and vegetables reduces cancer risk</td>
</tr>
<tr>
<td><strong>Perceived Barriers</strong></td>
<td>The potential negative consequences or challenges associated with the target behaviour which may act as a deterrent to performing that action</td>
<td>The belief that fruit and vegetables are expensive</td>
</tr>
<tr>
<td><strong>Cue to action</strong></td>
<td>An external or internal event which acts to trigger the behaviour</td>
<td>The presence of a cue in the external environment (e.g. promotional materials) that prompt consumption of fruit and vegetables</td>
</tr>
</tbody>
</table>

Adapted from *Health Behavior and Health Education: Theory, Research, and Practice*, by Glanz, K., Rimer, B. K., & Lewis, F. M. Copyright 2008 by Jossey-Bass.
In general, the theory assumes that individuals will engage in behaviour to reduce risk of disease when they perceive themselves to be at risk of the disease; if they believe the consequences of the disease to be severe; if they believe that the given course of action would have the benefit of either reducing the severity of or susceptibility to the disease; and if they believe that the barriers to performance of the behaviour are low (Becker, 1976; Rosenstock, 1990). According to the model, performance of the behaviour is precipitated by the presence of a specific cue to action.

**Empirical support.** The health belief model has been applied to a small number of studies seeking to explain or modify fruit and vegetable intake. Two constructs from the model, barriers and benefits, were reported as having strong or sufficient evidence of a link to fruit and vegetable consumption in the review conducted by Shaikh et. al. (2008). The association between perceived barriers and fruit and vegetable intake has been investigated in nine studies, six of which found a significant relationship between barriers and consumption (Shaikh, et al., 2008). Similarly, benefits of fruit and vegetable consumption have been investigated in six studies, four of which have linked perception of benefits to fruit and vegetable consumption (Shaikh, et al., 2008). However, few studies have applied the health belief model as a whole to the prediction of fruit and vegetable consumption. A recent meta-analysis of the use of theory in the prediction of adult fruit and vegetable consumption identified just one study that had applied the health belief model to prediction of adult fruit and vegetable consumption (Guillaumie, Godin, & Vézina-Im, 2010). That study, conducted in 1995 with 1,069 American adults, found that nutrition concern (benefits), susceptibility to cancer (perceived susceptibility), and barriers to consumption (barriers) were all significant
predictors of fruit and vegetable intake, and that the model accounted for 16% of the variance in fruit and vegetable consumption (Guillaumie, et al., 2010).

The lack of empirical studies which have applied the health belief model as a whole to the prediction of fruit and vegetable consumption is a major limitation of the research in this area. This is especially the case because the one study which has applied the model operationalised key constructs rather narrowly. For example, the concept of benefits was operationalised as nutrition concerns—suggesting that concern for nutrition is the only perceived benefit of fruit and vegetable consumption. Another concern is the relatively low proportion of variance in fruit and vegetable consumption that was accounted for by health-belief-model variables in that study. Indeed, meta-analysis clearly shows that, when applied to the fruit and vegetable consumption of healthy adults, the explanatory power of the health belief model is lower than the predictive utility of the next two models discussed in this chapter: social cognitive theory and the theory of planned behaviour (Guillaumie, et al., 2010). This may reflect the nature of the variables included in the health belief model, the model focuses on beliefs relevant to illness and its prevention and/or amelioration. These beliefs may not be relevant in the context of fruit and vegetable consumption. This may account for the lack of studies adopting the health belief model in the context of fruit and vegetable consumption and for the low explanatory power of the model when it has been applied.

**Social cognitive theory.** *Description.* Social cognitive theory (Bandura, 1986; Smith, 1998) is a socioenvironmental model of behaviour which seeks to explain behaviour using an approach which recognises the dynamic and reciprocal relationship between behaviour, personal factors (including cognitions), and the environment. According to the theory, environmental factors (such as the availability of resources) interact with personal factors (such as the individual’s evaluation of anticipated
outcomes of behaviour, ability to learn from others, and confidence in his or her own
ability to perform the behaviour) in order to determine behaviour. The performance (or
nonperformance) of behaviour in turn influence these environmental and personal
factors in a process called reciprocal determinism. This relationship is presented
graphically in Figure 3.

![Figure 3. Reciprocal determinism in social cognitive theory](image-url)

*Figure 3. Reciprocal determinism in social cognitive theory*

Adapted from *Health Behavior and Health Education: Theory, Research, and Practice*, by Glanz, K.,
Rimer, B. K., & Lewis, F. M. Copyright 2008 by Jossey-Bass.

The theory has also been graphically depicted in more detail, as in Figure 4.
In addition to the three umbrella constructs of personal factors, environmental factors, and behaviour, a large number of concepts have been included in studies using social cognitive theory (Glanz, et al., 2008a). A summary of some commonly used concepts is included in Table 8.
Table 8

**Social Cognitive Theory Variables with Illustrative Examples**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment</td>
<td>Factors physically external to the individual</td>
<td>The availability of fruit and vegetables in local supermarkets</td>
</tr>
<tr>
<td>Situation</td>
<td>An individual’s perception of their environment</td>
<td>The perceived cost of fruit and vegetables relative to the cost of other items which are highly valued by the individual</td>
</tr>
<tr>
<td>Outcome</td>
<td>Anticipated outcomes of the behaviour</td>
<td>The expectation that fruit and vegetable consumption would lead to appetite control</td>
</tr>
<tr>
<td>Outcome</td>
<td>The evaluation of the expected outcomes of the behaviour by the individual</td>
<td>The evaluation of appetite control as highly desirable to the individual</td>
</tr>
<tr>
<td>Self-control</td>
<td>Regulation of goal-directed behaviour by the individual</td>
<td>The ability to regulate diet by planning ahead to purchase fruit and vegetables</td>
</tr>
<tr>
<td>Observational</td>
<td>Learning through watching the actions of another person and the outcomes of that action</td>
<td>Learning to increase fruit and vegetables after observing a similar other model a healthy diet</td>
</tr>
<tr>
<td>Self-efficacy</td>
<td>The individual’s confidence in their ability to perform the behaviour and/or to overcome barriers to that behaviour</td>
<td>The belief that fruit and vegetable consumption is within an individual’s control</td>
</tr>
</tbody>
</table>

Adapted from *Health Behavior and Health Education: Theory, Research, and Practice*, by Glanz, K., Rimer, B. K., & Lewis, F. M. Copyright 2008 by Jossey-Bass.

**Empirical support.** Social cognitive theory has been widely applied to the challenge of understanding and modifying fruit and vegetable consumption (Guillaumie, et al., 2010; Shaikh, et al., 2008). Overall, a meta-analysis of studies that
have applied social cognition theory to the prediction of fruit and vegetable intake in healthy adults suggested that the theory accounts for 41% of the average variance in intake (Guillaumie, et al., 2010). This is significantly higher than the proportion of variance that has been accounted for using the health belief model (Guillaumie, et al., 2010).

However, when seeking to interpret this finding, it is important to do so in light of the conceptual and methodological challenges that researchers face when applying this theory to the prediction of behaviour. Most notable of these challenges is the large number of concepts that can be encapsulated in social cognition theory as well as the lack of consistency in how the theory is operationalised in predictive studies. Although Bandura has specified the more formal organisation of the theory shown in Figure 5, each of the three studies identified by Guillaumie et al. (2010) measured different concepts at the level of behaviour, the individual, and the environment. For example, one study used social support, self-efficacy, outcome expectations, and self-regulation to operationalise social cognition theory (Johnson, 2004). Another study measured outcome expectations, benefits, preference for meat meals, neophobia, perceived need to increase fruit and vegetable consumption, barriers, social support, self-efficacy, and knowledge (Eckel & Krauss, 1998). The final study measured availability and accessibility of fruit and vegetables, parental involvement, family cohesiveness, age, body mass index, employment status, nutrition knowledge, food preferences, outcome expectancies, modelling, and self-efficacy (Greenwald, Clifford, & Milner, 2001). That such a large degree of variation in variables included in studies which have applied social cognitive theory to fruit and vegetable intake means that it is difficult to determine how to best operationalise the theory in order to predict behaviour. This lack of consistency and parsimony is a major flaw of social cognitive theory based literature,
especially when attempting to systematically model fruit and vegetable consumption for the purposes of methodologically and theoretically rigorous intervention design and evaluation.

Meta-analysis suggests that social cognitive theory and the theory of planned behaviour do not differ from each other with regard to the proportion of variance in adult fruit and vegetable consumption accounted for (Guillaumie, et al., 2010). However, as is argued in the next sections, the theory of planned behaviour is substantially more parsimonious than social cognitive theory and includes a much clearer articulation of the relationship between variables included in each theory.

**Theory of planned behaviour. Description.** The theory of planned behaviour was developed as an extension of the earlier theory of reasoned action (TRA; Fishbein & Ajzen, 1975) and focuses on the cognitive factors that predict behavioural intention. According to this theory, intentions are the immediate precursor to the performance of any behaviour. In general, the stronger the intention to perform a behaviour, the more likely that it will be performed (Ajzen, 1991). As shown in Figure 5, the theory of planned behaviour includes three independent predictors of intention: attitudes, subjective norm, and perceived behaviour control.
Figure 5. The theory of planned behaviour.

These factors are briefly defined in detail in Table 9. The theory of planned behaviour, the relationships between component constructs, and the factors that contribute to the major constructs included in the theory are discussed in detail in Chapter 4.
Table 9

**Theory of Planned Behaviour Variables with Illustrative Examples**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attitude</td>
<td>The individual’s perception of the likely outcomes of the performance of the behaviour and their evaluation of the desirability of that outcome</td>
<td>The belief that fruit and vegetable consumption will lead to weight control, and the evaluation of weight control as highly desirable</td>
</tr>
<tr>
<td>Subjective norm</td>
<td>The individual’s beliefs about whether or not others believe that he/she should perform the behaviour, and the motivation to comply with the views of others</td>
<td>The individual’s belief that important others think that he/she should eat fruit and vegetables, and the desire to comply with that belief</td>
</tr>
<tr>
<td>Perceived Behavioural Control</td>
<td>The extent to which an individual believes that he/she is both capable of and in control of performing the behaviour of interest</td>
<td>The belief that eating fruit and vegetables is easy and within the individual’s control</td>
</tr>
<tr>
<td>Intention</td>
<td>The individual’s readiness and willingness to perform the behaviour of interest</td>
<td>The intention to consume fruit and vegetables daily</td>
</tr>
</tbody>
</table>

Adapted from *Predicting and changing behavior: The reasoned action approach*, by Fishbein, M., & Ajzen, I. Copyright 2010 by Psychology Press.

According to the theory, individuals will intend to consume fruit and vegetables to the extent that they believe the likely outcomes of consumption to be favourable, that they perceive social pressure from people who are important to them, and that they feel capable of consuming fruit and vegetables without difficulty (Fishbein & Ajzen, 2010). In addition to its influence on intention, perceived behavioural control is also thought to have a direct influence on behaviour (Fishbein & Ajzen, 2010).
Empirical support. The theory of planned behaviour has been widely applied to the prediction of behaviour (Armitage & Conner, 2001; Godin & Kok, 1996), including a large number of studies investigating the prediction of fruit and vegetable consumption (Guillaumie, et al., 2010; Shaikh, et al., 2008). All of the variables included in the theory were identified by Shaikh et. al. (2008) as being linked to fruit and vegetable consumption. Overall, meta-analysis of studies that have applied the theory of planned behaviour to the prediction of fruit and vegetable intake in healthy adults suggests that the model accounts for 45% of the variance in intake (Guillaumie, et al., 2010). This is significantly higher than the proportion of variance accounted for using the health belief model and is similar to that accounted for by the social cognitive theory (Guillaumie, et al., 2010).

However, while studies that have predicted fruit and vegetable consumption using the social cognitive model have used up to twelve variables in a single study (Greenwald, et al., 2001), the theory of planned behaviour has accounted for a consistently high proportion of variance in fruit and vegetable consumption using just four variables. This provides parsimony and, unlike the health belief model and social cognitive theory, there is little variation in the way in which this model has been applied to the prediction of behaviour.

Applying Social Cognition Models to the Modification of Behaviour

However, while the evidence showing the utility of the theory of planned behaviour to the prediction of behaviour may be convincing, it is important to note that this evidence relates only to the prediction of naturalistic behaviour. Although it might be reasonable to assume that theories that successfully predict behaviour are more likely to be successfully applied to the modelling and generation of behaviour change than theories that cannot account for variance in behaviour, few empirical studies have
investigated this assumption. It is assumed that increases in fruit and vegetable consumption will occur as the result of interventions that produce changes in theory-relevant constructs. For example, theory of planned behaviour–based behaviour change interventions assume that increases in intention will result in increased performance of the desired behaviour, and that intention change will occur as the result of change in PBC, attitude, subjective norm, or all of these (Fishbein & Ajzen, 2010). However, as Webb and Sheeran’s meta-analysis of the effect of change in intention on change in behaviour clearly shows, this is assumption does not necessarily hold (Webb & Sheeran, 2006). Indeed, that review found a relatively weak relationship between intention change and behaviour change.

Unfortunately, the influence of these theoretical predictors on behaviour change has rarely been studied. One recent systematic review reported the use of theoretical constructs in behavioural interventions to promote intake of fruit and vegetables (Rosen, 2000). That review concluded that the use of theory-based interventions was associated with changes in fruit and vegetable consumption and noted that, while a range of behaviour theories and constructs had been used in interventions, social cognitive theory and the transtheoretical stages of change model were the most commonly used. However, in addition to only considering papers published in the USA between 2005 and 2010, that review did not consider the way in which theory was applied and evaluated (Rosen, 2000). Importantly, this review did not consider the extent to which intervention-related behaviour change could be explained through theorised pathways.

The assumption that theory-based interventions work because of their influence on theory-specified constructs must be tested in order to justify the use of a social cognition model in intervention design. Researchers have argued that the only way to
show that a given theory accurately models behaviour change is to demonstrate (a) that interventions based on that theory lead to changes in the target behaviour and (b) that behaviour change is a result of changes in theory-specified constructs and pathways (Michie & Abraham, 2004). Statistically, this can be demonstrated through mediation analyses which show that behaviour change is mediated by changes in theory-relevant constructs such as intention. According to this line of reasoning, evidence that a theory is associated with intervention efficacy is insufficient to support use of that theory in the absence of evidence demonstrating the pathway for that effect. Instead, intervention evaluations should routinely test for mediation of behaviour change through specified pathways. Such analyses would provide a rigorous evidence base for intervention evaluation and for the design of future interventions.

**Research questions.** The purpose of this section is to conduct a rigorous and systematic review of interventions designed to increase fruit and vegetable consumption in order to evaluate the current body of evidence linking use of specific social cognitive theories to intervention efficacy. In particular, this review identifies studies that have provided support for the use of specific theories through mediation analyses of intervention effects.

The primary aim of the research presented in this section is to evaluate the evidence linking the use of each of the major theories of behaviour to success of interventions to increase fruit and vegetable consumption in healthy adults. The review is designed to address the following research questions:

1. What is the theoretical background of interventions to increase fruit and vegetable consumption?
2. How are behaviour change theories applied to intervention design and evaluation?
(3) Is there evidence that behaviour changes as a result of fruit and vegetable promotion interventions occur through theorised pathways?

**Methods.** A systematic search was undertaken to identify intervention programs that have been designed to increase fruit and vegetable consumption in healthy adults. Studies were identified through electronic literature searching and scanning of relevant reference lists. The electronic search was performed using Medline (1950 to April 2010), PREMEDLINE (Start to April 2010), CINAHL (1982 to May 2010), DARE (Start to 1st Quarter 2010), Cochrane Clinical Trials Registry (Start to 1st Quarter 2010) and PsycINFO (1806 to May 2010) databases. The last search was conducted in May 2010. The search strategy was designed for the Medline database (see Appendix A) and was adapted for use in other databases. The inclusion and exclusion criteria for this review are outlined in Table 10.

Table 10

*Inclusion and Exclusion Criteria for the Systematic Review*

<table>
<thead>
<tr>
<th>Inclusion criteria</th>
<th>Exclusion criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Randomised controlled trial design (with either a no-intervention control or alternative-intervention comparison group)</td>
<td>• Sample selected because of a pre-existing medical condition or prodromal symptoms (e.g. hypertension).</td>
</tr>
<tr>
<td>• Participants aged 18 years and above</td>
<td></td>
</tr>
<tr>
<td>• Published in English</td>
<td></td>
</tr>
<tr>
<td>• Fruit and vegetable intake measured at follow-up</td>
<td></td>
</tr>
</tbody>
</table>
A single reviewer performed eligibility assessment in a standardised manner. All articles meeting the search criteria were reviewed for initial eligibility using a specially designed eligibility checklist (Appendix B). Where eligibility, or noneligibility, could not be determined on the basis of title and abstract screening, the full text of each paper was obtained and screened.

Where a study was reported across multiple publications, the first postintervention outcome evaluation was included in the review. Where appropriate, further reports of the same study were used to obtain additional information. For example, because many outcome evaluations do not report detailed intervention descriptions, process evaluations were used to obtain more detailed accounts of interventions where available. Data extraction was completed in two stages.

In the first stage of data extraction, information about the program features, outcomes, sample, and method was collected using a data-extraction sheet based on the Cochrane Consumers and Communication Review Group’s (2008b) data extraction template and specifically adapted for the present study (see Appendix C). Information extraction from each publication included (1) characteristics of trial participants, (2) intervention characteristics, and (3) fruit and vegetable consumption in both the intervention and comparison conditions at baseline and follow-up.

The second stage of data extraction involved systematic coding of the use of theories of behaviour change in the interventions under review. The use of theory in each study was assessed using the theory coding scheme developed by Michie and Prestwich. This coding scheme provides a reliable method for describing the theoretical basis of interventions and allows researchers to identify and describe how theories of behaviour are used to design and evaluate interventions (Michie & Prestwich). All theory coding was completed by a single researcher who had been
trained in the use of the theory-coding scheme using the training manual provided by Michie and Prestwich. Items 4, 5, 6, 7, 8, 12, 15, and 16 were deemed most relevant to the current review (Michie & Prestwich). See Table 11 for a summary of these items.
## Table 11

*Relevant Items from the Theory Coding Scheme (Michie & Prestwich)*

<table>
<thead>
<tr>
<th>Item number</th>
<th>Item Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Theory/predictors are used to select recipients for the intervention. Participants were screened/selected based on achieving a particular score/level on a theory-relevant construct or predictor.</td>
</tr>
<tr>
<td>5</td>
<td>Theory/predictors are used to select/develop the intervention. The intervention is explicitly based on a theory or predictors or combination of theories or predictors.</td>
</tr>
<tr>
<td>6</td>
<td>Theory/predictors are used to tailor intervention techniques to recipients. The interventions differs for different subgroups that vary on a psychological construct (e.g., stage of change) or predictor at baseline.</td>
</tr>
<tr>
<td>7</td>
<td>All intervention techniques are explicitly linked to at least one theory-relevant construct/predictor. Each intervention technique is explicitly linked to at least one theory-relevant construct/predictor.</td>
</tr>
<tr>
<td>8</td>
<td>At least one, but not all, of the intervention techniques are explicitly linked to at least one theory-relevant construct/predictor. At least one, but not all, of the intervention techniques are explicitly linked to at least one theory-relevant construct/predictor.</td>
</tr>
<tr>
<td>12</td>
<td>Theory relevant constructs/predictors are measured. At least one construct of theory (or predictor) measured in relation to the intervention is measured <em>postintervention</em>.</td>
</tr>
<tr>
<td>15</td>
<td>Changes in theory-relevant constructs/predictors. The intervention leads to sig. change in at least one theory-relevant construct/predictor (versus control group) in favour of the intervention.</td>
</tr>
</tbody>
</table>
### Table 1: Theory Coding Scheme

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>Mediational analysis of constructs/predictors</td>
</tr>
<tr>
<td></td>
<td>In addition to 15, do the following effects emerge?</td>
</tr>
<tr>
<td>1.</td>
<td>Mediator predicts DV (or change in mediator leads to change in DV)</td>
</tr>
<tr>
<td>2.</td>
<td>Mediator predicts DV (when controlling for IV)</td>
</tr>
<tr>
<td>3.</td>
<td>Intervention does not predict DV (when controlling for mediator)</td>
</tr>
<tr>
<td>4.</td>
<td>Mediated effect statistically significant</td>
</tr>
</tbody>
</table>


### Results and discussion.**

The search of the selected databases provided a total of 2,232 citations; after adjusting for duplicates, 1,819 remained. Of these, 1,740 were discarded during title review or abstract screening. Papers were discarded only if it was clear that they did not meet eligibility criteria. A further 14 studies were identified through reference lists from previous reviews conducted in this area. The full text of 101 studies, identified from both reference lists and electronic databases, were examined in detail using the eligibility criteria for the present review. After full-text screening, 74 papers were identified as having met eligibility criteria, with the remaining papers discarded as ineligible. Of the 74 studies eligible for the review, only 43 reported that the intervention design, evaluation, or both were theory driven (i.e., scored yes on item 4, 5, or 6). See the flow diagram in Figure 6.

The remainder of this section reports findings from those theory-driven interventions. See Table 12 for a summary description of each of these studies.
Figure 6. PRISMA flowchart
Table 12

*Studies Applying Social Cognition Theories to Promote Change in Fruit and Vegetable Intake in Healthy Adults: Summary of Study*

**Characteristics**

<table>
<thead>
<tr>
<th>Intervention name</th>
<th>Author</th>
<th>Year</th>
<th>Country</th>
<th>Sample type (N)</th>
<th>Study design and intervention</th>
<th>Dietary measures and time points</th>
<th>Results</th>
</tr>
</thead>
</table>
| Pathways to Health | Ahluwalia et al. (2007) | USA | Smokers living in public housing (N = 173) | Cluster-randomised RCT | Intervention: 6-month multicomponent intervention delivered through public housing developments: fresh fruit and vegetables, cookbooks, dietary education materials, two videos on fruit and vegetable consumption and five sessions of motivational interviewing | NCI FFQ at baseline and 6 months | I: FVI increased by 1.05 servings/day between baseline and 6 months  
C: FVI increased by 0.27 servings/day between baseline and 6 months  
Intervention effects: \( ps = .01 \) |
| —                 | Baker & Wardle (2002) | UK | Patients aged 55-64 from cancer screening clinics (N = 742) | RCT | Intervention: single newsletter tailored to stage of change and perceived barriers to FVI | Dietary Instrument for Nutrition Education at baseline and 6 weeks | I: FVI increased by 1.06 servings/day between baseline and 6 weeks  
C: FVI increased by 0.26 servings/day between baseline and 6 weeks  
Intervention effect: \( p < .001 \) |
<table>
<thead>
<tr>
<th>Intervention name</th>
<th>Author</th>
<th>Year</th>
<th>Country</th>
<th>Sample type (N)</th>
<th>Study design and intervention</th>
<th>Dietary measures and time points</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seattle 5 a Day worksite program</td>
<td>Beresford et al.</td>
<td>(2001)</td>
<td>USA</td>
<td>Employees from Seattle worksites (N = 2828)</td>
<td>Cluster-randomised RCT&lt;br&gt;Intervention: 2-year multi-component intervention delivered through worksites: promotional flyers and posters, newsletters, food demonstrations, tip sheets, and a self-help manual</td>
<td>FFQ at baseline and 2 years</td>
<td>I: FVI increased by 0.5 servings/day between baseline and 2 years&lt;br&gt;C: FVI increased by 0.2 servings/day between baseline and 2 years&lt;br&gt;Intervention effect: $p &lt; .05$</td>
</tr>
<tr>
<td>Eating for a Healthy Life</td>
<td>Bowen et al.</td>
<td>(1996)</td>
<td>USA</td>
<td>Members of Seattle based religious organisations (N = 2175)</td>
<td>RCT&lt;br&gt;Intervention: 12-month multi-component intervention delivered through participating religious organisations: interpersonal support, motivational flyers and mailings, social events and endorsement by religious leaders</td>
<td>24 hour recall at baseline and 12 months</td>
<td>I: FVI increased by 0.29 servings/day between baseline and 12 months&lt;br&gt;C: FVI increased by 0.16 servings/day between baseline and 12 months&lt;br&gt;Intervention effect: $p = .03$</td>
</tr>
<tr>
<td>Intervention name</td>
<td>Author</td>
<td>Year</td>
<td>Country</td>
<td>Sample type (N)</td>
<td>Study design and intervention</td>
<td>Dietary measures and time points</td>
<td>Results</td>
</tr>
<tr>
<td>-------------------</td>
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</tr>
<tr>
<td>—</td>
<td>Brug, Glanz, Van Assema, Kok, &amp; van Breukelen</td>
<td>(1998)</td>
<td>The Netherlands</td>
<td>Community sample of Dutch adults (N = 800)</td>
<td>Three-arm RCT (I1 vs. I2 vs. generic information control)</td>
<td>FFQ at baseline and 8 weeks</td>
<td>I2: FI unchanged between baseline and 8 weeks; VI increased by 0.09 servings/day between baseline and 8 weeks</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>I1: single newsletter tailored to baseline intake, perception of own intake, attitudes towards increasing fruit and vegetable consumption and self-efficacy</td>
<td></td>
<td>I2: FI increased by 0.32 servings/day between baseline and 8 weeks; VI increased by 0.14 servings/day between baseline and 8 weeks</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>I2: I1 plus a second tailored message at Week 4; the second message provided feedback about dietary changes since baseline</td>
<td></td>
<td>C: FI decreased by 0.07 servings/day between baseline and 8 weeks; VI increased by 0.06 servings/day between baseline and 8 weeks</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Intervention effect: I1 and I2 both performed significantly better than control at increasing VI (p &lt; .05); no difference between change in VI between I1 and I2 (p = .38); significantly greater increase in FI in I2 than in I1 or control (ps &lt; .05); I1 and control were not significantly different (p = .31)</td>
</tr>
<tr>
<td>Intervention name</td>
<td>Author</td>
<td>Year</td>
<td>Country</td>
<td>Sample type (N)</td>
<td>Study design and intervention</td>
<td>Dietary measures and time points</td>
<td>Results</td>
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<td>------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| FoodSmart         | Campbell, Carbone, Honess-Morreale, Heisler-MacKinnon, Demissie, & Farrell | (2004a) | USA     | Attendees of Women Infants and Children clinics (N = 307) | RCT with waitlist control Intervention: tailored nutrition information delivered via CDROM: video soap opera to model positive dietary change, interactive ‘infomercials’ and tailored dietary feedback | FFQ at baseline and 1-2 months. | I: FVI increased by 0.1 servings/day between baseline and 2 months  
C: FVI increased by 0.1 servings/day between baseline and 2 months  
Intervention effect: n.s |
| Partners in Prevention | Campbell, DeVellis, Strecher, Ammerman, DeVellis, & Sandler | (1994) | USA     | Patients from a primary health care centre (N = 558) | Three-arm RCT (I1 vs. I2 vs. control)  
I1: single un-tailored nutrition information packet  
I2: single nutrition information packet tailored to stage of change, dietary intake and psychosocial information | FFQ at baseline and 4 months | I1: FVI decreased by 0.3 servings/day between baseline and 4 months  
I2: FVI decreased by 0.3 servings/day between baseline and 4 months  
C: FVI decreased by 0.3 servings/day between baseline and 2 months  
Intervention effects: n.s |
<table>
<thead>
<tr>
<th>Intervention name</th>
<th>Author</th>
<th>Year</th>
<th>Country</th>
<th>Sample type (N)</th>
<th>Study design and intervention</th>
<th>Dietary measures and time points</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black Churches United for Better Health</td>
<td>Campbell et al.</td>
<td>1999</td>
<td>USA</td>
<td>African American churchgoers (N = 2519)</td>
<td>Cluster randomised RCT with waitlist control</td>
<td>NCI Fruit and Vegetable Screener at baseline and 2 years</td>
<td>I: FVI increased by 0.5 servings/day between baseline and 2 years C: FVI decreased by 0.06 servings/day between baseline and 2 years Intervention effect: p &lt; .001</td>
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<tr>
<td>Intervention name</td>
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<tr>
<td>The WATCH project</td>
<td>Campbell, James, Hudson, Carr, Jackson, Oates, &amp; Demissie (2004b)</td>
<td>USA</td>
<td>African American churchgoers (N = 587)</td>
<td>Four-arm RCT (I1 vs. I2 vs. I3 vs. control)</td>
<td>FFQ at baseline and 1 year.</td>
<td>I1: FVI increased by 0.6 servings/day between baseline and 1 year</td>
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<td>I1: 9-month tailored intervention: 4 personalised newsletters and 4 targeted videotapes mailed to participants’ homes at month 2, 4, and 9 months post-baseline; newsletters were tailored to baseline intake, stage of change, social support, barriers to change, beliefs, and demographics</td>
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<td>I2: FVI unchanged between baseline and 1 year</td>
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<td>I2: 9-month lay health advisor led intervention delivered through participating churches: lay health advisors organised at least three church-wide activities promoting intervention goals</td>
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<td>I3: FVI increased by 0.3 servings/day between baseline and 1 year</td>
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<td></td>
<td>I3: I1 + I2</td>
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<td>C: FVI increased by 0.01 servings/day between baseline and 1 year</td>
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<td></td>
<td>Intervention effects: I1 significantly better than I2, I3 and control ($p &lt; .05$); no difference between I2, I3, and control ($p &gt; .05$)</td>
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<td>Intervention name</td>
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</table>
| Rural Physician Cancer Prevention Project | Carcaise-Edinboro, McClisch, Kracen, Bowen, & Fries | (2008) | USA     | Primary care patients from rural Virginia (N = 754) | RCT Intervention: 8-month tailored intervention: tailored dietary feedback at 4 weeks post-baseline and 4 self-guided intervention booklets between weeks 5 and 8 | NCI FFQ at baseline and 9 months | I: Participants <43 years FVI increased by 0.69 between baseline and 9 months  
Participants 43–55 years FVI increased by 0.48 between baseline and 9 months  
Participants 56+ years FVI increased by 1.01 between baseline and 9 months  
C: Participants <43 years FVI increased by 0.33 between baseline and 9 months  
Participants 43–55 years FVI increased by 0.68 between baseline and 9 months  
Participants 56+ years FVI increased by 0.7 between baseline and 9 months  
Intervention effects: Intervention significantly better than control for participants <43 years (p = .003) and 56+ years (p < .001) but not 43–55 years (p = .20) |
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<tr>
<th>Intervention name</th>
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<tbody>
<tr>
<td>—</td>
<td>Epton &amp; Harris (2008)</td>
<td>UK</td>
<td>Female undergraduates and graduates (N = 93)</td>
<td>Randomised parallel group trial (intervention vs. distracter comparison task)</td>
<td>Intervention: single session self-affirmation manipulation plus 5 a Day health promotion materials</td>
<td>Validated 7-day diary measure completed in the 1 week immediately post-intervention.</td>
<td>Intervention effect: $p = .016$</td>
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<td>—</td>
<td>de Vries, Kremers, Smeets, Brug, &amp; Eijmael (2008)</td>
<td>The Netherlands</td>
<td>Random sample of Dutch adults (N = 2827)</td>
<td>RCT with generic information control group</td>
<td>Intervention: 9 month tailored intervention: 3 printed letters with iterative feedback tailored to the individual, promoting smoking cessation, nutrition and physical activity</td>
<td>FFQ at baseline and 9 months.</td>
<td>I: FI increased by 0.07 pieces/day between baseline and 9 months; VI increased by 13.27 grams/day between baseline and 9 months C: FI decreased by 0.38 pieces/day between baseline and 9 months; VI decreased by 10.25 grams/day between baseline and 9 months</td>
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<td>Intervention name</td>
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<td>EatSmart</td>
<td>Delichatsios, Hunt, Lobb, Emmons, &amp; Gillman</td>
<td>(2001)</td>
<td>USA</td>
<td>Patients from a primary health care centre (N = 503)</td>
<td>Cluster-randomised RCT</td>
<td>FFQ at baseline and 3 months.</td>
<td>I: FVI increased by 1.1 servings/day between baseline and 3 months</td>
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<td>Intervention: 2 month multi-component intervention: mailed personalised recommendations and stage matched educational booklets, physician endorsements of recommendations, 2 motivational counselling sessions via telephone at 2 weeks and 2 months</td>
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<td>C: FVI increased by 0.4 servings/day between baseline and 3 months</td>
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<td>Intervention effect: $p = 0.02$</td>
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<td>PHLAME Feasibility Study</td>
<td>Elliot et al.</td>
<td>(2004)</td>
<td>USA</td>
<td>Firefighters (N = 33)</td>
<td>Three-arm RCT (I1 vs. I2 vs. control)</td>
<td>FFQ at baseline and 6 months.</td>
<td>I1: FVI increased by 1.1 servings/day between baseline and 6 months</td>
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<td></td>
<td>I1: Peer-led curriculum delivered over 11 manualised 45-minute group sessions</td>
<td></td>
<td>I2: FVI increased by 1.3 servings/day between baseline and 6 months</td>
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<td></td>
<td>I2: Individual motivational interviewing consisting of between 4 and 9 sessions</td>
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<td>C: FVI decreased by 0.2 servings/day between baseline and 6 months</td>
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<td>Intervention effects: $ps &lt; .05$</td>
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<tr>
<td>PHLAME</td>
<td>Elliot et al.</td>
<td>(2007)</td>
<td>USA</td>
<td>Firefighters (N = 599)</td>
<td>Three-arm RCT (I1 vs. I2 vs. control)</td>
<td>FFQ at baseline and 12 months</td>
<td>I1: FVI increased by 1.6 servings/day between baseline and 12 months</td>
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<td></td>
<td>I1: Peer-led curriculum delivered over 11 manualised 45-minute group sessions</td>
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<td>I2: FVI increased by 0.7 servings/day between baseline and 12 months</td>
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<td>I2: Individual motivational interviewing consisting of between 4 and 9 sessions</td>
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<td>C: FVI increased by 0.1 servings/day between baseline and 12 months</td>
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<td>Intervention effects: Both I1 and I2 were better than the control (ps &lt; .05); I1 and I2 not directly compared</td>
</tr>
<tr>
<td>Healthy Directions – Health Centers</td>
<td>Emmons et al.</td>
<td>(2005)</td>
<td>USA</td>
<td>Patients from community health centres (N = 2219)</td>
<td>Cluster-randomised RCT with a usual-care control</td>
<td>NCI Screener at baseline and 8 months</td>
<td>I: FVI increased by 0.29 servings/day between baseline and 8 months</td>
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<td>Intervention: study endorsement from clinicians, 1 in-person counselling session and 4 phone-delivered sessions, 6 sets of promotional materials tailored for family composition, social support and neighbourhood context</td>
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<td>C: FVI decreased by 0.04 servings/day –0.04 between baseline and 8 months</td>
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<td>Intervention effects: p = .005</td>
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<td>Intervention name</td>
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<tr>
<td>High 5, Low Fat Program (H5LF)</td>
<td>Haire-Joshu, Brownson, Nanney, Houston, Steger-May, Schechtman, &amp; Auslander</td>
<td>(2003)</td>
<td>USA</td>
<td>African American parents (N = 738)</td>
<td>Cluster-randomized RCT Interventions: dietary change program delivered by ‘parent educators’; personal visits, newsletters, multimedia resources and group meetings</td>
<td>FFQ at baseline and 6 months</td>
<td>I: FVI increased by 0.19 servings/day between baseline and 6 months</td>
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<td>C: FVI decreased by 0.34 servings/day between baseline and 6 months</td>
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<tr>
<td>Maryland WIC 5-A-Day Promotion Program</td>
<td>Havas, Damron, Langenberg, Ballesteros, &amp; Feldman</td>
<td>(1998)</td>
<td>USA</td>
<td>Attendees of Women Infants and Children clinics (N = 3122)</td>
<td>Cluster-randomized RCT Interventions: multicomponent intervention delivered through low-income health clinics; supplementary food and health education</td>
<td>FFQ at baseline and 8 months</td>
<td>Intervention effect: n.s I: FVI increased by 0.56 servings/day between baseline and 8 months</td>
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<td>C: FVI increased 0.13 servings/day between baseline and 8 months</td>
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</table>

Intervention effect: $p = 0.002$
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<tr>
<th>Intervention name</th>
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<tbody>
<tr>
<td>—</td>
<td>Heimendinger et al.</td>
<td>(2005)</td>
<td>USA</td>
<td>Callers to the Cancer Information Service (N = 3402)</td>
<td>Four-arm randomised parallel group trial (I1 vs. I2 vs. I3 vs. I4)</td>
<td>FFQ at 12 months</td>
<td>Intervention effects: I3 and I4 both significantly more effective than I1 ($p &lt; .001$); I1 and I2 not significantly different ($p = .07$); I3 and I4 not significantly different ($p = .69$)</td>
</tr>
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</table>

I1: 11-month untailored intervention; brief educational message plus one set of untailored health promotion materials

I2: 11-month tailored intervention; brief educational message plus one set of health promotion materials tailored to baseline intake, outcome expectations, stage of change, environmental concerns, and perceived barriers to consumption

I3: 11-month tailored intervention; brief educational message plus four sets of health promotion materials tailored to baseline intake, outcome expectations, stage of change, environmental concerns, and perceived barriers to consumption

I4: 11-month tailored intervention; brief educational message plus four sets of health promotion materials. First set tailored to baseline intake, outcome expectations, stage of change, environmental concerns, and perceived barriers to consumption, sets 2–4 tailored based on the same variables at 5 months.
<table>
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<tr>
<th>Intervention name</th>
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<tr>
<td>—</td>
<td>Irvine, Ary, Grove, &amp; Gilfillan-Morton</td>
<td>(2004)</td>
<td>USA</td>
<td>Hospital in-patients (N = 517)</td>
<td>Cluster randomized RCT with waitlist control</td>
<td>FFQ at baseline and 1 month</td>
<td>I: FVI increased by 0.33 servings/day from baseline to 1 month</td>
</tr>
<tr>
<td>—</td>
<td>John, Ziebland, Yudkin, Roe, &amp; Neil</td>
<td>(2002b)</td>
<td>UK</td>
<td>Primary care patients (N = 729)</td>
<td>RCT with waitlist control</td>
<td>FFQ at baseline and 6 months</td>
<td>Intervention effects: p &lt; 0.001 I: FVI increased by 1.4 servings/day between baseline and 6 months</td>
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<tr>
<td>Puget Sound Eating Patterns Study</td>
<td>Kristal, Curry, Shattuck, Feng, &amp; Li</td>
<td>(2000a)</td>
<td>USA</td>
<td>Random sample of health maintenance organization clients (N = 1459)</td>
<td>RCT</td>
<td>FFQ at baseline and 12 months</td>
<td>Intervention effects: p &lt; .001 I: FVI increased by 0.47 servings/day between baseline and 12 months</td>
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FFQ = Food Frequency Questionnaire; RCT = Randomized Controlled Trial; FVI = Food Variety Index.
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<tbody>
<tr>
<td>—</td>
<td>Lutz et al.</td>
<td>1999</td>
<td>USA</td>
<td>Health maintenance organization clients (N = 573)</td>
<td>Four-arm RCT (I1 vs. I2 vs. I3 vs. control)</td>
<td>FFQ at baseline and 6 months</td>
<td>I1: FVI increased by 0.7 servings/day between baseline and 6 months</td>
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<td>I1: 4 monthly ‘traditional’ non-tailored nutrition education newsletters</td>
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<td>I2: FVI increased by 0.8 servings/day between baseline and 6 months</td>
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<td>I2: 4 monthly nutrition education newsletters tailored to baseline intake, eating behaviours, nutrition-related activities, self-efficacy, stage of readiness and perceived benefits and barriers</td>
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<td>I3: FVI increased by 0.9 servings/day between baseline and 6 months</td>
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<td>I3: I2 plus specific advice to increase fruit and vegetable consumption to 5 or more servings a day</td>
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<td>C: FVI increased by 0.1 servings/day between baseline and 6 months</td>
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<td>Intervention effects: All three of the interventions were better than the control (ps &lt; .05); no differences in change in FVI between the three intervention groups (ps &gt; .05)</td>
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</table>
| —                 | Marcus et al. | (2001) | USA | Callers to the Cancer Information Service (N = 1717) | Cluster randomised RCT | FFQ at baseline and 4 months | I: FVI increased by 0.91 servings/day between baseline and 4 weeks  
C: FVI increased by 0.03 servings/day between baseline and 4 weeks |
| —                 | Marcus et al. | (1998b) | USA | Callers to the Cancer Information Service (N = 276) | Cluster randomised RCT | FFQ at baseline and 4 weeks | Intervention effects: \( p < 0.001 \)  
Intervention effect: \( p = 0.01 \) |
| —                 | Resnicow et al. | (2008) | USA | African American patients from integrated health care delivery systems (N = 512) | Randomised parallel group trial (I1 vs. I2)  
I1: 3 month tailored intervention delivered via newsletter: 3 newsletters tailored to demographic characteristics, neophobia, intake, food preferences, goal setting, intentions, outcome expectancies, social support, and barriers to eating fruit and vegetables  
I2: 3 month tailored intervention delivered via newsletter: 3 newsletters tailored to constructs listed in I1 and preference for autonomy | FFQ at baseline and 3 months | I1: FVI increased by 0.6 servings/day between baseline and 3 months  
I2: FVI increased by 0.7 servings/day between baseline and 3 months  
Intervention effect: \( n.s \) |
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<tr>
<td></td>
<td>Richards, Kattelmann, &amp; Ren</td>
<td>(2006)</td>
<td>USA</td>
<td>University undergraduates aged 18–24 years (N = 437)</td>
<td>RCT</td>
<td>FFQ at baseline and 4 months</td>
<td>I: FVI increased by 1.0 servings/day between baseline and 4 months&lt;br&gt;C: FVI unchanged between baseline and 4 months</td>
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<td></td>
<td>Alexander et al.</td>
<td>(2011)</td>
<td>USA</td>
<td>Health plan members (N=2032)</td>
<td>Three-arm randomised parallel group trial (I1 vs. I2 vs. I3)</td>
<td>FFQ at baseline and 12 months</td>
<td>Intervention effect: $p = .04$&lt;br&gt;I1: FVI increased by 2.34 servings/day between baseline and 12 months&lt;br&gt;I2: FVI increased by 2.68 servings/day between baseline and 12 months&lt;br&gt;I3: FVI increased by 2.80 servings/day between baseline and 12 months&lt;br&gt;Intervention effects: I3, but not I1, more effective than I1 ($ps&lt;.05$); no difference in FVI between I1 and I2($p&gt;.05$)</td>
</tr>
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<td>Intervention name</td>
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<td>—</td>
<td>Smeets et al.</td>
<td>(2007)</td>
<td>The Netherlands</td>
<td>Community sample of Dutch adults (N = 2827)</td>
<td>RCT with generic information control Intervenion: single health education letter tailored to smoking status, physical activity, dietary intake, awareness, motivations and beliefs</td>
<td>FFQ at baseline and 3 months</td>
<td>I: FI increased by 0.04 pieces/day between baseline and 3 months; VI decreased by 0.48 grams/day between baseline and 3 months C: FI decreased by 0.20 pieces/day between baseline and 3 months; VI decreased by 10.4 grams/day between baseline and 3 months Intervention effects: significant intervention effect for FI and VI (p&lt; not reported)</td>
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| Treatwell 5-A-Day Intervention | Sorensen, Stoddard, Peterson, Cohen, Hunt, Stein, Palombo, & Lederman | (1998) | USA | Worksite employees (N = 1294) | Three- arm RCT (I1 vs. I2 vs. control) | FFQ at baseline and 2 years | I1: FVI increased by 0.33 servings/day between baseline and 2 years  
I2: FVI increased by 0.4 servings/day between baseline and 2 years  
C: FVI increased by 0.01 servings/day between baseline and 2 years  
Intervention effects: I2 but not I1 significantly better than control ($p < .05$ for I2 vs. control) |
| — | Steptoe, Perkins-Porras, McKay, Rink, Hilton, & Cappuccio | (2003) | UK | Patients from a primary health care centre (N = 271) | Randomised parallel group trial (I1 vs. I2) | FFQ at baseline and 12 months | I1: FVI increased by 0.87 servings/day between baseline and 12 months  
I2: FVI increased by 1.49 servings/day between baseline and 12 months  
Intervention effect: $p=.021$ |
<table>
<thead>
<tr>
<th>Intervention name</th>
<th>Author</th>
<th>Year</th>
<th>Country</th>
<th>Sample type (N)</th>
<th>Study design and intervention</th>
<th>Dietary measures and time points</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALIVE</td>
<td>Sternfeld et al. (2007) USA</td>
<td>Employees from administrative offices of a healthcare organisation (N = 787)</td>
<td>RCT</td>
<td>FFQ at baseline and 4 months</td>
<td>Intervention was significantly more effective than control at increasing FVI between baseline and 4 months ($p = .03$)</td>
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<td>—</td>
<td>Stevens, Glasgow, Toobert, Karanja, &amp; Smith (2002) USA</td>
<td>Female health maintenance organization members (N = 616)</td>
<td>Cluster randomised RCT</td>
<td>FFQ at baseline and 12 months</td>
<td>I: FVI increased by 1.24 servings/day between baseline and 12 months C: FVI increased by 0.19 servings/day between baseline and 12 months Intervention effect: $p &lt; .001$</td>
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</tr>
<tr>
<td>Next Step</td>
<td>Tilley et al. (1999) USA</td>
<td>Automotive industry employees (N = 5024)</td>
<td>Cluster randomised RCT</td>
<td>NCI FFQ at baseline and 24 months</td>
<td>I: FVI increased by 0.21 servings/day C: FVI increased by 0.03 servings/day Intervention effect: $p &lt; .001$</td>
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<td>Author</td>
<td>Year</td>
<td>Country</td>
<td>Sample type (N)</td>
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| SENIOR            | Greene et al. | (2008) | USA | Community-dwelling adults aged 60+ years (N = 1277) | RCT | NCI Fruit and Vegetable Screener at baseline and 12 months | I: Median FVI increased by 1.95 servings/day between baseline and 12 months  
 C: Median FVI increased by 0.91 servings/day between baseline and 12 months |
| Little by Little  | Block, Wakimoto, Mandel, Metz, Fujii, Feldman, & Sutherland | (2004) | USA | Low income females aged 40–65 years (N = 491). | Three-arm RCT (I1 vs. I2 vs. attention control) | Modified 24-hour dietary recall at baseline and 2 months | Intervention effects: p < .001 |
|                   |        |      |        |                | I1: single exposure to the intervention materials on CDROM; dietary screening, immediate feedback, educational/motivational modules, and goal setting  
 I2: I1 plus two reminder telephone calls over 2 months | I1: FVI increased by 1.32 occurrences/day between baseline and 12 months  
 I2: FVI increased by 1.20 occurrences/day between baseline and 12 months  
 C: FVI increased by 0.71 occurrences/day between baseline and 12 months |

Intervention effects: I1 better than control (p < .05); I2 not significantly different from control (p > .05); two intervention conditions were not compared
<table>
<thead>
<tr>
<th>Intervention name</th>
<th>Author</th>
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<th>Dietary measures and time points</th>
<th>Results</th>
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</thead>
<tbody>
<tr>
<td>Cancer Awareness and Prevention Trial</td>
<td>Wolf, Lepore, Vandergrift, Basch, &amp; Yaroch</td>
<td>(2009)</td>
<td>USA</td>
<td>Community sample of urban, mostly immigrant, African American men</td>
<td>RCT with attention control Intervention: mailed brochure plus 2 tailored telephone calls. Intervention materials designed to increase awareness of dietary guidelines, serving size, and health benefits</td>
<td>Fruit and vegetable screener at baseline and 8 months</td>
<td>I: FVI increased by 1.4 servings/day between baseline and 8 months C: FVI increased by 0.3 servings/day between baseline and 8 months</td>
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<tr>
<td>Wellness for Women</td>
<td>Walker et al.</td>
<td>(2009)</td>
<td>USA</td>
<td>Community sample of women aged 50–69 years from rural areas (N = 225)</td>
<td>Cluster-randomised RCT with generic information control group Intervention: 18 newsletters tailored to benefits, barriers, self-efficacy, and interpersonal support and intake delivered over 12 months</td>
<td>Block Health Habits and History Questionnaire at baseline and 12 months</td>
<td>I: FVI increased by 0.92 servings/day between baseline and 12 months C: FVI increased by 0.10 servings/day between baseline and 12 months</td>
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Intervention effects: $p < .001$

Intervention effects: $p < .05$
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<th>Sample type (N)</th>
<th>Study design and intervention</th>
<th>Dietary measures and time points</th>
<th>Results</th>
</tr>
</thead>
</table>
| Guide to Health   | Winett, Anderson, Wojcik, Winett & Bowden | (2007) | USA | Baptist or United Methodist churchgoers (N = 1071) | Three-arm RCT (I1 vs. I2 vs. waitlist control) | FFQ and family food shopping receipts averaged together at baseline and 6 months | I1: FVI increased by 0.8 grams/1000kcal between baseline and 6 months  
I2: FVI increased by 0.76 grams/1000kcal between baseline and 6 months  
C: FVI increased by 0.3 grams/1000kcal between baseline and 6 months  
Intervention effects: Both interventions significantly better than control ($p < .001$); interventions not significantly different than each other |
Intervention: Combination of materials from Eat for Life and Better Churches for Better Health delivered over 6 months; intervention components included: motivational interviews, cookbook, church-wide activities, education sessions, cooking classes, and printed materials | NCI FFQ at baseline and 6 months | I: FVI increased by 0.8 servings/day between baseline and 6 months  
Control: FVI increased by 0.3 servings/day between baseline and 6 months  
Intervention effect: $p < .05$ |
<table>
<thead>
<tr>
<th>Intervention name</th>
<th>Author</th>
<th>Year</th>
<th>Country</th>
<th>Sample type (N)</th>
<th>Study design and intervention</th>
<th>Dietary measures and time points</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Abood, Black &amp; Feral</td>
<td>(2003)</td>
<td>USA</td>
<td>University employees (N = 53)</td>
<td>RCT with waitlist control</td>
<td>FFQ at baseline and 8 weeks</td>
<td>I: VI increased by 0.18 servings/day between baseline and 8 weeks; FI increased by 0.34 servings/day between baseline and 8 weeks</td>
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<td></td>
<td>Intervention: 1 hour educational sessions weekly for 8 weeks</td>
<td></td>
<td>Control: VI decreased by 0.29 servings/day between baseline and 8 weeks; FI decreased by 0.29 servings/day between baseline and 8 weeks</td>
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<tr>
<td></td>
<td>Kellar &amp; Abraham</td>
<td>(2005)</td>
<td>UK</td>
<td>University undergraduates (N = 218)</td>
<td>RCT</td>
<td>Self-reported fruit and vegetable consumption at baseline and 1 week</td>
<td>Intervention effect: <em>p</em> &lt; .05</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>Intervention: brief leaflet based intervention with persuasive messages; implementation-intention planning task</td>
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</tbody>
</table>

Note: C = control, FFQ = food frequency questionnaire, FI = fruit intake, FVI = fruit and vegetable intake, I = Intervention, RCT = randomised controlled trial, VI = vegetable intake.
The 43 studies included in this review included 38 randomised-controlled-trial designs where active interventions were compared to usual-care or no-intervention control groups. Across these studies, a total of 49 different active interventions were compared to a control group. Of these, 36 were reported to be more effective than the control in increasing fruit and vegetable consumption. Additionally, one intervention increased fruit (but not vegetable) consumption relative to control, and one intervention increased fruit and vegetable consumption relative to control in some segments of the study sample. The remaining interventions were reported to be no more effective than control.

Ten studies included comparisons between one or more active intervention groups. These included randomised-parallel-group trials and randomised controlled trials with three or more study arms. Across these studies, a total of 25 interventions were statistically compared to at least one other active intervention. Of these, seven interventions were reported to be more effective than a comparison intervention. In most cases, the intervention with the higher level of intensity was the more effective. For example, the study conducted by Brug, Glanz, Van Assema, Kok, & van Breukelen (1998) found that a single tailored newsletter was not significantly different from control at increasing fruit intake but, when participants received a second tailored newsletter four weeks postbaseline, researchers observed an increase in fruit intake that was significantly greater than those in both the control condition and the lower-intensity intervention. Similarly, a four-arm, randomised parallel group trial conducted by Heimendinger et al. (2005) between tailored and untailored materials at different levels of intensity found that the provision of four sets of tailored materials was more effective than the provision of a single set of tailored, or untailored, intervention materials.
All studies reported in this review assessed fruit and vegetable consumption using self-reported measures of fruit and vegetable intake. Most studies used measures of intake that have previously been compared to objective indicators of fruit and vegetable consumption such as plasma vitamin C levels (Resnicow et al., 2000). While objective measurement of fruit and vegetable consumption would be an improvement to the quality of the literature in this area, it is useful to note that studies which have compared food frequency questionnaires and food diaries to objective measures of fruit and vegetable consumption (e.g. Resnicow, et al., 2000) suggest that these measures are valid and reliable indicators of fruit and vegetable intake.

**Use of theory in selected studies.** The major aim of this review was to evaluate how each theory has been used and evaluated in interventions designed to increase fruit and vegetable consumption. The results of theory coding for each of the theory-based interventions are reported in Table 13. No interventions used theory to select participants for the intervention, so this item is not included in Table 13.
<table>
<thead>
<tr>
<th>Intervention name</th>
<th>Theory used</th>
<th>Theory used to design materials</th>
<th>Theory used to tailor content</th>
<th>All intervention techniques linked to a theoretical construct</th>
<th>Some, but not all, intervention techniques linked to a theoretical construct</th>
<th>Theory constructs measured</th>
<th>Theory constructs changed</th>
<th>Mediation tested</th>
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<td>SCT</td>
<td>y</td>
<td>x</td>
<td>x</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>y</td>
</tr>
<tr>
<td>Resnicow et al. (2004)</td>
<td>SCT, Social Determination Theory</td>
<td>y</td>
<td>x</td>
<td>x</td>
<td>y</td>
<td>y</td>
<td>y</td>
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</tr>
<tr>
<td>Abood et al. (2003)</td>
<td>HBM</td>
<td>y</td>
<td>x</td>
<td>x</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>x</td>
</tr>
<tr>
<td>Kellar &amp; Abraham (2005)</td>
<td>TPB</td>
<td>y</td>
<td>x</td>
<td>y</td>
<td>—</td>
<td>y</td>
<td>y</td>
<td>y</td>
</tr>
</tbody>
</table>

Note: y = yes, x = no, — = not applicable, HBM = Health Belief Model, SCT = Social Cognitive Theory, TPB = Theory of Planned Behaviour, TTM = Transtheoretical Stages of Change Model, TRA = Theory of Reasoned Action.
Each of the theories summarised in this chapter were used in at least one fruit and vegetable intervention. Twenty-five unique interventions were based on a combination of two or more theories; 18 of these interventions were successful in achieving changes in fruit and vegetable consumption relative to controls. However, the interventions based on single theories provide the clearest picture of the relationship between theoretical approach and intervention efficacy. Of the interventions based on a single theory, 12 were based on the transtheoretical stages of change model, and four were based on social cognitive theory. The health belief model and theory of planned behaviour accounted for one intervention each.

All of the studies based on the transtheoretical stages of change model were successful in achieving increased fruit and vegetable consumption relative to controls. However, two studies also compared an intervention based on the transtheoretical stages of change model with an atheoretical comparison intervention (Heimendinger, et al., 2005; Lakshman, et al., 2011). Both studies compared the impact of tailored and untailored interventions on fruit and vegetable intake and found that the stage-tailored intervention was no more effective than the equivalent untailored intervention in achieving change in fruit and vegetable intake.

Of the four studies that evaluated social cognitive theory–based interventions, three found that the theoretically based intervention led to increases in fruit and vegetable consumption relative to control (Elliot, et al., 2004; Elliot, et al., 2007; Winett, et al., 2007).

The single study to report the effect of an intervention based on theory of planned behaviour reported a significant increase in fruit and vegetable consumption as a result of the intervention (Kellar & Abraham, 2005).
Only one study tested the effects of an intervention based on the health belief model; that intervention did not lead to significant increases in fruit and vegetable consumption relative to controls (Abood, et al., 2003).

This review shows that theories of behaviour are used widely in interventions designed to increase fruit and vegetable consumption. The results of this review clearly show that the social cognition theory and transtheoretical stages of change model are widely used in intervention design and evaluation in this field. This is consistent with the only previous review of the theoretical basis of interventions to promote fruit and vegetable consumption, which also found that these two models accounted for the majority of theory-based interventions (Rosen, 2000). The other two theories reviewed in this chapter, the health belief model and the theory of planned behaviour, were much less widely applied. The relative paucity of intervention studies based on these theoretical approaches is surprising, given that they are both widely used in theory-based research across health domains (Painter, et al., 2008) and have both been applied to the prediction of fruit and vegetable consumption (Guillaumie, et al., 2010). This is particularly the case for the theory of planned behaviour because, as discussed above, that theory is the most the widely supported for the prediction of fruit and vegetable consumption in healthy adults (Guillaumie, et al., 2010).

When interpreting the pattern of theory use across the fruit and vegetable—promotion literature, it is important to note that the relatively large number of interventions based on the Social cognitive theory and the transtheoretical stages of change model does not imply that these theories are more effective. Rather, the large number of interventions that have used social cognitive theory or the transtheoretical stages of change model may simply reflect the broad appeal of these theoretical approaches.
The dearth of studies that have evaluated the outcomes of interventions based on other theoretical models, specifically the health belief model and the theory of planned behaviour, is a major gap in the theory-based intervention literature in this area. Research designed to evaluate the impact of these theoretical approaches on fruit and vegetable consumption is needed in order to properly assess the relative effectiveness of the major theories of behaviour.

*Application of theory to selection and design of intervention materials.* As shown in Table 13, most studies used theoretical constructs to guide the selection or design of intervention materials. However, there was substantial variation in the way in which the link between theoretical constructs and intervention materials was reported.

While each of the interventions discussed in this section were described by authors as being based on a specific theoretical approach, the way in which the theory corresponded to intervention materials was unclear in many cases. Only ten studies explicitly linked all intervention techniques to at least one theory-relevant construct. There was no explicit link between any theory-relevant construct and any intervention technique for five intervention studies. For example, the Rural Physician Cancer Prevention Project, which was ostensibly based on the transtheoretical stages of change model and social cognitive theory, included dietary feedback at 4 weeks and self-guided intervention booklets (Carcaise-Edinboro, et al., 2008). The relationship between the intervention materials and specific constructs from the transtheoretical stages of change model and social cognitive theory was not explicitly discussed in the description or evaluation of the intervention. It is important to note that because the theory coding scheme is designed to code for explicit use of theory in intervention design (Michie & Prestwich), the fact that links could be drawn between dietary feedback and aspects of social cognitive theory such as self-efficacy and self-regulation.
is not sufficient to conclude that intervention techniques were linked to theoretical constructs. This is, at least in part, because the description of intervention techniques such as the provision of dietary feedback in this study (Carcaise-Edinboro, et al., 2008) is not sufficiently detailed to allow judgements about the relationship between techniques and theoretical constructs in the absence of explicit mention of those links.

Even where the link between theory and intervention content and processes was more clearly articulated, there were some inconsistencies in the ways in which theories were applied. Twenty-nine interventions linked at least one intervention technique to at least one construct but included one or more intervention techniques that were not clearly related to the stated theoretical basis of the intervention. The inclusion of intervention techniques that are not theory relevant may hamper the detection of the true relationship between theory use and intervention efficacy. These results are broadly consistent with findings from other reviews of the use of theory in health behaviour–change interventions. For example, a review of theory use in web-based interventions conducted in 2010 identified 37 intervention studies in which theory had been used to select or develop intervention techniques and materials (Webb, et al., 2010). Of these, only 19 had linked at least one intervention technique to a theory-relevant construct. The authors noted that interventions included in that review differed substantially in the way in which theories had been applied to intervention design (Webb, et al., 2010).

This variability in theory use, even among interventions ostensibly based on a single theory, means that it is difficult to combine results across interventions based on the same theory and that researchers should be cautious in interpreting differences in intervention effects between interventions based on different theories as necessarily indicating the superiority of any one theory. Some interventions claiming to be theory-
based contain no explicit link between intervention materials and theoretical approach, whereas other interventions have fully accounted for the theoretical underpinnings of all intervention materials. This is likely to partially reflect the fact that many theories fail to provide guidance about the methods through which change in theory-relevant constructs can be achieved. If researchers are to compare interventions based on different theories that differ so dramatically in the use of intervention design, the effectiveness of some theoretical approaches is likely to be dramatically under- or overestimated.

Ultimately, the large degree of variation in the description of theory-based interventions and in the application of theory to intervention design points to a need for better reporting of intervention design in the behaviour-change literature. This is consistent with calls for better intervention reporting across behaviour change interventions more broadly, where researchers have argued that there is a need for improvements in the way in which intervention characteristics such as behaviour-change techniques are described in intervention reports and manuals (Abraham & Michie, 2008; Michie & Abraham, 2004). These researchers have argued that the way in which behaviour-change techniques are currently reported makes it difficult to establish the utility of different approaches to behaviour change. As this review makes clear, the same can be said of the way theory use is reported in interventions in this field.

However, while better reporting of intervention design will make it easier to assess the link between intervention content and theoretical approach, it is still the case that a relatively large number of well-described interventions include some techniques that are not linked to any of the theoretical constructs on which the interventions are ostensibly based. While better reporting will make these instances more easily
recognisable in the intervention literature, there is also a need to improve the ways in
which theories are used in intervention design. The inclusion of non-theory-linked
intervention materials and techniques in theory-based intervention research undermines
the rationale for the use of theory in intervention design and makes it difficult to
interpret intervention effects in theory-based interventions as support for a given
theory.

Research designed to evaluate the impact of intervention programs that are fully
accounted for using a single theory of behaviour is needed in order to properly assess
the relative effectiveness of the major theories of behaviour in the absence of the
confounding effect of atheoretical intervention materials.

**Application of theory to evaluation of intervention efficacy.** Twenty-two
studies included in this review measured theory-relevant constructs at one or more
postintervention time points. In the studies where theory-relevant constructs were
measured, the interventions each resulted in significant change in at least one theory-
based construct in 18 studies. The relationship between behaviour change and change in
theory-relevant constructs (i.e., mediation of intervention effects through theorised
pathways) was tested in 11 studies.

Self-efficacy-mediated change in fruit and vegetable consumption was
demonstrated in the Body and Soul, Treatwell 5-A-Day, Black Churches United for
Better Health, Guide to Health, and Maryland WIC 5-a-Day interventions (Beresford, et
al., 2001; Campbell, et al., 1999; Fuemmeler et al., 2006; Havas, et al., 1998;
Resnicow, et al., 2004; Sorensen et al., 1999; Winett, et al., 2007). Other studies
demonstrated mediation of change in fruit and vegetable consumption through a range
of other factors. These were as follows: change in predisposing and enabling factors
(Kristal, Glanz, Tilley, & Li, 2000b; Tilley, et al., 1999), reduction in perceived barriers
to fruit and vegetable consumption (Ahluwalia, et al., 2007), and changes in social norms (Elliot, et al., 2007; Ranby et al., 2011). These variables have all been previously linked to the prediction of fruit and vegetable consumption in prospective studies (Shaikh, et al., 2008). The implications for the detection of these mediation effects for specific theories are discussed in a following section.

While this review did identify a number of mediators of intervention effects in the reviewed studies, it is clear that rigorous use of theory in intervention evaluation is not yet routine practice. Relatively few studies identified in this review examined whether changes in theory-based constructs occur as a result of theory-based interventions. Even fewer studies have examined whether changes in theory-based constructs were related to changes in fruit and vegetable consumption.

This is consistent with previous reviews of the use of the theory of planned behaviour that have shown that very few studies have tested mediation in the context of that theory (Elliott & Armitage, 2009; Hardeman et al., 2002). The results of this review extend that work by demonstrating that the lack of studies which have demonstrated mediation effects is not an issue specific to the literature surrounding a single theory but rather a wider problem in the intervention-evaluation literature.

In order to improve the state of the literature in this field, it is clear that researchers should routinely measure theory-based constructs pre- and postintervention and should routinely test and report the effect of mediation analyses. It is interesting that, while only 11 studies reported the effects of mediation analyses, 22 studies measured at least one theory relevant construct at pre- and postintervention time points. For these studies, it would appear that mediation was not tested, despite the availability of relevant data. It is also worth noting that the methods through which mediation is assessed should be carefully considered, since if behaviour is measured at the same
time as proposed mediators it can be argued that behaviour affects the proposed mediator rather than the reverse. Where possible, mediators should be measured before behaviour.

As with previous reviews, the results of this review show that still more research is needed to evaluate the extent to which intervention effects can be mediated through theorised pathways.

Support for Selected Theories Based on This Review

The focus of this review was the use of theory in intervention design and evaluation. The intervention studies identified in this review demonstrate diversity in the use and evaluation of the major theories of behaviour that are routinely applied to the prediction of fruit and vegetable consumption in prospective studies. This section will summarise the evidence for the each four major theories identified this chapter—the transtheoretical stages of change model, the health belief model, social cognitive theory and the theory of planned behaviour—which emerged in the process of this systematic review.

Transtheoretical Stages of Change Model. The transtheoretical stages of change model was the most widely used theoretical framework for interventions included in this review. A total of 12 interventions were based purely on the transtheoretical stages of change model. As already reported, all of the interventions that were based on the transtheoretical stages of change model led to increases in fruit and vegetable consumption relative to the no-intervention control group. However, two of these studies each included an atheoretical comparison group which compared the impact of transtheoretical stages of change model–based materials with equivalent but atheoretical materials. In both cases this meant a comparison between stage-tailored materials and nontailored comparison materials. Both of the studies which compared
the impact of stage tailored and untailed materials found that tailored materials were no more effective than equivalent untailed materials. These results cast doubt on the strength of the evidence supporting the use of the theory in intervention design because they indicate that the success of the interventions based on transtheoretical stages of change model constructs may reflect a general trend for the provision of intervention materials to lead to improvements in fruit and vegetable consumption rather than the effectiveness of the theory on which those materials were based.

Critics of the transtheoretical stages of change model have noted that most experimental tests of the model have compared stage-matched intervention to no-intervention comparison groups. They have argued that experimental studies should instead compare the efficacy of stage matched and stage mismatched interventions (Littell & Girvin, 2002; Sutton, 2000). To date, very few studies have compared stage-matched and mismatched interventions in this way.

Of the four studies that have compared stage-matched and mismatched interventions across any health domain, two studies found that a stage-matched intervention performed no better than a mismatched intervention. The two remaining studies provide only partial support for stage matching. While Blissmer & McAuley (2002) found greater increases in physical activity in individuals exposed to the stage-matched intervention, that intervention performed no better than a non-targeted usual-care intervention. This finding would suggest that even if stage matching were preferable to mismatching, the transtheoretical stages of change model does not appear to increase efficacy in this context. Dijkstra, de Vries, Roijackers, and van Breukelen (1998) reported that their study provides support for the transtheoretical stages of change model by demonstrating greater intervention effects in the stage matched than mismatched intervention. However, it is important to note that this difference was
significant only at the trend level. It is also worth noting that that study assessed stage progression as the primary outcome of interest, meaning that the influence of stage matching on behaviour change was not directly assessed. This body of evidence, although small, would appear to suggest that stage matching is unlikely to be significantly more effective than stage mismatched interventions. While the evidence clearly shows that stage-matched interventions are more effective than control interventions, this does not necessarily suggest that the theory provides a good model for behaviour change. This finding speaks to the need to examine not only the effect of interventions but also the pathways by which behaviour change is thought to occur before interpreting intervention efficacy as support for a given theory.

Of the 11 studies which measured mediation of intervention effects, four did so in the context of an intervention based on the transtheoretical stages of change model. These studies all provided support for mediation of intervention effects through constructs specified in the model. However, as noted below, the direct interpretation of these effects is made difficult by the fact that the majority of these studies have found support for the mediation of intervention through self-efficacy. This construct is included in some form in all of the studies reviewed in this chapter, meaning that it is difficult to argue that mediation of intervention effects through self-efficacy represents unambiguous support for any theory.

Ultimately, this review shows that the transtheoretical stages of change model is both widely used and generally successful when compared with control conditions. But the failure of these interventions to demonstrate effects over and above the effect of equivalent, but non-theory-based comparisons is consistent with a wider critique about the utility of the stages of change construct in explaining behaviour change (Sutton, 1996, 2000; Sutton, 2001). The ongoing arguments about the conceptual basis of this
model, coupled with the ambiguity of the mediation effects surrounding this model mean that this review provides only partial support for the use of this theory in intervention design.

**Health belief model.** This review reveals a general paucity of research evaluating interventions based on the health belief model in the context of increasing fruit and vegetable consumption in healthy adults. The review identified just one intervention which was based solely on the health belief model; as already reported, that intervention did not lead to a significant increase in fruit and vegetable consumption relative to controls. When interpreting the lack of intervention effects in the only intervention based on this model, it should be acknowledged that, with a total sample of just 53 individuals, this intervention had a substantially smaller sample than most interventions reviewed in this chapter. The use of such a small sample may well have undermined the ability to detect intervention effects in that study.

It is also interesting to note that, although none of the studies which tested mediation were directly based on the health belief model, the results of mediation analyses provide some limited support for the mediation of intervention effects through constructs included in the health belief model, namely perceived barriers and self-efficacy.

Ultimately, despite some support in the predictive literature, the health belief model has been largely overlooked in the research evaluating the impact of theory-based interventions on fruit and vegetable consumption. Given the significant shortcomings of the research that has been conducted on health belief model interventions to date, and the indications that behaviour change may be mediated through some theory-relevant constructs, there is a clear justification to conduct further
research using this model in order to clarify its effectiveness in the context of interventions designed to increase fruit and vegetable consumption.

**Social cognitive theory.** Social cognitive theory has been widely applied to the design and evaluation of interventions to increase fruit and vegetable consumption in healthy adults. Four studies included in this review were based on social cognitive theory, with a further 16 studies using the theory as part of a multitheory framework. As already reported, three of the four social cognitive theory–based interventions included in this review led to increases in fruit and vegetable consumption relative to a no-intervention control group.

Of the 11 studies which measured mediation of intervention effects, six did so in the context of an intervention based on the social cognitive theory. These studies all provided support for mediation of intervention effects through constructs specified in the model. In particular, intervention studies have linked change in fruit and vegetable consumption to change in enabling and predisposing factors, self-efficacy, and perceived barriers. However, as already mentioned, many of these constructs are included (in some form) in more than one model reviewed in this chapter. As such, it is difficult to argue that mediation of intervention effects through these constructs represents unambiguous support for any social cognitive theory. However, in spite of this ambiguity, the model is the most strongly supported of any of the theories reviewed in this section. Among the four theories reviewed in this section, social cognitive theory enjoys a combination of broad application and empirical and conceptual support. In light of this research there is also justification for the continued application of this model to the design and evaluation of interventions designed to increase fruit and vegetable consumption.
**Theory of planned behaviour.** This review reveals a general scarcity of research evaluating interventions based on the theory of planned behaviour in the context of increasing fruit and vegetable consumption in healthy adults. The review identified just one intervention which was based solely on the theory of planned behaviour. As already reported, that intervention did lead to a significant increase in fruit and vegetable consumption relative to controls. That study also investigated the mediation of intervention effects and found that change in fruit and vegetable consumption could not be explained by change in theory-relevant constructs.

However, when interpreting the results of this study, it is important to consider the limitations of both the intervention design and the statistical methods used to evaluate mediation in that study. This is likely to have been exacerbated by the statistical methods used to assess intervention effects and mediation. Unlike most other studies included in this review, which measured fruit and vegetable consumption using continuous measures, this study assessed intervention effects through the proportion of the sample in each of the study groups that consumed five or more servings of fruit and vegetable consumption and the mean number of days by which individuals achieved recommended intake of fruit and vegetables. This measurement is less responsive to changes in fruit and vegetable consumption because it is unable to detect changes in fruit and vegetable consumption where individuals fall below five servings of fruit and vegetables (e.g., where individuals move from consuming no fruit and vegetables to consuming four servings of fruit and vegetables every day).

There were also limitations to the ways in which mediation was assessed; these are linked to the use of the implementation-intention planning task to increase the consumption of fruit and vegetables. Implementation-intention tasks are designed to increase the successful performance of behaviour without change in intention.
However, the mediation analyses in that study investigated the extent to which behaviour change could be explained using change in intention. Because the implementation intention task was not expected to change intention, mediation analyses were unlikely to show that intervention effects are mediated through intention if they resulted from the effects of the implementation intention task on fruit and vegetable intake.

While the mediation analyses of the only study to explicitly use the theory of planned behaviour were not supportive of the model, it is interesting to note that the results of mediation analyses conducted in the context of other interventions do provide some support for the theory of planned behaviour, namely through the mediation of intervention effect through self-efficacy (which is very similar to perceived behavioural control) and social norms.

Ultimately, despite wide support in the predictive literature, the theory of planned behaviour has been largely overlooked in the research evaluating the impact of theory-based interventions on fruit and vegetable consumption. Given the significant shortcomings of the research that has been conducted on theory of planned behaviour interventions to date, and the indications that behaviour change may be mediated through some theory-relevant constructs, there is a clear justification for conducting further research using this model in order to clarify its effectiveness in the context of interventions designed to increase fruit and vegetable consumption.

**Selecting a Model Based on Literature Presented in This Chapter**

The aim of this chapter was to guide the selection of a theory for use in the design of the intervention described in this thesis. The selection of a theory must be guided by evidence from both the predictive and the intervention literature that has been conducted in this area.
As already discussed, the predictive literature provides clear support for the use of the theory of planned behaviour in fruit and vegetable promotion. Both social cognition theory and the theory of planned behaviour have been found to account for large proportions of the variance in fruit and vegetable consumption of healthy adults (2010). However, as discussed in this chapter, the theory of planned behaviour has the advantages of having been more consistently applied in the prediction literature and of being relatively parsimonious.

The results from the review of intervention literature are much harder to interpret. Of the four theories reviewed in this chapter, social cognitive theory is the most empirically supported and appears to be the most likely to be successful. Its use is supported by promising results from mediation analyses. But it should be noted that the relative success of this theory may be a reflection as much of some of the limitations of the research on competing models as of the strength of evidence to support the use of social cognitive theory itself. In particular, there is a lack of well-designed research evaluating the health belief model and the theory of planned behaviour. This represents a significant gap in the extant literature.

Research from other domains indicates that the use of the theory of planned behaviour is associated with larger effect sizes, on average, than use of other theoretical approaches (Webb, et al., 2010). The lack of studies evaluating the theory of planned behaviour means that it is difficult to reconcile the predictive literature and literature from other domains with the results of the systematic review completed in the latter part of this chapter. This presents two alternative options for theory selection: (a) the use of social cognitive theory on the basis of the results of the systematic review of intervention studies and (b) the use of the theory of planned behaviour on the basis of the results from the review of predictive studies, coupled with the limited evidence in
support of mediation of behaviour change through some theory-relevant constructs in
the intervention literature. Either selection would be justifiable on the basis of research
in this chapter. For the purposes of this thesis, the theory of planned behaviour was
selected to guide intervention design. This choice was made on the basis of the results
of predictive studies, because the lack of studies investigation theory of planned
behaviour–based interventions presents a significant gap in the extant literature, which
this thesis seeks to address. The predictive literature provides a strong theory-based
justification for the use of the theory of planned behaviour in this context, specifically
its parsimony and its comparative success in predicting fruit and vegetable consumption
(Guillaumie, et al., 2010) and other health behaviours (Armitage & Conner, 2001;
Godin & Kok, 1996).
Chapter 4

Predicting the Fruit and Vegetable Consumption of Young Adults: A Prospective Study Using the Theory of Planned Behaviour

Detailed Description of the Theory of Planned Behaviour

The review of literature presented in Chapter 3 provided the rationale for the use of the theory of planned behaviour in the design and evaluation of interventions designed to increase fruit and vegetable consumption. That chapter included a short description of the theory of planned behaviour in order to facilitate the review of the empirical support for use of the theory for this purpose. However, a more detailed discussion of the model, and each of the major constructs, is required in order to frame the intervention design and evaluation described in the remainder of this thesis. The following sections will present a detailed description of the theory of planned behaviour in order to provide a strong conceptual framework for the empirical studies presented later in this thesis.

Behaviour. In the context of the theory of planned behaviour, behaviour is “the manifest, observable response in a given situation with respect to a given target” (Fishbein & Ajzen, 1975, p. 13). Clear definition of the behaviour of interest is a crucial first step in any application of the theory of planned behaviour (Fishbein & Ajzen, 2010). In large part this is because the way in which behaviour is defined shapes the measurement and operationalising of all other constructs of the model (Fishbein & Ajzen, 2010). Planned-behaviour theorists typically conceptualise behaviour as consisting of four elements: target, action, context, and time (Fishbein & Ajzen, 2010).
Definitions of behaviour should use these elements in order to specify the parameters for the behaviour of interest. An important concept with regard to the way in which behaviour is defined is that of the principle of correspondence (Ajzen & Fishbein, 1977; Fishbein & Ajzen, 2010). According to this principle, each of the four elements of behaviour can be defined to different degrees of specificity or generality. In order to predict behaviour optimally, the degrees of specificity and generality of measures of intention, attitude, subjective norm, and perceived behavioural control must correspond with the degrees of specificity and generality of the measure of behaviour.

**Behavioural intention.** Behavioural intention is an indication of an individual’s readiness and willingness to perform the behaviour of interest (Fishbein & Ajzen, 2010). The construct of intention is generally assumed to capture the motivational factors that influence an individual’s behaviour (Ajzen, 1991). Although some researchers have suggested a conceptual distinction between behavioural intention (I intend to) and behavioural expectation (I expect to) (Warshaw & Davis, 1985) and between intention (I intend to) and willingness (I want to) (e.g. Gibbons, Gerrard, Blanton, & Russell, 1998), such distinctions have not been consistently empirically supported (Armitage & Conner, 2001; Sheeran & Orbell, 1998). As such, the individual’s estimate of the likelihood of performing the behaviour (I expect to) remains an essential underlying dimension of this construct (Fishbein & Ajzen, 2010).

**Attitudes towards the behaviour.** Attitude can be defined as an individual’s tendency or disposition to respond favourably or unfavourably to the behaviour of interest (Ajzen, 1991). Attitudes are essentially evaluative; most contemporary theorists agree that this evaluative component is bipolar in nature. This definition of attitudes ascribes each attitude a place on a bipolar continuum which ranges from a positive or favourable disposition towards the behaviour to a negative or unfavourable disposition
towards the behaviour while passing through a neutral midpoint (Fishbein & Ajzen, 2010).

Within the theory of planned behaviour, attitudes are thought to follow directly from beliefs about a behaviour, or “behavioural beliefs” (Fishbein & Ajzen, 1975). In this sense, a belief is defined as the perceived (or subjective) probability that the behaviour of interest has a certain outcome (Fishbein & Ajzen, 2010)—for example, the belief that eating fruit and vegetables will reduce risk of disease. It is important to note that such subjective estimations need not be veridical. For example, a person who incorrectly believes that eating vegetables would result in increased risk of heart disease would form attitudes and act on those attitudes in the same way as an individual who had a similar but correct belief would. The way in which attitudes follow from behavioural beliefs is described by Fishbein’s summation theory of attitudes, an expectancy-value model (Fishbein & Ajzen, 2010).

This model assumes that attitude formation is an automatic process which occurs as behavioural beliefs are formed. Individuals are assumed to have preexisting evaluations of outcomes that become linked to the behaviour in the process of behavioural-belief formation. The strength of the belief determines the extent to which these outcome evaluations are associated with the behaviour. Behavioural beliefs come to produce an overall attitude towards the behaviour in a summative process. Once this summative process has occurred, thoughts about the behaviour (or the behaviour itself) will elicit the previously summated evaluative response, or attitude.

As a summative model, this theory of attitude formation requires that an individual’s attitudes are determined by the set of beliefs which he or she holds about the outcomes of the given behaviour (Fishbein & Ajzen, 2010). Conceptually, attitude formation could occur on the basis of a very large number of beliefs. However, most
research on attitude formation assumes that attitudes are formed on the basis of a relatively small number of behavioural beliefs (Fishbein & Ajzen, 2010). It is thought that beliefs that are salient, or readily accessible in memory, are most influential in attitude formation (Fishbein & Ajzen, 2010).

Many theorists propose that attitudes can be calculated through the multiplication of behavioural beliefs and outcome expectancies and that subjective norm and perceived behavioural control can be calculated on the basis of similar relationships with their component constructs (Fishbein & Ajzen, 2010). However, it should be acknowledged that more recent work within health psychology suggests that this method is likely to be conceptually flawed (French & Hankins, 2003). Since, detailed consideration of the relationship between the product of expectancy-value and attitude (and equivalent relationships for subjective norm and perceived behavioural control) is outside the scope of this thesis, direct measures of all theory of planned behaviour constructs will be used in the remainder of this thesis.

**Subjective norm.** Subjective norm refers to the perceived social pressure to perform or not perform a behaviour (Fishbein & Ajzen, 1975). More specifically, it is defined as the individual’s perception that most people who are important to him or her believe that the individual should (or should not) engage in the behaviour of interest; the definition also includes their beliefs about whether or not important others do or do not perform the behaviour themselves (Fishbein & Ajzen, 2010). As with other components of the model, this perceived social pressure does not necessarily reflect an accurate representation of the social environment.

Like attitudes, which are thought to be the product of behavioural beliefs, subjective norms are thought to be derived from an individual’s set of normative beliefs. These normative beliefs relate to the perceived probability that important
individuals or groups (e.g., parents, friends, or health professionals) believe that the person should or should not engage in the behaviour of interest (Fishbein & Ajzen, 2010). The theory allows any group or significant individual to act as a key referent with regard to perceived subjective norm, but, as with attitudes, an individual’s subjective norms are thought to be formed on the basis of salient, or easily accessible, normative beliefs (Fishbein & Ajzen, 2010).

Another important factor in the formation of subjective norm is the issue of motivation to comply. This refers to an individual’s motivation to conform to the expectations or wishes of specific individuals or groups (Fishbein & Ajzen, 2010). Conceptually, it is possible for an individual to perceive strong social pressure from someone in his or her environment; however, if that individual is not motivated to comply with the wishes of that other person, then the overall subjective norm will not be influenced. Motivation to comply and normative beliefs are often multiplied to produce indirect measures of subjective norm (i.e. perceived social pressure from friends multiplied by motivation to comply with social pressure from friends).

**Perceived behavioural control.** Unlike the components of the theory of planned behaviour which have been discussed thus far, the concept of perceived behavioural control was not part of the original formulation of the reasoned action framework—the theory of reasoned action (Fishbein & Ajzen, 1975). Perceived behavioural control is defined as the extent to which an individual believes that he or she is both capable of and in control of performing the behaviour of interest. This component of the theory reflects the fact that performance of much behaviour may be outside the individual’s control (i.e., be nonvolitional). An individual’s ability to perform the behaviour of interest, even in the presence of strong positive attitudes and
subjective norm, may be limited by nonmotivational factors such as the availability of resources and opportunities required for successful performance of behaviour.

Perceived behavioural control is thought to consist of control beliefs (i.e. factors are believed to that determine the controllability of the behaviour) and perceived power (i.e. the belief that a given factor will influence the individual’s ability to perform the behaviour). These two sets of beliefs are often multiplied to form perceived behavioural control (Fishbein & Ajzen, 2010).

**Relationship between components of the theory of planned behaviour.**

According to the theory of planned behaviour, and the theory of reasoned action before it, the most immediate antecedent of behaviour is behavioural intention (Fishbein & Ajzen, 2010). The theory of planned behaviour is typically formulated as a simple additive model (see Figure 5), where attitude, subjective norm, and perceived behavioural control are all thought to influence behaviour through their effect on behavioural intention. Perceived behavioural control is often also thought to have a direct effect on behaviour, over and above its influence on intention. According to this formulation of the model, the relationships between constructs are all assumed to be linear.

However, while the relationships between these constructs are well specified in comparison to some of the other theories discussed in this thesis, the exact relationship between constructs (i.e., their relative weighting and valance) is thought to be both population and behaviour specific (Fishbein & Ajzen, 2010).

Research presented in the previous chapter showed that the theory of planned behaviour has been applied to the prediction of fruit and vegetable consumption across a number of contexts (Guillaumie, et al., 2010). However, to date, no study has applied the model to the prediction of fruit and vegetable consumption amongst Australian
young adults. Because the exact relationships between behaviour, intention, subjective norm, attitude, and perceived behavioural control are thought to be both population and behaviour specific (Ajzen, 1991), formative quantitative research is an important part of both theory selection and the content and process-design stages of research (Fishbein & Ajzen, 2010). The need for such formative quantitative research to determine the relationship between theory-of-planned-behaviour constructs in the context of the fruit and vegetable consumption of Australian young adults led to the conduct of the first empirical study reported in this thesis, described below.

**Applying the Theory of Planned Behaviour to the Prediction of Fruit and Vegetable Consumption in Population of Australian Young Adults**

This section presents the results of an empirical study showing that the theory of planned behaviour can be successfully used to predict variation in fruit and vegetable consumption in Australian young adults.

**Aim of the study.** The primary aim of this study was to understand the utility of the theory of planned behaviour constructs in predicting the fruit and vegetable consumption of a population of Australian young adults. The study was designed to test the assumption that the theory of planned behaviour would predict fruit and vegetable consumption in Australian young adults, and to specify the relationship between each of the specific theory-of-planned-behaviour variables in this context.

**Research questions and hypotheses.** Based on previous research in this area it was predicted that:

1. Attitudes, subjective norms, and perceived behavioural control will significantly predict intentions to eat recommended quantities of fruit and vegetables.
2. Intentions to eat recommended quantities of fruit and vegetables will be a significant predictor of behaviour.
(3) Perceived behavioural control will be a significant predictor of behaviour over and above the influence of intention.

**Method. Participants and procedure.** Data were collected from undergraduate students from a wide range of disciplines who were undertaking a first-year psychology course at an Australian University in early 2009. All aspects of the experiment, including recruitment, occurred online and could be completed from any computer with Internet access. Participants received course credit for their participation. As recruitment for all studies included in this thesis followed an opt-in procedure, where potentially eligible participants responded to an advertisement, it is not possible to assess the numbers of students who chose not to participate; nor can potential bias in the sample be determined.

A web-based questionnaire was developed for the purpose of this study. The online questionnaire allowed the administration of a questionnaire at Time 1, which included demographic measures, a measure of behaviour, and the theory of planned behaviour questionnaire. One week later, at Time 2, participants completed the behaviour measure. The length of follow-up used in this preliminary study is consistent with several other recent studies of the theory of planned behaviour in similar populations (Collins & Mullan, 2011; Wong & Mullan, 2009).
Measures. Theory-of-planned-behaviour questionnaire. The present study used a purpose-designed questionnaire designed to assess intention, attitude, subjective norm, and perceived behavioural control. The questionnaire was designed using the guidelines for theory of planned behaviour questionnaire construction developed by Francis et. al (2004). Intention, attitude, subjective norm and perceived behavioural control were all assessed using direct measures on a 100-point visual analogue scale (Appendix D). Thus scores could theoretically range from 0 to 100.

Intention. Intention to eat two servings of fruit and five servings of vegetables was measured by three items, each relating to an individual’s plans and intentions regarding future fruit and vegetable consumption (e.g., I plan to eat two servings of fruit and five servings of vegetables each day from now on: strongly disagree–strongly agree). Consistent with previous research, the overall intention score was derived from the mean of the three items, with a higher score indicating greater intention (Francis, et al., 2004). Cronbach’s $\alpha$ for the three items in this sample was .893.

Attitude. Attitude was assessed as the mean of six items each, measured on a semantic differential scale using bipolar adjective pairs (e.g., For me to eat two servings of fruit and five servings each day from now on would be: good/bad). All endpoints for the attitude items were selected from Osgood et al.’s work on evaluative adjective pairs (Osgood, Suci, & Tannenbaum, 1957). In order to minimise response biases (Francis, et al., 2004), items were arranged so that the ends of the scales were a mix of positive and negative endpoints; scores were reverse-coded before analysis as needed. A higher score indicates a stronger positive attitude towards eating two servings of fruit and five of vegetables. The 12 items had high internal consistency in this sample (Cronbach’s $\alpha = .899$).
Subjective norm. The 6-item subjective norm scale was made up of items measuring both injunctive and descriptive norms (Fishbein & Ajzen, 2010). Injunctive-norm items related to the individual’s perception of the extent to which important others believe that they should or should not consume fruit and vegetables (e.g., Most people who are important to me think that I _____ eat two servings of fruit and five servings of vegetables each day from now on: should/should not), whereas the descriptive-norm items related to the individual’s perception of the fruit and vegetable consumption of others (e.g. Many people like me eat two servings of fruit and five servings of vegetables each day from now on: extremely likely–extremely unlikely). Items assessing both injunctive and descriptive norm were combined into a single measure of subjective norm using the mean of the 6 items (Fishbein & Ajzen, 2010; Francis, et al., 2004). A higher score indicates greater perceived social pressure to consume two servings of fruit and five of vegetables. The 6-item combined scale had adequate internal consistency in this sample (Cronbach’s α = .725).

Perceived behavioural control. Perceived behavioural control was measured by four items; two items measured the extent to which the individual believed that fruit and vegetable consumption was under his or her control (e.g., It is mostly up to me whether or not I eat two servings of fruit and five servings of vegetables from now on: strongly agree–strongly disagree), and two items measured the perceived ease or difficulty of adequate fruit and vegetable consumption (e.g., If I wanted to I could eat two servings of fruit and five servings of vegetables from now on: definitely true–definitely false). Consistent with previous research, the overall perceived-behavioural-control score was derived from the mean of the four items, with a higher score indicating greater perceived control over behaviour (Francis, et al., 2004). Cronbach’s α for the three items was .807.
Behaviour. Fruit and vegetable consumption was measured using a brief self-report measure of previous day fruit and vegetable consumption. The 2-item measure of previous-day fruit and vegetable consumption is similar to the measure of fruit and vegetable consumption used in the National Health Survey and in evaluations of the success of the Go for 2&5 health-promotion campaign (Australian Bureau of Statistics, 2009a; Woolcott Research, 2007). The measure asks participants to indicate the number of servings of fruit and the number of servings of vegetables they consumed in the previous day. This type of measure has been shown to be well correlated with estimates of fruit and vegetable consumption obtained from 24 hour dietary recall and less likely to be subject to over-reporting of fruit and vegetable consumption than longer food frequency questionnaires (Peterson, et al., 2008).

Ethics. This study was approved by the Human Research Ethics Committee at the University of Sydney (see Appendix E).

Data Analysis. Data was analysed using the SPSS 15.0 software package for Windows. Descriptive and exploratory analyses of fruit and vegetable consumption were performed. Correlation and multiple regression analyses were conducted to test models consistent with the research hypotheses. Tests of normality were conducted on all theory of planned behaviour constructs. The distributions of data approached normality.

Results. Sample characteristics. Of the one hundred four participants who completed baseline assessment, 90 went on to complete Phase 2 of the study at 1-week follow-up. This represents a loss to follow-up of 13.5% across the duration of the study. Age in years in the present sample ranged from 18 to 25, with a mean age of 19.20 years (SD = 1.45). The majority of the sample’s participants (78.8%) were female, and they identified their predominant ethnicity as Australian (58.6%). Most participants
lived at home with their parents (80.6%) and identified the heads of their households as working in managerial, clerical, administrative, or professional positions (67.3%).

Mean fruit and vegetable consumption at baseline was 3.42 servings per day (SD = 1.52). Mean values for theory of planned behaviour constructs at baseline are reported in Table 14. There were no significant differences between individuals who completed follow-up and those who did not.

Table 14

Descriptive Statistics for Theory of Planned Behaviour–Related Constructs

<table>
<thead>
<tr>
<th>Construct</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attitude</td>
<td>22.42</td>
<td>100</td>
<td>84.37</td>
<td>12.98</td>
</tr>
<tr>
<td>Subjective norm</td>
<td>25.33</td>
<td>100</td>
<td>64.46</td>
<td>15.13</td>
</tr>
<tr>
<td>PBC</td>
<td>35.25</td>
<td>100</td>
<td>80.35</td>
<td>15.28</td>
</tr>
<tr>
<td>Intention</td>
<td>2</td>
<td>100</td>
<td>64.29</td>
<td>22.55</td>
</tr>
</tbody>
</table>

The relationship between attitude, subjective norm, perceived behavioural control, and intention. A linear regression analysis was used to examine the effect of theory of planned behaviour constructs (attitude, subjective norm, and perceived behavioural control) on intention to consume two servings of fruit and five servings of vegetables. Attitude, subjective norm, and perceived behavioural control were entered simultaneously into the regression analysis. The overall model was significant and accounted for 54.1% of the variance in intention ($R^2 = .541; F_{3,100} = 39.25; p < .001$). As shown in Table 15, attitude, subjective norm, and perceived behavioural control were all significant predictors of intention.
Table 15

Baseline TPB Constructs Regressed on Intention

<table>
<thead>
<tr>
<th>Model</th>
<th>β</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Constant)</td>
<td>-5.436</td>
<td></td>
<td>&lt;.001**</td>
</tr>
<tr>
<td>PBC</td>
<td>.330</td>
<td>4.615</td>
<td>&lt;.001**</td>
</tr>
<tr>
<td>Subjective norm</td>
<td>.291</td>
<td>3.455</td>
<td>.001**</td>
</tr>
<tr>
<td>Attitude</td>
<td>.350</td>
<td>4.275</td>
<td>&lt;.001**</td>
</tr>
</tbody>
</table>

Note: Dependent variable = intention; overall $R^2 = .541$; ** denotes statistical significance at the <.01 level

The relationship intention, perceived behavioural control, and behaviour at one week. Hierarchical linear regression analyses were used to examine the effect of intention and perceived behavioural control on fruit and vegetable consumption at one-week follow-up. Intention was entered in Step 1, and perceived behavioural control was entered in Step 2.

Intention was a significant predictor of behaviour at 1 week: intention predicted 25.3% of the variance in previous-day fruit and vegetable consumption ($R^2 = .253; F_{1,87} = 29.47; p < .001$).

When controlling for effects of intention, perceived behavioural control was not a significant predictor of behaviour. Perceived behavioural control accounted for an additional 1.9% of variance in previous-day fruit and vegetable consumption. This was not a significant $R^2$ change ($F_{1,87} = .019, p = .889$). A model summary is shown in Table 16.
Table 16

*Intention and Perceived Behavioural Control Regressed on Previous-Day Fruit and Vegetable Consumption at Time 2*

<table>
<thead>
<tr>
<th>Model</th>
<th>β</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. (Constant)</td>
<td>17.347</td>
<td>&lt;.001**</td>
<td></td>
</tr>
<tr>
<td>Intention</td>
<td>.503</td>
<td>5.428</td>
<td>&lt;.001**</td>
</tr>
<tr>
<td>2. Constant</td>
<td>7.960</td>
<td>&lt;.001**</td>
<td></td>
</tr>
<tr>
<td>Intention</td>
<td>.415</td>
<td>3.819</td>
<td>&lt;.001**</td>
</tr>
<tr>
<td>PBC</td>
<td>.164</td>
<td>1.511</td>
<td>.135</td>
</tr>
</tbody>
</table>

** denotes statistical significance at the >.01 level

**Discussion of findings.** This study was conducted in order to determine whether the theory of planned behaviour could provide a good model of fruit and vegetable consumption in the target population, Australian young adults, and to investigate the relationship between those variables in the target population.

The research presented in this section provides support for the use of the theory of planned behaviour for intervention design in the present sample. Results indicated that the constructs of the theory of planned behaviour—namely attitude, subjective norm, and intention—can be used to predict intention to consume two servings of fruit and five servings of vegetables.

The findings also show that intention to consume two servings of fruit and five servings is a significant predictor of behaviour at 1-week follow-up. The proportion of variance in fruit and vegetable consumption accounted for in the current study, 25%, is lower than that observed in meta-analyses of studies which have applied the theory of planned behaviour to the prediction of fruit and vegetable consumption (Guillaumie, et
al., 2010). However, it is consistent with studies which have investigated the predictive utility of these variables across a range of behaviours (Armitage & Conner, 2001).

This study used a relatively short follow-up period; 1 week. While consistent with other several other recent studies of the theory of planned behaviour in similar populations (Collins & Mullan, 2011; Wong & Mullan, 2009), the use of such a short follow-up period is a limitation of the present study and should be taken into account when interpreting results (see Chapter 7).

Contrary to expectations, perceived behavioural control did not predict variance in fruit and vegetable consumption over and above the influence of intention. This is similar to results from other recent studies of dietary behaviour in Australian young people (Kothe, Mullan, & Amaratunga, 2011; Wong & Mullan, 2009). It appears that although perceived behavioural control is predictive of intention to consume fruit and vegetable consumption, it has no direct impact on young-adult fruit and vegetable intake. Because the influence of perceived behavioural control on behaviour separate from intention is often interpreted as reflecting a lack of actual control over behaviour (Ajzen, 1991), this effect may be accounted for by a relatively high level of actual control over fruit and vegetable intake in this population. Participants in the present sample are well educated and are typically from high socioeconomic backgrounds. These factors may limit the generalisibility of findings from the other study to samples with different sociodemographic characteristics; this issue is discussed in depth in Chapter 8. This contrasts with the research presented in Chapter 2 that suggested that low educational attainment and low income may relate to limited availability of fruit and vegetables in areas of socioeconomic disadvantage. It may be reasonable to assume that young adults in the present sample do not experience many of the environmental barriers to fruit and vegetable consumption that would lead to low actual control over
behaviour. This finding is particularly important in the present context because, by suggesting that low fruit and vegetable consumption is driven by low motivation to consume fruit and vegetables rather than limited access, it supports the use of psychosocial interventions to increase fruit and vegetable consumption in this population.

**Conclusion.** The use of the theory of planned behaviour in program design is supported by previous research into the predictors of fruit and vegetable consumption, and findings of this study support the use of this model in the target population, Australian young adults. The model predicted a significant proportion of variance in fruit and vegetable intake, and the proportion of variance accounted for compared favourably with other studies in this area. However, although this research presents a sound quantitative basis for the design of the intervention, exploration of the beliefs which underlie attitude, subjective norm, and perceived behavioural control was outside of the scope of this phase of the research. As will be discussed in the next chapter, these questions are best assessed using a qualitative research design. The next study, presented in Chapter 5, is to provide information on fruit and vegetable consumption from the perspective of young adults themselves.
Chapter 5

Identifying Salient Beliefs and Intervention Preferences

Factors Influencing the Fruit and Vegetable Consumption of Australian Young Adults: A Focus Group Study

According to the theory of planned behaviour, the beliefs that determine attitudes, subjective norms, and perceive behavioural control are specific to both the behaviour and the population (Ajzen, 1991). As discussed in Chapter 4, changes in these salient beliefs are necessary in order for change in attitudes, subjective norms, or perceived behavioural control to occur (Ajzen, 1991). Researchers have argued that formative research is required in order to identify the salient beliefs for each population and behaviour (Fishbein & Ajzen, 2010). The identification of salient beliefs requires that researchers must have an in-depth understanding of the perspective of members of the population at whom the intervention is aimed (Fishbein & Yzer, 2003). Because qualitative research allows unexpected, but important, beliefs to be elicited from members of the target population (Wilkinson, 2004), this type of research is essential during the formative-research stage.

This chapter describes the results of a qualitative study investigating salient beliefs about fruit and vegetables held by young adults. Using the theory of planned behaviour as a framework, the study considers the fruit- and vegetable-related cognitions of Australian young adults. In particular, young people’s attitudes towards fruit and vegetable consumption and their perceived behavioural control and subjective norm were investigated in order to guide the development of intervention materials.
The use of semistructured focus groups was selected as the most appropriate data-collection method for this stage of the research.

Focus-group studies have been used to investigate beliefs about nutrition in a range of contexts (Brug, et al., 1995; McGee et al., 2008). Focus groups have been used extensively in health and social-science research (Beyea & Nicoll, 2000; Wilkinson, 1998) and have been recognised as particularly useful in eliciting information related to lifestyle and health (Kitzinger & Barbour, 1999). Researchers have argued that they are especially suited to the study of evaluative beliefs and related experiences (Kitzinger & Barbour, 1999).

The popularity of the focus-group methodology has arisen in large part because of the distinct advantages that focus groups have over other formats for qualitative data collection, such as one-on-one interviews (Beyea & Nicoll, 2000; Wilkinson, 2004). In contrast to resource-intensive one-on-one interviews, focus groups provide a way of collecting data from a relatively large number of participants both quickly and cheaply (Beyea & Nicoll, 2000; Wilkinson, 1998, 2004). Researchers have also argued that focus groups provide a more ecologically valid and naturalistic research setting than dyadic encounters. In large part, this is due to the nature of interparticipant interactions in focus groups (Kitzinger & Barbour, 1999; Wilkinson, 2004). The group setting allows participants to react and respond to the responses of other members of the target population, creating a synergistic effect (Stewart, Shamdasani, & Rook, 2007) which often results in the generation of more elaborate comments than would be expected in a one-on-one interview (Kitzinger & Barbour, 1999; Stewart, et al., 2007). The supportive group setting is also thought to encourage disclosure of sensitive issues, such that a significant body of research suggests that individuals are more likely to
discuss potentially sensitive topics in a focus group than in a dyadic interview context (for review, see Farquhar, 1999).

The semistructured format was selected because it enables collection of qualitative data directly relevant to the research questions (Giskes, Turrell, Patterson, & Newman, 2002a). The question format balances the need to elicit specific information and openly explore themes while minimising influence from the researcher’s preconceptions (Billson, Pryer, & Nichols, 1999). For these reasons, a semistructured approach to data collection facilitates the elicitation of themes which have not previously been reported in the literature (Turrell, Hewitt, Patterson, & Oldenburg, 2003) and provides rich and complex data that would be overlooked in most quantitative approaches to data collection (Giskes, et al., 2002a).

**Research questions and hypotheses.** The study aimed to address four main research questions:

1. How do young adults conceptualize the consequences (advantages and disadvantages) of fruit and vegetable intake and lack of intake?
2. How do young adults experience social pressure with regard to their own fruit and vegetable intake?
3. Do young adults perceive themselves as in control of their fruit and vegetable intake? If not, what factors do they perceive as undermining their behavioural control?
4. What are the intervention needs and preferences of young adults?

**Method. Participants.** Participants were 28 students (n = 21 females) aged 18–25 years studying at a large, urban university in Australia. Students were enrolled in degree programs from a variety of fields including arts, sciences, engineering, and health sciences. Participants received course credit for their participation.
Procedure. Recruitment. Five mixed-gender focus groups were conducted over the course of 2009–2010. Each group consisted of between four and seven participants with discussion lasting approximately one hour. Data collection ceased once data saturation had been reached (Ball, Crawford, & Mishra, 2006).

The interview process. Focus groups were conducted according to standardised procedures (described below), with all focus groups facilitated by the same researcher. During the sessions, participants were encouraged to speak until all views were expressed; additional probing and clarification by the facilitator followed discussion of each concept as appropriate.

Transcription. All focus groups were audio-recorded, with the participants’ consent. Each recording was then transcribed verbatim and checked twice to ensure accuracy. Data was entered into NVIVO 8.0 (QSR, 2003) for analysis.

Measures. A topic guide designed by the research team guided discussion in all focus-group sessions (see Appendix F). The theory of planned behaviour was used as a theoretical basis for the topic guide. Questions in the topic guide were designed to address issues relevant to young people’s attitudes towards fruit and vegetable consumption and their perceived behavioral control and subjective norm beliefs (e.g., “Are there any particular people in your life who would approve of you eating two servings of fruit and five servings of vegetables every day?”) The focus groups adopted a semistructured format to include further follow-up questions that enabled enhancement and clarification of participants’ responses (Silverman, 2004).

Ethics. The study was approved by the University Human Research Ethics Committee (see Appendix G); consistent with ethics approval for this study, participants were not asked to disclose identifying information in the course of this study. Therefore, the only demographic information available is gender. Although age
was an inclusion/exclusion criterion for this study, eligibility was verified without age being recorded.

**Data analysis.** This study used thematic analysis to code and analyse data collected during focus-group discussions (Wilkinson, 2004). Within this approach, there are two main types of qualitative data coding and analysis. Inductive, bottom-up, coding and theoretical, or deductive, top-down, coding (Shohaimi et al., 2004). This study used a primarily theoretical approach to coding. Emergent themes were organised into a thematic framework developed a priori. The coding framework used in the present study was developed to help classify themes as relating to attitude, subjective norms, perceived behavioural control, or all of these. Beliefs were categorised as *attitudinal beliefs* if they related to an evaluation of fruit and vegetable consumption and its outcomes, as *control beliefs* if they related to the ability to successfully consume desired quantities of fruit and vegetables, and as *normative beliefs* if they related to others’ fruit and vegetable consumption, others’ consumption patterns, or both. Within these broad categories, a more inductive approach to data analysis was used, where themes were identified and grouped as they emerged, in a bottom-up process.

This approach meant that superordinate themes (i.e., attitude, subjective norm, and perceived behaviour control) were theoretically derived, but subordinate themes (content of attitude, control, and normative beliefs) were investigated using an exploratory approach.

There were three stages to qualitative data analysis conducted during this thesis:

1. familiarisation
2. identification of a thematic framework
3. indexing
Familiarisation was achieved through repeated readings of each transcript. A thematic framework was then developed by generating thematic categories, including superordinate categories that grouped common themes as well as more specific subordinate themes. The thematic framework was developed in consultation with a second researcher; the two researchers coded transcripts independently and then resolved differences through consensus. Indexing was accomplished by line-by-line coding of all transcripts in NVIVO using the thematic framework.

**Results. Beliefs about fruit and vegetables.** The beliefs about fruits and vegetables elicited over the course of the focus-group discussions are summarised in Table 17. This table indicates whether an individual theme was mentioned in a given group but does not provide data on the number of people who made reference to each theme in a session, because group dynamics in focus groups make analysis of this kind problematic. Dominant beliefs and important deviant expressions of themes are discussed in detail in this section.
**Table 17**

*The Reporting of Themes by Focus-Group Session*

<table>
<thead>
<tr>
<th>Theme</th>
<th>Focus group session</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td><strong>Behavioural beliefs</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Negative</strong></td>
<td></td>
</tr>
<tr>
<td>Fruit is unhealthy</td>
<td>Y</td>
</tr>
<tr>
<td>Dislike of fruit and vegetables</td>
<td>Y</td>
</tr>
<tr>
<td>Fruit and vegetable consumption is a hassle</td>
<td>Y</td>
</tr>
<tr>
<td><strong>Positive</strong></td>
<td></td>
</tr>
<tr>
<td>Fruit and vegetable consumption is good for health</td>
<td>Y</td>
</tr>
<tr>
<td>Liking of fruit and vegetables</td>
<td>Y</td>
</tr>
<tr>
<td>Cooking is enjoyable/pleasurable</td>
<td>Y</td>
</tr>
<tr>
<td><strong>Normative beliefs</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Positive</strong></td>
<td></td>
</tr>
<tr>
<td>Parents are supportive of fruit and vegetable intake</td>
<td>Y</td>
</tr>
<tr>
<td><strong>Negative</strong></td>
<td></td>
</tr>
<tr>
<td>Friends are unsupportive of fruit and vegetable intake</td>
<td>Y</td>
</tr>
<tr>
<td>Family is unsupportive of fruit and vegetable intake</td>
<td>Y</td>
</tr>
<tr>
<td><strong>Control beliefs</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Barriers</strong></td>
<td></td>
</tr>
<tr>
<td>Limited access/availability</td>
<td>—</td>
</tr>
<tr>
<td>Cost</td>
<td>Y</td>
</tr>
<tr>
<td>Storage difficulties</td>
<td>Y</td>
</tr>
<tr>
<td>Preparation difficulties</td>
<td>Y</td>
</tr>
<tr>
<td>Negative social influences</td>
<td>Y</td>
</tr>
<tr>
<td>Temptation</td>
<td>—</td>
</tr>
<tr>
<td>Low Motivation</td>
<td>—</td>
</tr>
<tr>
<td>Forgetfulness</td>
<td>Y</td>
</tr>
<tr>
<td>Unhealthy food is more convenient</td>
<td>—</td>
</tr>
<tr>
<td><strong>Facilitators</strong></td>
<td></td>
</tr>
<tr>
<td>Supportive parents</td>
<td>Y</td>
</tr>
<tr>
<td>Easy availability of healthy alternatives</td>
<td>Y</td>
</tr>
<tr>
<td>Planning ahead</td>
<td>—</td>
</tr>
</tbody>
</table>

*Y = theme was mentioned by at least one participant in the focus group session*
Attitudes towards fruit and vegetable consumption were generally positive. Health benefits associated with fruit and vegetable consumption were major motivators for many participants. However, while the majority of participants did perceive a link between fruit and vegetable intake and wellbeing, a small but significant minority of participants questioned the health benefits of fruit and vegetable consumption. For example, some participants were unsure that fruit and vegetable consumption was necessary for good health: “you see heaps of people who don’t follow [dietary guidelines for fruit and vegetable consumption], like hardly anyone follows it, and they’re still really healthy.” Worryingly, participants across multiple sessions reported the perception that fruit and vegetable consumption may actually be unhealthy. This perception was particularly related to fruits thought to be high in sugar and the belief that consumption would lead to weight gain and increased body fat: “Well, I really love fruit and I sometimes get told to steady on because it’s not as good for you as you first think” and “fruit makes you fat . . . high sugar content.” Interestingly, the belief that fruit consumption is unhealthy was often reinforced by overt disapproval for fruit and vegetable consumption by friends: “I used to eat it and then people used to tell me there was heaps of sugar in fruit and I shouldn’t eat it, so I stopped eating it for a long time.”

Overt disapproval of fruit consumption was just one way in which participants experienced social pressure surrounding fruit and vegetable consumption. Social pressure to consume fruit and vegetables, both in terms of descriptive and injunctive norms (Fishbein & Ajzen, 2010), came from a range of sources. Analysis of the focus-group discussion identified two major sources of social influence over fruit and vegetable consumption: immediate family members and friends.

Family provided a positive normative influence for many participants: “my mum she is kind of like a health freak . . . so it’s kind of like one of those things that
I’ve grown up with.” Participants who had been successful in increasing their fruit and vegetable intake in the past frequently reported that this had been possible because of support from families. Most participants who had received familial support reported that once their families were committed to dietary change, they felt compelled to maintain high intake of fruit and vegetables. However, a minority of participants reported that their family environment was unsupportive of fruit and vegetable consumption: “I had a very carnivore family; lots of boys in my family so there wasn’t really that much on offer.”

Interestingly, all participants who discussed the influence of their friends on their eating behaviours reported social pressure that was unsupportive of fruit and vegetable consumption. Participants reported that their friends did not eat fruit and vegetables, and that they felt uncomfortable or out-of-place choosing to eat fruit and vegetables with their friends: “Even at uni [university] when you’re eating with friends and stuff . . . it’s not like you’re going to bring and apple and an orange every other fruit you have at home to uni when everyone else is buying their food from uni.”

Participants also reported a large number of factors that fit within the theme of perceived behavioural control. In general, participants reported limited control over their own consumption of fruit and vegetables and generated a large number of barriers to consumption. Of these, three dominant themes emerged during data analysis: (a) access and availability, (b) preparation, and (c) the need to plan fruit and vegetable consumption.

Participants with ready access to fruit and vegetables in their home environments, especially where parents provided healthy, cooked meals, tended to report that fruit and vegetable consumption was easy and within their control. However, where access to fruit and vegetable consumption was more limited, fruit and vegetable
consumption tended to be perceived as more difficult or outside of the individuals’ control. Seasonality appeared to have a major impact on perceived access: “I like pomegranate and I know it’s very healthy, but it’s seasonal so it’s hard for you to have it . . . so when they’re not in season I tend to go off my fruit eating so that really affects everything else.” Cost was another significant determinant of the availability of fruits and vegetables for many participants. In fact, the perceived high cost of fresh produce was the most commonly cited barrier to increased consumption of fruit and vegetables across all sessions: “Yeah—well buying, eating healthy is so expensive, and so sometimes you do have to live off like you know your two-minute [ramen] noodles or your pasta packs and stuff like that.”

Issues surrounding preparation of fruit and vegetables emerged as a major theme underlying perceptions of control over personal fruit and vegetable consumption. While some participants reported that their enjoyment of cooking made it easier to eat fruit and vegetables, others reported that they were constrained by a lack of cooking skills: “I’ve got no idea what to do with them [brussels sprouts]. They’re good in some kind of curry but I can’t cook that type of curry.” For others, the major preparation issues related to the time taken to prepare fruits and vegetables. Perceived lack of time was not limited to foods which needed to be cooked before consumption; a small number of participants reported that time was an issue even when consuming fruits that could be eaten raw: “I think it takes longer to go and get fruit and peel it and everything. It’s just easier to grab some biscuits or something”; “It takes a lot of time to wash them and stuff.”

The need to plan was a dominant theme in the discussion of fruit and vegetable consumption. Participants reported that without planning ahead they were likely to either forget to eat fruits and vegetables or would find that their food choices were
limited “when I do want it it’s sort of mum’s bought it at the beginning of the week, it’s sort of rotten, chocolate’s looking better—you know, you just don’t eat it.” Many participants reported that planning the purchase and consumption of fruit and vegetables was valuable. However, participants varied in the extent to which they were able to successfully plan and regulate their consumption. Some participants were able to increase their fruit and vegetable consumption by planning. However, other participants reported experiences where they had failed to adhere to plans “it was really hard because I’d go and buy all these veggies and have all these big plans for the week and then like by Wednesday everything is going off.”

**Intervention preferences.** The majority of participants reported that they would prefer that programs designed to help them increase their fruit and vegetable consumption be delivered online. The needs for intervention materials to be free of charge and coming from a reputable source were also mentioned by some participants.

**Discussion of findings.** These findings support the use of the theory of planned behaviour in research designed to predict fruit and vegetable consumption, and in the design and evaluation of interventions designed to increase consumption. Consistent with quantitative studies of older adults (Guillaumie, et al., 2010), and with the prospective study presented in Chapter 4, the theory of planned behaviour provided a meaningful framework for organising and interpreting individuals’ beliefs about their own fruit and vegetable intake.

Whilst perceptions of fruit and vegetable consumption were generally positive, participants also held some negative beliefs about fruit and vegetables which are likely to limit consumption. These included some commonly cited negative attitudes such as taste (Brug, et al., 1995; McGee, et al., 2008), as well as some novel findings. Some participants believed that fruit consumption would lead to weight gain, and many felt
that friends were unsupportive of fruit and vegetable consumption. These negative beliefs had not previously been identified in the context of fruit and vegetable consumption. While held by a minority of participants in the present study, these beliefs would appear to offer an important point of intervention for individuals in this age group. This is particularly important given that the belief that fruit consumption would lead to weight gain was so often transferred through overt disapproval by friends, leading some young adults to decrease fruit and vegetable consumption in the presence of peers.

Social pressure to consume fruit and vegetables varied considerably within the group interviewed. Parents and friends were the primary point of social comparison and social support for fruit and vegetable intake. While most family members provided positive normative influence on fruit and vegetable consumption, friends tended to have a negative impact on consumption. All young adults who discussed the influence of friends on dietary behavior reported that their friends were unsupportive of fruit and vegetable intake and that they were likely to reduce their fruit and vegetable intake when eating with friends. This finding is unexpected and has serious implications for intervention design in this population. In particular, there is a clear need to reduce the influence of the perceived negative social pressure on young adults’ fruit and vegetable consumption in order to develop successful interventions for this population. However, there is little research investigating how best to change young adults’ perception of social norms surrounding nutrition behaviors. It may be helpful to incorporate work from alcohol and smoking literature in order to address this problem (Poirier, et al., 2006; Unit, 2006). This literature suggests that providing information about normative behaviour (especially where actual rates of performance of the behaviour are different
from commonly held descriptive norms) may help change normative influences on behaviour.

Young people in the current study reported a large number of internal and external factors that undermined their control over their own fruit and vegetable consumption. Many of these—such as cost, storage, and preparation—are common to other populations (Brug, et al., 1995; McGee, et al., 2008).

Findings suggest that strategies for improving the fruit and vegetable intake of Australian young adults should be aimed at improving attitudes, subjective norm, and perceived behavioural control as they relate to fruit and vegetable intake. Overall, these findings indicate that interventions designed to increase the fruit and vegetable consumption of young adults should specifically address uncertainty surrounding the health benefits of fruit and vegetable consumption, as well as perceptions that peers would be unsupportive of such consumption, and control beliefs relating to cost, lack of cooking skills, and poor planning.

Since this study was used as the basis for developing intervention materials, participants were not asked to comment on specific behaviour change techniques or on intervention content. The design and pilot testing of an intervention to address these issues are described in the next chapter.
Chapter 6

Design and Evaluation of the Fresh Facts Pilot Intervention

The Feasibility and Acceptability of the Fresh Facts Pilot Intervention

The previous chapters have outlined the theoretical basis for the intervention tested in this thesis and have presented findings relating to the intervention preferences and needs of young adults. Together these strands of research provide a preliminary framework for the design of intervention content.

Researchers have called for extensive feasibility and acceptability testing of any intervention prior to full-scale implementation (Bartholomew, et al., 2001; Tones & Tilford, 2001). Comprehensive pretesting increases the likelihood that the intervention is seen as comprehensive, relevant, memorable, credible, and acceptable to participants (Bartholomew, et al., 2001; Tones & Tilford, 2001). These factors are thought to be prerequisites for successful behaviour change (Weinreich, 1999). In light of this need for pretesting, this chapter presents the design and evaluation of a pilot intervention based on the theory of planned behaviour and intended to increase fruit and vegetable consumption of young adults.

The Fresh Facts Pilot Intervention

The intervention described in this section, the Fresh Facts pilot intervention, was developed on the basis of research presented in previous chapters. Research presented in Chapter 3 guided the selection of the theory of planned behaviour for use as the overarching theoretical framework for the present intervention. The findings of empirical research presented in Chapters 4 and 5 supported the selection of this theory by demonstrating that the theory could be meaningfully applied to the prediction of
fruit and vegetable intake in Australian young adults in both quantitative (Chapter 4) and qualitative (Chapter 5) studies.

Together these two strands of empirical research suggest that interventions to modify fruit and vegetable consumption in young adults should target attitude, subjective norm, and perceived behavioural control in order to bring about changes in intention that ultimately lead to increased fruit and vegetable intake. More specifically, the qualitative research presented in Chapter 5 suggested a number of important beliefs that should be addressed in interventions to increase fruit and vegetable consumption in this population. These included the perceived health consequences of fruit and vegetable consumption, perceptions of the social environment as unsupportive of fruit and vegetable consumption, and commonly perceived barriers to consumption (e.g., time, cost, and availability). However, while the studies presented in Chapter 4 and Chapter 5 provide information about suitable targets for intervention, the research presented so far does not provide a detailed structure for the format and content of intervention messages. The research presented in the remainder of this chapter provides a preliminary investigation of this issue in the context of interventions to increase fruit and vegetable consumption in Australian young adults.

**Intervention modality.** Young adults who participated in the focus-group study presented in Chapter 5 expressed a clear preference for interventions targeting their fruit and vegetable consumption to be delivered online. This is consistent with calls for increased web-based research in young adult populations (Weinstein, 2006). Indeed, such research has resulted in improvements across a range of health domains, including exercise, weight loss, and nutrition (Wantland, Portillo, Holzemer, Slaughter, & McGhee, 2004) as well as several fruit and vegetable intervention studies presented in Chapter 3 (Buller et al., 2008; Cassady, et al., 2007; Lakshman, et al., 2011; Winett, et
al., 2007). However, one of the major problems in the development of web-based interventions is the facilitation of participant engagement. One of the most simple methods of web-based intervention delivery is the development and dissemination of a static website which may or may not be updated over the study period. While some studies have successfully used websites to increase fruit and vegetable consumption, many such studies have struggled to sufficiently engage participants with intervention materials. For example, the 5 a Day Rio Grande Way study reported that only 50% of participants assigned to the website-intervention group visited the website after having been registered by study staff (Buller, et al., 2008). Even among those participants who did access the website, time on the website was highly variable, with 25% of participants who accessed the website doing so for less than 2 minutes (Buller, et al., 2008).

In response to these issues, some researchers have investigated the used of automated emails in health-promotion interventions (Cassady, et al., 2007; Webb, et al., 2010). This modality has the advantage of encouraging continued engagement with intervention materials over time. Automated email-based interventions also have the advantage of allowing participants to begin receiving intervention materials immediately on study enrolment without the need for a run-in period to allow for full study enrolment before the mass publication of a study website. Email-based interventions that make use of commercial email-distribution software also facilitate intervention and dissemination through the full automation of most study-administration tasks, including randomisation, distribution of intervention materials, and follow-up reminders.

In light of the clear preference for a web-based intervention shown by participants in the focus group study, and the relative advantages of email-based
interventions over other web-based modalities as well as existing support for the use of automated email in the research environment in which this thesis was conducted, the Fresh Facts pilot intervention was delivered using automated emails.

The version of the intervention tested in the pilot study consisted of a 15-day module which included the delivery of up to 15 intervention messages between baseline and follow-up. The intervention intensity and dosage is discussed below.

**Intervention content and processes of change.** The pilot intervention described in this chapter was designed to target perceived behaviour control, because this provided a discrete set of beliefs that could be easily tested in the pilot study.

The taxonomy of behaviour-change techniques (Abraham, Kok, Schaalma, & Luszczynska, 2010; Abraham & Michie, 2008) was used to guide the selection of intervention processes and content. The taxonomy of behaviour-change techniques is a system that allows process elements of behaviour-change interventions to be categorised into a set of distinct, theory-linked behaviour change techniques. Each technique has been linked to theory-relevant constructs from theories of health behaviour commonly used in health psychology (Abraham & Michie, 2008). Because it specifies behaviour-change techniques that are likely to be linked to theory-relevant constructs within each of the major theories, the taxonomy provides a useful starting point for the selection of processes in intervention design. The most recent version of the taxonomy available at the time of intervention design listed 40 techniques that could be used to change behaviour (Abraham, et al., 2010). Of these, 23 were broadly related to constructs in the theory of planned behaviour. This provided an initial list of potentially suitable intervention techniques that was then refined on the basis of each technique’s suitability for the selected intervention modality, applicability to the promotion of fruit and vegetable consumption in young adults, and the desire to target
attitude, subjective norm, and perceived behavioural control. This process of refinement was conducted by two researchers, who eliminated techniques on a consensus basis. A large number of techniques were excluded because they were incompatible with the selected modality (e.g., the demonstration of performance of the behaviour), or because they did not seem relevant to the performance or nonperformance of the behaviour within the target group (e.g., reattribution). Other techniques were excluded because they did not correspond to constructs within the theory of planned behaviour, for example the provision of information about affective consequences of behaviour which was excluded because the technique was judged to be more consistent with the anticipated regret literature (Sheeran & Orbell, 1999) than with the conceptualisation of attitude used in the present thesis.

The list of behaviour-change processes that were selected to target perceived behavioural control is shown in Table 18.

Table 18

<table>
<thead>
<tr>
<th>Behaviour Change Techniques Identified as Theory and Modality Appropriate</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Perceived Behavioural Control:</strong></td>
</tr>
<tr>
<td>Argue to bolster self-efficacy</td>
</tr>
<tr>
<td>Provide instruction</td>
</tr>
</tbody>
</table>

Intervention messages specific to these techniques were developed on the basis of the focus group findings presented in Chapter 5. The full set of intervention messages used in the pilot intervention is listed in Appendix H. The content of intervention messages described in this thesis emerged from the qualitative interviews using an intervention mapping approach. This approach provided a framework for the design of all intervention content.

Message frequency. One aspect of intervention design that was not addressed in Chapters 4 and 5 was that of preferred message frequency. Indeed, despite the fact that message frequency is obviously a crucial feature of the design and evaluation of interventions that include multiple contacts (Campbell, et al., 2000), there is a general paucity of research investigating ideal message frequency in the design of new interventions.

Pretesting of the type described in this chapter allows researchers to determine optimal levels of message frequency. To allow for investigation of the impact of differing levels of intervention contact on participants engagement and interest in the intervention, the Fresh Facts pilot intervention was designed at three levels of message frequency.

Research Aim

The main aim of this study was to investigate acceptability and feasibility of a recently developed web-based intervention promoting fruit and vegetable consumption in a university-based population of young adults. As such, this chapter reports data regarding usability, user-friendliness, credibility, feasibility, clarity, readability, and related factors in a sample of individuals exposed to a pilot version of the Fresh Facts intervention. A secondary aim of the study was to explore whether there were differences in reported feasibility and acceptability of the Fresh Facts pilot intervention.
between participants of different ages, genders, and living situations, and at different levels of intervention intensity.

**Method**

**Participants and procedure.** As with previous studies presented in this thesis, participants in this study were students undertaking a first-year psychology course at an Australian university. All participants in this study received course credit for their participation.

Participants who enrolled in the study were randomly assigned to one of three groups generated at random by a computer: low intensity, medium intensity, and high intensity (see Table 19). Randomisation was completed using automated group assignment, meaning that study administrators were not aware of individual participants’ group assignment. All aspects of the experiment, including recruitment, occurred online and could be completed from any computer with Internet access.

**Table 19**

*Email Frequency by Intervention Group*

<table>
<thead>
<tr>
<th>Intervention group</th>
<th>Email frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low intensity intervention</td>
<td>5 emails over 15 days</td>
</tr>
<tr>
<td>Medium intensity intervention</td>
<td>10 emails over 15 days</td>
</tr>
<tr>
<td>High intensity intervention</td>
<td>15 emails over 15 days</td>
</tr>
</tbody>
</table>

Upon entry to the study, each participant received the study URL, which provided access to the study website and Part 1 of the user survey. In this part of the survey, demographic information (age, gender, ethnicity, and occupation of head of household) was collected. Successful completion of Part 1 triggered delivery of Fresh Facts email messages. Each participant received an automated invitation to complete
the follow-up survey 15 days after completing Part 1. Participants who had not completed the Part 2 survey within 1 week received a single email reminder. The follow-up survey contained a series of feasibility and acceptability questions as described below.

**Measures**

Although many researchers have called for increased pretesting of intervention materials before intervention implementation (Bartholomew, et al., 2001; Tones & Tilford, 2001; Vandelanotte & De Bourdeaudhuij, 2003), there is currently no comprehensive theory or model that outlines how these constructs should be measured (Vandelanotte & De Bourdeaudhuij, 2003). In particular, there are no widely accepted guidelines about acceptable levels of feasibility and acceptability during intervention pretesting.

However, several key concepts are believed to be important in the pretesting process. Vandelanotte and De Bourdeaudhuij (2003) identified these as usability, user-friendliness, credibility, clarity, and readability. In the present study, a self-administered questionnaire was used to assess these concepts for both intervention components: the planning task and the automated emails. The questionnaire used in this study was based on an existing questionnaire used to measure feasibility and acceptability of a web-based physical activity intervention (Vandelanotte & De Bourdeaudhuij, 2003).

The feasibility and acceptability questionnaire comprised two parts. Part A consisted of questions about both intervention components. The questions examined the extent to which participants found each intervention component to be the following: annoying, interesting, credible, logical, easy to understand, personally relevant, confusing, complete, too long, and useful. To avoid excessively neutral response
patterns, each item was scored on a 6-point Likert scale (1 = strongly disagree, 6 = strongly agree) with no neutral midpoint (Kulas & Stachowski, 2009). In Part B, participants were asked to report their actual levels of usage of the intervention components (e.g., *Do you remember receiving emails about fruit and vegetables during the week?* Yes/No) and were given the opportunity to make specific comments and suggestions in two open-ended questions.

In addition to self-reported measures, feasibility was also evaluated by investigating the level of attrition over the course of the study.

**Ethics.** The study was approved by the University Human Research Ethics Committee (see Appendix I).

**Data analysis.** All quantitative analyses were performed using SPSS 17.0. All items were scored from 1 to 6, with a higher score indicating greater agreement with target statements. In order to increase clarity in the reporting of statistics, each item mean is accompanied by the percentage of participants who agreed with target statement. The “percent agreed” represents the proportion of participants who answered “strongly agree” or “agree” on the individual item.

Independent sample *t* tests were conducted to explore differences in feasibility ratings between participants who reported reading the emails and those who reported receiving the emails but not reading them, and between male and female participants. Bivariate correlation analyses were conducted to investigate the relationship between age (a continuous variable) and reported feasibility and acceptability. One-way ANOVAs were used to explore the influence of intervention intensity on feasibility and acceptability items.

Thematic analysis was used to interpret comments and suggestions which intervention participants made about intervention components (Silverman, 2004).
Thematic analysis was conducted using NVivo 8.0. Common themes are reported using illustrative quotes.

Results

Data were collected from 90 students at baseline: 24.4% of the baseline sample was male; age at baseline ranged from 18 to 25 years (M=19.29). The demographic characteristics of the sample are presented in Table 20. Participants were randomised to the three levels of the intervention as follows: low intensity (n=39), medium intensity (n=21), and high intensity (n=30). There were no significant between-group differences in demographic characteristics at baseline. This would suggest that randomisation was successful.
Table 20

Demographic Characteristics of the Baseline Sample

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>19.29</td>
<td>1.32</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>22</td>
<td>24.4</td>
</tr>
<tr>
<td>Female</td>
<td>68</td>
<td>75.6</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australian</td>
<td>45</td>
<td>50</td>
</tr>
<tr>
<td>North West European</td>
<td>4</td>
<td>4.4</td>
</tr>
<tr>
<td>South East European</td>
<td>2</td>
<td>2.2</td>
</tr>
<tr>
<td>North African</td>
<td>4</td>
<td>4.4</td>
</tr>
<tr>
<td>South East Asian</td>
<td>16</td>
<td>17.8</td>
</tr>
<tr>
<td>North East Asian</td>
<td>11</td>
<td>12.2</td>
</tr>
<tr>
<td>South Asian</td>
<td>3</td>
<td>3.3</td>
</tr>
<tr>
<td>Other</td>
<td>5</td>
<td>5.6</td>
</tr>
<tr>
<td>Occupation of head of household*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Higher managerial, administrative, or professional</td>
<td>34</td>
<td>37.8</td>
</tr>
<tr>
<td>Intermediate managerial, administrative, or professional</td>
<td>19</td>
<td>21.1</td>
</tr>
<tr>
<td>Supervisor, clerical, or junior</td>
<td>6</td>
<td>6.7</td>
</tr>
<tr>
<td>Skilled manual worker (e.g., tradesperson)</td>
<td>6</td>
<td>6.7</td>
</tr>
<tr>
<td>Semi- and unskilled manual worker</td>
<td>4</td>
<td>4.4</td>
</tr>
<tr>
<td>Student</td>
<td>17</td>
<td>18.9</td>
</tr>
</tbody>
</table>

* Percentages do not add to 100 due to missing values

A total of 82 participants completed the feasibility and acceptability measures at follow-up. This represents a total attrition rate of 9% over the course of the study.

Between groups, there were no significant differences in the drop-out rate.

Quantitative responses to the Fresh Facts pilot intervention. Table 21 presents scores for all items related to the feasibility and acceptability of the Fresh
Facts pilot intervention. A total of 12 participants reported that they did not receive intervention emails. Thus, this section only reports responses from individuals who reported receiving emails. As shown, scores for this intervention component were very positive. Over 90% of participants rated the automated emails as interesting, credible, logical, easy to understand, and useful; less than 10% of participants rated the intervention as confusing. However, about one fifth of participants (21.2%) rated the intervention as annoying.

Table 21

Sample Means and Proportion Agreed for Automated Email Feasibility and Acceptability Items

<table>
<thead>
<tr>
<th>Email</th>
<th>Sample mean</th>
<th>% agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annoying</td>
<td>2.77</td>
<td>21.2</td>
</tr>
<tr>
<td>Interesting</td>
<td>4.93</td>
<td>97.6</td>
</tr>
<tr>
<td>Credible</td>
<td>4.78</td>
<td>92.5</td>
</tr>
<tr>
<td>Logical</td>
<td>4.89</td>
<td>97.6</td>
</tr>
<tr>
<td>Easy to understand</td>
<td>5.38</td>
<td>100</td>
</tr>
<tr>
<td>Personally relevant</td>
<td>4.40</td>
<td>86.1</td>
</tr>
<tr>
<td>Confusing</td>
<td>1.90</td>
<td>4.4</td>
</tr>
<tr>
<td>Comprehensive</td>
<td>4.31</td>
<td>87.1</td>
</tr>
<tr>
<td>Too long</td>
<td>2.53</td>
<td>11.8</td>
</tr>
<tr>
<td>Useful</td>
<td>4.50</td>
<td>90.9</td>
</tr>
</tbody>
</table>

A total of 18 participants who reported receiving emails reported that they did not read the intervention emails. Participants who rated the emails as annoying, \( t(54) = 3.787 \ p > .001 \), or too long, \( t(54) = 3.109 \ p = .003 \), were significantly less likely to report having read all of the emails. Conversely, individuals who rated the emails as useful,
Predictors of feasibility and acceptability ratings. With regard to gender, women were more likely than men to rate the automated emails as comprehensive, \(t(56) = -2.283, p = .026\). There were no other significant gender-related differences. No differences in feasibility and acceptability scores were detected between people living with parents and not living with parents. There were no significant relationships between age and any of the feasibility and acceptability items.

No effects of intervention intensity on reported feasibility and acceptability scores were detected.

Qualitative responses to the Fresh Facts intervention. Comments about the feasibility and acceptability of the Fresh Facts pilot intervention materials are reported separately for each level of intervention intensity. Common themes are reported using illustrative quotes.

Low-intensity intervention participants reported that the emails were a “good reminder,” and several participants commented that they found the recipes and tips to be especially useful: “good recipes—I never imagined fruits and vegies could make so many dishes”, reported a 20-year-old female participant. However, some participants reported that the emails were “just common sense”.

Most medium-intensity intervention participants who commented on the automated emails reported that they found the emails to be encouraging, and that the emails helped them to “remember to eat fruit and veg more often”. However, some participants reported that they found the emails repetitive, and that they felt they received too many emails: “They were fairly encouraging but a bit repetitive. After a
while *sic* I didn’t pay too much attention to them”, reported an 18-year-old female participant.

Like participants in the low- and medium-intensity intervention, the majority of respondents in the high-intensity intervention reported that the intervention provided good motivation to increase fruit and vegetable consumption: “the emails were interesting to read and they encouraged and motivated me to eat healthy”, reported a 19-year-old participant. Responses from participants suggest that the emails were effective in increasing perceived behavioural control: “they made keeping healthy seem very easy”, reported an 18-year-old female participant.

However, as with the lower-intensity interventions, some high-intensity participants reported that at least some of the emails were “a little obvious”. Interestingly, no participants in the high-intensity intervention reported feeling that they received too many emails.

**Discussion of Findings**

Generally speaking, the quantitative and qualitative data all showed the Fresh Facts intervention to be a feasible and acceptable intervention for improving fruit and vegetable consumption in a university-based sample of young adults. There was a low rate of attrition over the course of the study, and nearly all participants responded favourably to the intervention, reporting that the automated emails were credible, interesting, useful, easy to understand, personally relevant, and comprehensive. Because these factors are thought to be related to intervention efficacy (Weinreich, 1999), these findings provide support for the use of the Fresh Facts program to increase fruit and vegetable consumption in Australian university undergraduates.

**Potential threats to intervention acceptability.** While the majority of participants rated the intervention positively, more than one fifth of participants
indicated that the automated emails were annoying. This is consistent with qualitative responses indicated that a number of participants felt that the intervention materials were “just common sense” or “too repetitive”. Although the vast majority of participants rated the intervention as acceptable, this relatively small number of negative responses is still important to consider, because these factors may cause higher than expected drop-out rates during intervention implementation. Unfortunately, the design of the study did not allow individuals who dropped out of the study to complete the feasibility and acceptability measures, so this hypothesis cannot be directly tested. However, on the basis of this finding, aspects of the Fresh Facts intervention which are likely to be rated as annoying, namely the relatively high level of repetition of intervention messages across the study period, should be reduced in future studies using this intervention. One aspect of the intervention that was partly responsible for the repetition of messages over the study period was the pilot intervention’s design, which targeted just one aspect of the theory of planned behaviour, namely perceived behavioural control. Because increasing the number of intervention targets would increase the variability of intervention messages, it was expected that the full version of the intervention would be rated as less repetitive.

With regard to the acceptability of the intervention across a range of subgroups, only one significant difference was found between acceptability ratings across different subgroups. This provides strong support for the belief that this intervention would be suitable for increasing the fruit and vegetable consumption of young adults across a range of age and gender groups. This is a major goal in intervention development and is widely consistent with reports of intervention feasibility and acceptability for other web-based interventions (Vandelanotte & De Bourdeaudhuij, 2003; Vandelanotte, De Bourdeaudhuij, & Brug, 2004). While the total sample size was relatively low, the
demographic characteristics of this sample are similar to the characteristics of other university-based samples (Kothe, et al., 2011; Wong & Mullan, 2009). Given that the Fresh Facts intervention was designed to be used in a university context, it would appear that this sample is generally appropriate.

One of the key reasons to explore the influence of intervention intensity on intervention ratings was the concern that the high-intensity email intervention may be less acceptable to participants. However, the low rates of attrition across all study groups and the lack of intervention intensity effects would suggest that intervention intensity does not affect the acceptability of the intervention to participants. This is consistent with qualitative findings. However, it is important to note that, although intervention intensity may not influence acceptability of the intervention, there is some evidence to show that intervention intensity may influence efficacy (Kroeze, Werkman, & Brug, 2006). Research on the links between intensity, acceptability, and efficacy is currently very limited. This issue is explored further in Chapter 7.

The present study indicated that intervention message frequency was unlikely to have a large impact on intervention acceptability. However, because this study did not measure fruit and vegetable consumption, it is not possible to determine the extent to which variations in message frequency might impact intervention efficacy. Behavioural measures should be included in future studies of message frequency in order to allow the investigation of this relationship. In the current study, different groups received different quantities of intervention materials and messages over the course of the intervention. This variation would be a significant confound in studies designed to test the relationship between message frequency and intervention efficacy. Different levels of message frequency should be matched for content over the course of the intervention period in order to remove this confounding factor.
Potential threats to feasibility. As in all intervention studies, one potential challenge to intervention feasibility is the issue of intervention fidelity. While fidelity data was not directly collected in this study, there are some indications that such measures should be included in future evaluations of Fresh Facts and similar interventions. Eighteen participants reported receiving but not reading intervention emails. However, the self-reported nature of this item may have lead to underreporting. Twelve participants in the current study reported not receiving automated emails. Where possible, future email-based interventions should include fidelity checks to ensure that participants are truly receiving the interventions as designed. In particular, the use of email-management systems which allow tracking of email delivery status and email open rates may be useful in tracking intervention fidelity in future studies.

Comparison of intervention feasibility and acceptability across studies. Because so few researchers routinely publish feasibility and acceptability information for newly development interventions, it is not possible to compare the feasibility and acceptability results with previous interventions of a similar format. However, given the limited comparisons which are available, this intervention does compare favourably to previous interventions. For example, Vandelanotte and De Bourdeaudhuij (2003) reported that only 53.8% of participants rated computer-tailored physical activity feedback in their study as personally relevant or useful. In contrast, despite the fact that Fresh Facts intervention materials are not individually tailored, 86–88% of participants reported that the intervention components were personally relevant.

Limitations of the present study. In addition to the issues discussed in the above sections, this study has a number of methodological limitations which should be taken into consideration when interpreting these results. The intervention received high ratings of acceptability across all groups. This may have created ceiling effects and
limited variability of acceptability items. As such, it is possible that some analyses may not have reached significance due to low variability in acceptability.

The most obvious limitation of the current design was the fact that this study did not include measures of behaviour or theory-of-planned-behaviour variables; as such, the impact of the Fresh Facts pilot intervention on fruit and vegetable consumption cannot be determined on the basis of this study. The present study was also limited by the fact that the pilot intervention targeted just one aspect of the theory of planned behaviour: perceived behavioural control.

**Implications for intervention design.** Despite limitations in the current body of work in this field, these results broadly support the conclusion that this email-delivered intervention is an acceptable and feasible tool for promoting increased fruit and vegetable consumption. Although further studies are needed to examine the intervention efficacy, this study provides support for the continued development of the Fresh Facts program. On the basis of these findings, further investigations of the intervention should test the full version of the intervention, described in more detail in the next chapter, in order to investigate the efficacy of intervention designed to target attitude, subjective norm, and perceived behavioural control together.
Chapter 7

Evaluation of the Fresh Facts Intervention

The previous chapter describes the design and evaluation of the Fresh Facts pilot intervention study. The results showed that the chosen intervention modality, format, and content were highly feasible and acceptable to participants. However, because that study tested only a short version of the intervention, which only targeted perceived behavioural control, and did not include measures of theory-of-planned-behaviour constructs or behaviour, further testing of the intervention is needed in order to determine the impact of the intervention on important primary and secondary outcomes, namely attitude, subjective norm, perceived behaviour control, intention and fruit and vegetable consumption.

This chapter describes the final version of the Fresh Facts intervention as well as the results of two studies that were designed to evaluate the impact of the intervention on fruit and vegetable consumption and theory-of-planned-behaviour constructs.

The Fresh Facts Intervention

The design of the Fresh Facts intervention followed very closely from the Fresh Facts pilot intervention described in Chapter 6. The key aspects of the final intervention are described below.

Intervention modality. In light of the success of the feasibility testing of the Fresh Facts pilot materials, the modality of intervention delivery remained unchanged. As described in the next section, the final version of the Fresh Facts intervention was expanded to include a greater number of intervention messages. In order to facilitate
this change, the study period was expanded to 30 days. The intervention intensity and dosage are discussed in detail this chapter.

**Intervention content and processes of change.** As with the pilot intervention described in the previous chapter, the design of intervention content for the final Fresh Facts intervention was guided by the taxonomy of behaviour-change techniques and the results of the focus group study discussed in Chapter 5.

Unlike the pilot intervention, which only targeted perceived behavioural control, the final intervention was designed to increase perceived behavioural control, attitude, and subjective norm. As with intervention messages in the pilot intervention, the findings from the focus group study were used to develop intervention messages that addressed each of the behaviour-change techniques identified as relevant using the process described in Chapter 6. The full list of intervention techniques used the final Fresh Facts intervention is shown in Table 22. The full set of intervention messages used in the final intervention is listed in Appendix J.
Table 22

*Summary of Behaviour-Change Techniques Identified as Theory and Modality*

**Appropriate**

<table>
<thead>
<tr>
<th>Attitude</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Provide general information on behaviour–health link</td>
<td>Information about the relationship between the behaviour and health</td>
</tr>
<tr>
<td>Provide general information on the material consequences of behaviour</td>
<td>Information focusing on what will happen if the person performs the behaviour including the benefits and costs (or negative consequences) of action or inaction, including perceived severity of symptoms</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Subjective Norm</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Provide information about others’ behaviour</td>
<td>Information about what other are doing, i.e., indicating that a particular action or sequence of actions is common or uncommon amongst a group</td>
</tr>
<tr>
<td>Provide information about others’ approval</td>
<td>Information about how other people or specific others judge or approve of the individual’s behaviour</td>
</tr>
<tr>
<td>Provide opportunities for social comparison</td>
<td>Provide a setting in which social comparison can occur</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Perceived Behavioural Control</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Argue to bolster self-efficacy</td>
<td>Involves telling the individual that he or she can successfully perform the behaviour, arguing against self-doubts and asserting that he or she can and will succeed</td>
</tr>
<tr>
<td>Provide instruction</td>
<td>Telling participants how to perform a behaviour or preparatory behaviours e.g., instructions providing “tips”</td>
</tr>
</tbody>
</table>

Although a secondary endpoint for this study, the intervention did not directly target intention. Change in perceived behavioural control, subjective norm and attitude was expected to be mediated by change in intention. It is also worth noting that while some participants in the focus groups reported in Chapter 5 reported overt social pressure from friends - the techniques that are likely to be most helpful in training participants to resist social pressure in the form of overt disapproval were excluded on the basis of modality incompatibility. Instead participants were encouraged to seek social support and were provided with information about normative behaviour amongst their peers.

**Message frequency.** One of the aims of the pilot intervention study was to investigate the preferred message frequency for intervention messages. The results of the pilot study indicated the message frequency had no discernible impact on the feasibility and acceptability of the pilot intervention.

However, as discussed in Chapter 6, it is possible that variations in message frequency may impact intervention efficacy even without having an impact on reported acceptability of the intervention. This relationship was investigated in the first study presented in this chapter. In order to facilitate the investigation of the impact of message frequency in that study, two parallel versions of the final intervention were developed. These two versions were matched for overall message content so that the intensity of the intervention was removed as a confounding factor.

The low-frequency version of the intervention included the delivery of nine intervention emails over 30 days. Each of these emails included three intervention messages—each targeting subjective norm, attitude, and perceived behavioural control so that each email addressed all three of the intervention targets. The high-frequency version of the intervention included the delivery of 27 intervention emails over 30 days,
with each email including one intervention message targeting subjective norm, attitude, or perceived behavioural control. The email messages were matched across the two versions so that all participants, regardless of group, would receive identical intervention content over the full course of the intervention (see Appendix J).

Promoting Fruit and Vegetable Consumption Using the Fresh Facts Intervention: Testing Fresh Facts at Two Levels of Message Frequency

Research questions and hypotheses. The present study evaluated the Fresh Facts intervention at two levels of message frequency. The aims of the study were to evaluate the impact of the intervention on theory-of-planned-behaviour variables and behaviour, to investigate the extent to which intervention effects could be explained using pathways implied by the theory of planned behaviour, and to examine the efficacy of the final Fresh Facts program at different levels of email frequency.

It was hypothesised that:

(1) The theory of planned behaviour would provide a good model of intention and behaviour at both baseline and follow-up.

(2) Change in behaviour could be explained by change in intention and perceived behavioural control.

(3) Change in intention could be explained by change in attitude, subjective norm, and perceived behavioural control.

(4) Exposure to the intervention would result in changes in attitude, subjective norm, perceived behavioural control, intention, and behaviour.

The relationship between message frequency and behaviour change was also investigated.
**Method. Participants and procedure.** As with the previous studies reported in this thesis, data were collected from undergraduate students from a wide range of disciplines who were undertaking a first-year psychology course at an Australian university. All aspects of the experiment, including recruitment, occurred online and could be completed from any computer with Internet access. Participants received course credit for their participation.

After completing a consent form online, participants completed a baseline questionnaire at Time 1, which included demographic measures, a self-report measure of behaviour, and a theory-of-planned-behaviour questionnaire. Once they had completed the baseline survey, participants were added to the study mailing list and began receiving Fresh Facts intervention messages via email. Participants were randomised to the two levels of email frequency described in this chapter. All participants received an invitation to complete the follow-up questionnaire on Day 30, upon completion of the intervention. The Time 2 questionnaire included a second administration of the behaviour measure and theory-of-planned-behaviour items.

*Theory-of-planned-behaviour questionnaire.* This study used the theory-of-planned-behaviour questionnaire described in Chapter 4. As already described, the questionnaire was designed using published guidelines for theory-of-planned-behaviour questionnaire construction (Francis, et al., 2004). Intention, attitude, subjective norm, and perceived behavioural control were all assessed using direct measures on a 100-point visual analogue scale at both baseline and post-intervention follow-up.

*Behaviour.* As with previous studies, a short self-report measure of previous-day fruit and vegetable consumption was used to measure behaviour. Scores from the two items were summed to create a composite score of the previous-day fruit and vegetable consumption.
**Ethics.** This study was approved by the Human Research Ethics Committee at the University of Sydney. Ethics approval documents relating to this study are listed in Appendix K.

**Design.** This study used a randomised parallel group trial design to investigate the effects of the Fresh Facts intervention. This design was chosen because it allowed for the comparison of the two parallel versions of the intervention while maximising statistical power (Howell, 2006). Such preliminary research is an important first step in investigating the effects of an intervention before embarking on a larger and more expensive randomised controlled trial.

**Data analysis.** Analysis of intervention effects and all descriptive analyses were conducted in SPSS 17.0. Paired-samples t tests were used to investigate changes in theory-of-planned-behaviour variables and behaviour between the two time points.

Path analysis with Amos 19.0 using the maximum likelihood estimation was used to test the theory-of-planned-behaviour models. All models were specified using covariance matrices. Separate path models were tested in cross-sectional analyses of the theory of planned behaviour at baseline and follow-up, and in analyses of change in theory-of-planned-behaviour variables between Time 1 and Time 2. This method of analysis is consistent with previous intervention studies assessing the TPB using path analysis (Hardeman, et al., 2011). Each model was evaluated by examining the comparative fit index (CFI), the Tucker-Lewis index (TLI), the root-mean-square-error of approximation (RMSEA), and $\chi^2$ divided by degrees of freedom ($\chi^2$/df). A good model fit was indicated by a high CFI or TLI (> 0.90), a low RMSEA (< 0.10), and a $\chi^2$/df between 1 and 3 (Kline, 2005). For the cross-sectional models (Model 1 and Model 2), structural pathways were drawn from attitude, subjective norm, and perceived behavioural control to intention, and from intention and perceived behavioural control
to previous-day fruit and vegetable intake. Covariances were drawn between all independent variables. For the modelling of change between Time 1 and Time 2 (Model 3), pathways were drawn between attitude change, subjective norm change, and perceived behavioural control change to intention change, and from intention change and perceived behavioural control change to behaviour change. As with the cross-sectional models, covariances were drawn between all independent variables.

Results. One hundred ninety-four participants completed baseline data collection and were sent intervention emails. Age in years in the present sample ranged from 18 to 25, with a mean age of 18.94 years ($SD = 1.41$). The majority of participants (74.7%) were female (see Table 23). Given this sample size, the study was sufficiently powered to detect within group changes with an effect size of $d \geq 0.20$. This is typically classified as a small effect (Schneider, Gruman, & Coutts, 2005).
<table>
<thead>
<tr>
<th>Demographic Characteristic</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>145</td>
<td>74.7</td>
</tr>
<tr>
<td>Male</td>
<td>47</td>
<td>24.2</td>
</tr>
<tr>
<td><strong>Living Situation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With parents</td>
<td>147</td>
<td>75.8</td>
</tr>
<tr>
<td>With friends</td>
<td>14</td>
<td>7.2</td>
</tr>
<tr>
<td>Residential college</td>
<td>14</td>
<td>7.2</td>
</tr>
<tr>
<td>Alone</td>
<td>11</td>
<td>5.6</td>
</tr>
<tr>
<td>With partner</td>
<td>5</td>
<td>2.6</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australian</td>
<td>73</td>
<td>37.6</td>
</tr>
<tr>
<td>Northeast Asian</td>
<td>52</td>
<td>26.8</td>
</tr>
<tr>
<td>Southeast Asian</td>
<td>23</td>
<td>11.9</td>
</tr>
<tr>
<td>Southern and Eastern European</td>
<td>15</td>
<td>7.7</td>
</tr>
<tr>
<td>Southern and Central Asian</td>
<td>12</td>
<td>6.2</td>
</tr>
<tr>
<td>Northwest European</td>
<td>6</td>
<td>3.1</td>
</tr>
<tr>
<td>North African and Middle Eastern</td>
<td>6</td>
<td>3.1</td>
</tr>
<tr>
<td>New Zealander or Pacific Islander</td>
<td>3</td>
<td>1.5</td>
</tr>
<tr>
<td>Sub-Saharan African (e.g., South African, Zimbabwean)</td>
<td>1</td>
<td>.5</td>
</tr>
</tbody>
</table>
Tests of representativeness. A series of independent-sample \( t \) tests and chi-squared tests of independence were conducted to ensure that the two groups were equivalent at baseline. The two groups were compared on all demographic variables and on baseline theory-of-planned-behaviour and behaviour measures. The results showed that there were no significant between group differences on any measure (all \( ps > .05 \)). Therefore, it was concluded that randomisation was successful.

Of participants enrolled in the study, 166 completed the postintervention questionnaire on Day 30. This represents a loss to follow-up of 15.3% over the course of the study. A series of independent-sample \( t \) tests were conducted to ensure that the participants who dropped out of the study at follow-up were representative of those responding at two time points. Participants who dropped out of the study were compared to completers on baseline theory-of-planned-behaviour and behaviour measures. The results showed that there were no significant differences between completers and drop-outs on any measure (\( t_{190-191} = 0.41-1.32, \text{ all } ps > .05 \)). Therefore it was concluded that selective attrition was not likely to be a factor in this study.

Descriptive statistics. Across both time points, participants generally intended to consume the recommended quantity of fruit and vegetables each day. This was accompanied by evaluations of the behaviour as positive, within their control, and socially acceptable at both baseline and follow-up.

Fruit and vegetable consumption in this population was generally low. At baseline, 83.3% of participants reported consuming less than the recommended daily intake of fruit and vegetable on the day before data collection; 51.6% ate less than two servings of fruit, and 87.5% ate less than five servings of vegetables.
Cross-sectional prediction of fruit and vegetable consumption using the theory of planned behaviour. The first cross-sectional model (see Figure 7) tested associations between attitude, subjective norm, perceived behavioural control, intention, and fruit and vegetable consumption at baseline. Fit indices indicate that the model provided a good fit to the data (see Table 24).

![Path coefficients diagram](image)

Note. Path coefficients are standardized. ** p<.001, *p<.05

**Figure 7. Model of theory of planned behaviour at baseline (Model 1, N = 194).**

**Table 24**

**Model Fit Indices**

<table>
<thead>
<tr>
<th>Model Description</th>
<th>TLI</th>
<th>CFI</th>
<th>RMSEA</th>
<th>χ²/df</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 1 – Baseline cross-sectional model</td>
<td>.980</td>
<td>.979</td>
<td>.041</td>
<td>1.33</td>
</tr>
<tr>
<td>Model 2 – Follow-up cross-sectional model</td>
<td>.935</td>
<td>.991</td>
<td>.079</td>
<td>2.20</td>
</tr>
<tr>
<td>Model 3 – Change model</td>
<td>1.03</td>
<td>1.00</td>
<td>.000</td>
<td>0.82</td>
</tr>
</tbody>
</table>

TLI = Tucker-Lewis index, CFI = comparative fit index, RMSEA = root-mean-square-error of approximation.
Subjective norm and perceived behavioural control, but not attitude, were significant predictors of intention. Intention, but not perceived behavioural control, was a significant predictor of fruit and vegetable consumption at baseline. The model accounted for 44.5% of the variance in intention, and 16.8% of the variance in behaviour, at baseline.

The second cross-sectional model (Figure 8) tested associations between attitude, subjective norm, perceived behavioural control, intention, and fruit and vegetable consumption immediately postintervention. As with the previous model, fit indices (Table 24) indicate that the model provided a good fit to the data.

Note. Path coefficients are standardized. ** p < .001, *p < .05

Figure 8. Model of theory of planned behaviour at follow-up (Model 2, N = 166).

Subjective norm, attitude, and perceived behavioural control were significant predictors of intention. Intention, but not perceived behavioural control, was a significant predictor of fruit and vegetable consumption at Time 2. The model accounted for 55.1% of the variance in intention, and 24.3% of the variance in behaviour, at follow-up.
Prediction of change in fruit and vegetable consumption using the theory of planned behaviour. The third structural model (Figure 9) investigated associations between change in attitude, subjective norm, and perceived behavioural control as well as change in intention and behaviour.

Note. Path coefficients are standardized. ** p < .001, *p < .05

Figure 9. Model of change in theory of planned behaviour cognitions and behaviour between baseline and follow-up (Model 3, N = 166).

Fit indices indicate adequate model fit (Table 24), but the results represent a significant departure from theory. Attitude change, subjective norm change, and perceived behavioural control change are all predictors of intention change. However, intention change and perceived behavioural control change do not predict change in fruit and vegetable consumption between baseline and follow-up. The model accounted for 24.5% of the variance in change in intention but just .03% of the variance in change in behaviour. It was not possible to formally test for mediation because change in intention and change in behaviour were not significantly correlated (Baron & Kenny, 1986).
**Testing intervention effects.** Differences between the low-frequency and high-frequency intervention were tested using independent sample *t* tests. There were no differences between the two groups on any of the primary and secondary outcomes (*p* > .05). In light of this, the two groups were analysed and reported together for the remaining analyses in this report.

Combined intervention effects were formally tested using a series of paired-sample *t* tests, which examined change in primary and secondary outcome measures between the two time points. The results of these analyses are summarised in Table 25.

**Table 25**

*Means (Standard Deviations) and Tests of Effects on Theory of Planned Behaviour*

<table>
<thead>
<tr>
<th>Variables and Behaviour</th>
<th>Time 1</th>
<th>Time 2</th>
<th>t</th>
<th>df</th>
<th>p</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit and vegetable servings/day</td>
<td>4.40 (2.26)</td>
<td>5.24 (2.28)</td>
<td>-4.806</td>
<td>163</td>
<td>&lt;.001</td>
<td>0.37</td>
</tr>
<tr>
<td>Intention</td>
<td>62.17 (22.54)</td>
<td>74.20 (17.42)</td>
<td>-8.276</td>
<td>163</td>
<td>&lt;.001</td>
<td>0.60</td>
</tr>
<tr>
<td>Perceived behavioural control</td>
<td>77.92 (16.78)</td>
<td>80.09 (15.43)</td>
<td>-2.054</td>
<td>162</td>
<td>.042</td>
<td>0.13</td>
</tr>
<tr>
<td>Attitude</td>
<td>84.01 (11.32)</td>
<td>87.21 (12.54)</td>
<td>-3.795</td>
<td>162</td>
<td>&lt;.001</td>
<td>0.27</td>
</tr>
<tr>
<td>Subjective Norm</td>
<td>65.48 (16.00)</td>
<td>72.19 (14.61)</td>
<td>-6.817</td>
<td>162</td>
<td>&lt;.001</td>
<td>0.44</td>
</tr>
</tbody>
</table>

*Note: scores for intention, perceived behavioural control, attitude and subjective norm range from 1-100.*

Participants consumed an average of 4.4 servings of fruit and vegetables on the day before baseline testing; at follow-up, participants reported consuming an average of
5.2 servings of fruit and vegetables on the day before testing. This represents a significant increase in fruit and vegetable consumption between the two time points.

Intention increased significantly between Time 1 and Time 2, indicating that participants had a greater intention to consume recommended quantities of fruit and vegetables at follow-up than they did preintervention. Perceived behavioural control increased an average of 2.17 points between Time 1 and Time 2; this effect was significant. This indicates an increase in the perception that consumption of fruit and vegetable was achievable, controllable, or both. Subjective norm also increased, by an average of 6.7 points, between Time 1 and Time 2. This effect was significant. This indicates an increase in perceived social pressure to consume fruit and vegetables between baseline and postintervention follow-up. There was a significant difference in reported attitudes between baseline and follow-up, with positive evaluations of fruit and vegetable consumption increasing between Time 1 and Time 2.

Discussion of findings. This study served as an experimental test of the theory of planned behaviour. Consistent with findings from the predictive study reported in Chapter 4, results from this study indicate that the model can be successfully applied to cross-sectional prediction of behaviour. Interestingly, the model was more effective at predicting behaviour at postintervention. This may reflect an increase in temporal stability and a more coherent understanding of fruit and vegetable consumption at postintervention (Hardeman, et al., 2011). These findings replicate the results of the predictive study (Chapter 4) and support the ongoing use of this model to predict fruit and vegetable consumption in young adults.

In addition to testing the predictive utility of the model when used cross-sectionally, this study also sought to investigate the extent to which changes in behaviour could be explained using the behaviour change processes implied by the
theory of planned behaviour. It was predicted that change in intention would predict change in behaviour, and the effect of change in attitude, subjective norm, and perceived behavioural control on behaviour would be mediated by intention change. However, this hypothesis was not supported. While changes in attitude, subjective norm, and perceived behavioural control were found to predict intention change, behaviour change was not predicted by intention change or perceived-behavioural-control change. The lack of significant association between intention and perceived-behavioural-control change and behaviour change means that tests of mediation were not appropriate (Baron & Kenny, 1986) and suggest that changing intention and perceived behavioural control may not be enough to change behaviour. This is consistent with findings from a meta-analytic review of the relationship between change in intention and change in behaviour (Webb & Sheeran, 2006). Further, the behaviour change exhibited in this study may be due to changes in determinants of behaviour other than those specified by the theory of planned behaviour. This finding may challenge theoretical assumptions that form the justification for the use of the theory of planned behaviour in intervention design. This possibility is discussed in more detail in Chapter 8.

However, despite these conceptual issues, the intervention led to increased consumption of fruit and vegetables amongst this sample of Australian young adults. Average self-reported fruit and vegetable intake rose by 0.83 servings between baseline and immediate postintervention follow-up. It has been argued that a change in fruit and vegetable intake of this size is likely to be clinically significant (for a review of clinical significance in fruit and vegetable consumption see Ciliska et al., 2000). The results also indicate that the Fresh Facts intervention successfully increased perceived behavioural control, subjective norm, and attitudes towards fruit and vegetable intake.
The intervention also increased reported intention to consume fruit and vegetables at recommended levels. These results broadly support the second set of hypotheses: that the intervention would result in changes in attitude, subjective norm, perceived behavioural control, intention, and self-reported behaviour. These are promising findings, suggesting that an intervention based on automated emails could promote fruit and vegetable consumption in Australian young adults.

This study also investigated the relationship between message frequency and change in fruit and vegetable related cognitions. There were no between-group differences observed for any of the primary or secondary outcome measures. However, it is important to note that, because the two groups were matched for overall intervention content, this does not reflect a failure to detect a dose–response relationship. Rather, on the basis of these findings it would appear that practitioners should feel free to select message frequency on the basis of feasibility and acceptability in a given context rather than based on the concern that it may impact intervention efficacy. In the context of this thesis, the major implication of this finding is that the evaluation of the intervention reported in the next study made use of the lower-frequency intervention, because this version of the intervention was less resource intensive than the higher-frequency intervention.

However, it is also possible that this pattern of results reflects limitations in the study methodology. While participants in the study reported increases in both theory-relevant constructs and fruit and vegetable intake, it is difficult to determine whether these reported changes reflect actual changes in intake as a result of the intervention or an artefact of the experimental design. This issue could be resolved by replication of these findings using a randomised-controlled-trial design where participants are randomised into a no-intervention control group and an active-intervention group rather
than the two levels of message frequency used as the basis of randomisation in the present study. The pre- and postanalyses used in the present study also limit interpretations of intervention effects. While this study provides preliminary evidence that the Fresh Facts intervention increases fruit and vegetable consumption, replication of this finding using a no-intervention comparison group would provide clearer evidence of intervention effects.

Evaluating the Fresh Facts Intervention Using a Randomised-Controlled-Trial Design

The research presented in the first half of this chapter provides preliminary support for the Fresh Facts intervention. The results indicate that the intervention may lead to increases in fruit and vegetable consumption relative to baseline. However, the interpretation of intervention effects and mediation analyses is limited by the lack of a no-intervention control group. These methodological limitations clearly demonstrate the need for a randomised controlled trial of the Fresh Facts intervention in order to properly test and evaluate the effect of the intervention on behaviour and theory-of-planned-behaviour variables. This section reports the results of a study designed to address that need.

Research questions and hypotheses. The present study used a randomised-controlled-trial design to test an intervention to promote fruit and vegetable consumption amongst young adults. This study was intended to replicate and extend findings from previous evaluations of the intervention through the addition of a control group. The aims of the study were to evaluate the impact of the intervention on theory-of-planned-behaviour variables and behaviour and to investigate the extent to which
intervention effects could be explained using the processes of change implied by the theory of planned behaviour.

It was hypothesised that:

(1) Change in behaviour could be explained by change in intention, attitude, subjective norm, and perceived behavioural control.

(2) Exposure to the intervention would result in greater changes in attitude, subjective norm, perceived behavioural control, intention, and behaviour relative to controls.

**Method.** The method of recruitment for this study was identical to that used in the previous study reported in this chapter.

**Fresh Facts intervention.** This study investigated the full Fresh Facts intervention tested in the previous study. This study evaluated the low-intensity version of the intervention; participants in the intervention condition received automated intervention messages every 3 days over the course of the 30-day intervention period. As reported above, the intervention consisted of a 30-day program designed to target attitude, subjective norm, and perceived behavioural control.

**Participants and procedure.** The recruitment of participants and procedure for this study was identical to that reported above in this chapter. The only variation in procedure was the inclusion of a control group and the elimination of the high-frequency comparison group. Participants in this study were randomised to either the low-frequency intervention group or the no-intervention control group. All other procedures were identical. Participants who participated in the previous study were not eligible to participate in the present study.

**Measures**

The measures used in this study were identical to those described above in this
chapter.

**Ethics.** This study was approved by the Human Research Ethics Committee at the University of Sydney. Ethics approval documents relating to this study are listed in Appendix L.

**Design.** This study investigated the effects of the Fresh Facts intervention using a randomised-controlled-trial design.

**Results.** Two hundred six participants completed baseline data collection. Of these, 180 confirmed their email addresses and were randomised. These 180 participants make up the baseline sample. Age in years of the present sample ranged from 18 to 25, with a mean age of 18.84 years (SD = 1.30). The majority of participants (83.3%) were female. Detailed demographic characteristics of the sample are presented in Table 26.
### Table 26

**Demographic Characteristics of the Baseline Sample**

<table>
<thead>
<tr>
<th>Demographic Characteristic</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>135</td>
<td>83.3</td>
</tr>
<tr>
<td>Male</td>
<td>27</td>
<td>16.7</td>
</tr>
<tr>
<td>Living Situation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>With parents</td>
<td>127</td>
<td>78.4</td>
</tr>
<tr>
<td>With friends</td>
<td>14</td>
<td>8.6</td>
</tr>
<tr>
<td>Residential college</td>
<td>6</td>
<td>3.7</td>
</tr>
<tr>
<td>Alone</td>
<td>7</td>
<td>4.3</td>
</tr>
<tr>
<td>With partner</td>
<td>1</td>
<td>0.6</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australian</td>
<td>76</td>
<td>46.9</td>
</tr>
<tr>
<td>Northeast Asian</td>
<td>41</td>
<td>25.3</td>
</tr>
<tr>
<td>Southeast Asian</td>
<td>12</td>
<td>7.4</td>
</tr>
<tr>
<td>Southern and Eastern European</td>
<td>5</td>
<td>3.1</td>
</tr>
<tr>
<td>Southern and Central Asian</td>
<td>7</td>
<td>4.3</td>
</tr>
<tr>
<td>Northwest European</td>
<td>7</td>
<td>4.3</td>
</tr>
<tr>
<td>North African and Middle Eastern</td>
<td>7</td>
<td>4.3</td>
</tr>
<tr>
<td>New Zealander or Pacific Islander</td>
<td>2</td>
<td>1.2</td>
</tr>
</tbody>
</table>

**Tests of representativeness.** A series of two-way analyses of variance (ANOVAs) were conducted to ensure that randomisation of participants to conditions was successful and that participants who dropped out of the study between baseline and follow-up (n=30) did not systematically differ from those who completed both time points (n=132) on any of the primary or secondary endpoints. The independent variables in each analysis were condition (0 = control, 1 = intervention) and drop-out (0 = dropped out of the study between baseline and follow-up, and 1 = took part at both
time points). The dependent variables were the baseline theory of planned behaviour and behaviour measure.

The results showed that there were no significant differences between the control and intervention group, or between completers and drop-outs, on any primary or secondary endpoints. The ANOVAs revealed no significant condition x attrition interactions, indicating an equivalent effect of attrition between the two conditions.

On the basis of lack of differences in both demographic variables and primary and secondary endpoints, it was concluded that that randomisation of participants to conditions was successful and that selective attrition was not likely to be a factor in this study.

Descriptive statistics. Means and standard deviations for each variable at each time point are shown in Table 27. Inspection of the means shows that, across both time points, participants generally intended to consume the recommended quantity of fruit and vegetables each day. This was accompanied by evaluations of the behaviour as positive, within their control, and socially acceptable at both baseline and follow-up.
Table 27

Means (Standard Deviations) for Theory of Planned Behaviour Variables and Behaviour at Time 1 and Time 2 by Condition

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th></th>
<th>Follow-up</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control</td>
<td>Intervention</td>
<td>Control</td>
<td>Intervention</td>
</tr>
<tr>
<td>Fruit and vegetable servings/day</td>
<td>4.59</td>
<td>4.69</td>
<td>5.02</td>
<td>5.31</td>
</tr>
<tr>
<td></td>
<td>(2.22)</td>
<td>(1.92)</td>
<td>(2.10)</td>
<td>(2.08)</td>
</tr>
<tr>
<td>Intention</td>
<td>67.36</td>
<td>70.29</td>
<td>74.43</td>
<td>77.91</td>
</tr>
<tr>
<td></td>
<td>(22.89)</td>
<td>(17.25)</td>
<td>(20.48)</td>
<td>(13.96)</td>
</tr>
<tr>
<td>Perceived behavioural control</td>
<td>81.43</td>
<td>81.98</td>
<td>84.51</td>
<td>84.67</td>
</tr>
<tr>
<td></td>
<td>(15.7)</td>
<td>(14.8)</td>
<td>(12.74)</td>
<td>(12.08)</td>
</tr>
<tr>
<td>Attitude</td>
<td>91.38</td>
<td>89.66</td>
<td>90.72</td>
<td>91.17</td>
</tr>
<tr>
<td></td>
<td>(10.48)</td>
<td>(10.39)</td>
<td>(10.32)</td>
<td>(9.72)</td>
</tr>
<tr>
<td>Subjective norm</td>
<td>68.18</td>
<td>66.63</td>
<td>73.77</td>
<td>76.23</td>
</tr>
<tr>
<td></td>
<td>(14.77)</td>
<td>(15.85)</td>
<td>(15.37)</td>
<td>(12.26)</td>
</tr>
</tbody>
</table>

Note: scores on intention, perceived behavioural control, attitude and subjective norm scales range from 1-100.

Fruit and vegetable consumption in this population was generally low. At baseline, 82.1% of participants reported consuming less than the recommended daily intake of fruit and vegetable on the day before data collection; 44.4% ate less than two servings of fruit, and 86.4% ate less than five servings of vegetables.

Prediction of change in fruit and vegetable consumption using the theory of planned behaviour. Path analysis with Amos 19.0 using the maximum-likelihood estimation was used to test whether the theory of planned behaviour could be used to model behaviour change in the context of this intervention. The method of analysis used in the current study is consistent with previous studies which have used path analysis to
investigate the theory of planned behaviour (Hardeman, et al., 2011). Consistent with
the theory-of-planned-behaviour model, pathways were drawn between attitude change,
subjective norm change, and perceived behavioural control change to intention change,
and from intention change and perceived behavioural control change to behaviour
change. Pathways were also drawn between condition and change in behaviour,
intention, perceived behavioural control, subjective norm, and attitude (see Figure 10).
The model was evaluated by examining the comparative fit index (CFI), the Tucker-
Lewis index (TLI), the root-mean-square-error of approximation (RMSEA), and \( \chi^2 \)
divided by degrees of freedom (\( \chi^2/\text{df} \)). A good model fit was indicated by a high CFI or
TLI (> 0.90), a low RMSEA (< 0.10) and a \( \chi^2/\text{df} \) between 1 and 3 (Kline, 2005).

\[ \text{Note. Path coefficients are standardized.} \]

**Figure 10. Model of change in theory-of-planned-behaviour cognitions and
behaviour between baseline and follow-up (N = 162).**

The observed fit statistics indicate very poor model fit according to all cutpoints
(Table 28).
Table 28

Model Fit Indices

<table>
<thead>
<tr>
<th></th>
<th>TLI</th>
<th>CFI</th>
<th>RMSEA</th>
<th>$\chi^2$/df</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 1. Change model</td>
<td>-59.029</td>
<td>.000</td>
<td>.472</td>
<td>36.85</td>
</tr>
</tbody>
</table>

TLI = Tucker-Lewis index, CFI = comparative fit index, RMSEA = root-mean-square-error of approximation.

The model also represents a significant departure from theory. The model accounts for 4.9% of the variance in intention change and only 2.3% of the change in behaviour. Consistent with the previous study, change in perceived behavioural control and intention did not predict change in behaviour.

**Testing intervention effects.** Intervention effects were formally tested using a series of repeated measures ANOVAs. The dependent variables were the behaviour and theory-of-planned-behaviour measures. Time of assessment was entered as a within-subjects factor and condition was entered as a between-subjects factor. A time-by-group interaction term was calculated to investigate differences in the rate of change between each group for all of the primary and secondary endpoints.

Consistent with the lack of between-group differences reported above, there was no main effect of condition for any of the primary or secondary endpoints. However, there was a main effect for time on several variables of interest. There was a significant main effect for time on subjective norm, $F(1,130) = 42.25 \ p < .001$; perceived behavioural control, $F(1,130) = 13.059 \ p < .001$; intention $F(1,130) = 23.345 \ p < .001$; and behaviour, $F(1,130) = 8.45 \ p = .004$. This indicates that, for both groups, subjective norm, perceived behavioural control, intention, and behaviour changed significantly between baseline and follow-up. There was no time effect for attitude.

Interaction terms revealed intervention effects across a range of endpoints. There was a significant time x condition interaction for attitude, indicating that change
in attitude between baseline and follow-up varied as a function of condition, $F(1,130) = 6.137 \ p = .015 \ d = 0.345$. The increase in attitude between baseline and follow-up was significantly greater in the intervention group than in the control group. There was also a significant time x condition interaction for subjective norm, $F(1,130) = 4.919 \ p = .028 \ d = 0.345$, indicating that change in subjective norm between baseline and follow-up was significantly greater in the intervention group than in the control group. The time x condition interaction was not significant for perceived behavioural control, $F(1,130) = 0.001 \ p = .977$; intention, $F(1,130) = 0.046 \ p = .830$; or behaviour, $F(1,130) = 0.459 \ p = .499$.

Consistent with the theoretical framework of the theory of planned behaviour, the data-analytic plan for the study included tests of mediation effects to determine whether intervention effects on intention and behaviour were mediated through expected pathways. However, due to a lack of correlations between intention change and behaviour change, and between condition and both intention and behaviour change, mediation analyses were not appropriate (Baron & Kenny, 1986).

**Discussion of findings.** The aims of the present study were to examine the extent to which change in fruit and vegetable consumption could be explained using the causal pathways implied by the theory of planned behaviour and to evaluate the impact of the Fresh Facts intervention on theory-of-planned-behaviour variables (intention, subjective norm, attitude, perceived behavioural control) and fruit and vegetable intake using a randomised control design. These two aims are discussed separately in the following sections.

*Explanation of change in fruit and vegetable intake using change in intention, subjective norm, attitude, and perceived behavioural control.* The current study sought to investigate the extent to which changes in behaviour could be explained
using behaviour change processes implied by the theory of planned behaviour. As with the first study reported in this chapter, it was predicted that change in intention would predict change in behaviour, and that change in intention would be predicted by change in attitude, subjective norm, and perceived behavioural control. However, as was the case in the previous study, this hypothesis was not supported. Change in intention did not predict change in behaviour. This pattern of results was highly consistent between the two studies—in both cases, the model accounted for less than 3% of change in fruit and vegetable consumption.

Once again, the lack of significant associations between behaviour change and change in intention, in perceived behavioural control, or in both meant that formal tests of mediation were not performed (Baron & Kenny, 1986). These data suggest that change in intention or perceived behavioural control does not lead to change in behaviour. This pattern of results implies that, even if the Fresh Facts intervention had lead to change in intention or perceived behavioural control, this change is unlikely to have led to increased fruit and vegetable consumption.

This has serious implications for the use of the theory of planned behaviour to design interventions to promote fruit and vegetable consumption because it suggests that changes in behaviour are likely to occur independently of changes in intention. This finding, although inconsistent with theoretical assumptions of the theory of planned behaviour, is consistent with a recent study that found that the theory of planned behaviour did not successfully model change in exercise behaviour between Time 1 and Time 2 (Hardeman, et al., 2011). The findings are also consistent with a study of walking behaviour conducted by Darker and colleagues that found that intervention effects were not mediated by theory-relevant constructs (Darker, French, Eves, & Sniehotta, 2010). The authors of both studies concluded that their findings did
not support the proposed causal pathway of the theory of planned behaviour (Darker, et al., 2010; Hardeman, et al., 2011). The findings in this study are also consistent with the only previous study to apply the theory of planned behaviour to interventions to increase fruit and vegetable consumption in healthy young adults (Kellar & Abraham, 2005). As reported in Chapter 3, that study also found that change in fruit and vegetable consumption was not mediated by change in theory-of-planned-behaviour constructs.

At first glance, studies that have found that behaviour is not explained by change in theory-of-planned-behaviour variables appear inconsistent with the results of a meta-analysis of the relationship between change in intention and change in behaviour which indicated that a medium to large change in intention would lead to a small to medium change in behaviour (Webb & Sheeran, 2006). Crucially, however, that study concluded that, although intention change did engender behaviour change, behaviour change was also seen to occur over and above the change accounted for by intention change. In that meta-analysis, this effect was demonstrated through analyses that indicated that some interventions had a significant association with behaviour change even after controlling for the effect of the intervention on intention. Webb and Sheeran offered two possible explanations for behaviour change that occurred independent of intention change: (1) behaviour change occurred as a result of change in perceived behavioural control, and (2) behaviour change occurred through a route not modelled by the theory of planned behaviour (such as activation of automatic goals; Webb & Sheeran, 2006). The first interpretation is not supported by data in the present study because perceived behavioural control change had no relationship with change in behaviour. The second interpretation, however, is more plausible, in that the behaviour change exhibited in this study may be due to changes in determinants of behaviour other than those specified by the theory of planned behaviour.
It is possible that the lack of relationships between changes in theory-relevant cognitions and targeted behaviour may be specific to the processes underlying behaviour change in the Fresh Facts intervention. For example, Kelley & Abraham (2004) argued that goal setting, an important component of their intervention, may explain behaviour change in their intervention targeting physical activity in older adults and would not be detected by measurement of theory of planned behaviour–relevant cognitions (Kelley & Abraham, 2004). It may be that a similar process underlies the behaviour change observed in the current study. The inclusion of behaviour-change techniques in this study was guided by the taxonomy of behaviour-change techniques and work linking specific techniques to theoretical models (Abraham, et al., 2010). However, many of the techniques used in this intervention may have had multiple pathways through which to affect behaviour. For example, one of the techniques used to increase perceived behavioural control was “providing instruction”; this technique includes telling participants how to perform preparatory behaviours (Abraham, et al., 2010). Fresh Facts intervention materials designed to use this technique provided a number of suggestions for preparatory behaviour, such as having fruit and vegetables on hand. These techniques may have led to increases in habitual performance of behaviour, a factor which would not be captured by measures designed to assess change in theory-of-planned-behaviour variables but which would be expected to lead to increased fruit and vegetable consumption (Guillaumie, et al., 2010; Shaikh, et al., 2008).

A second interpretation of the current findings would be that the theory of planned behaviour may not, in fact, adequately model changes in behaviour, regardless of the intervention used. The lack of support for casual pathways from the theory of planned behaviour found in this thesis is consistent with findings from a number of
previous studies which have investigated the processes by which theory of planned
behaviour–based interventions lead to increases in desired behaviours (Hardeman, et
al., 2011; Kelley & Abraham, 2004). However, it is important to note that other studies
which have found limited associations between theory-of-planned-behaviour change
and behaviour change have also found that the theory of planned behaviour did not
model behaviour cross-sectionally (Hardeman, et al., 2011). Therefore, the lack of
support for the behaviour change processes implied by the theory of planned behaviour
found in those studies may indicate problems with the application of the model in a
given context rather than lack of support for behaviour change processes of the model
more specifically. This study is one of the first to suggest that the theory of planned
behaviour may not adequately model behaviour change even if it does model
behaviour. This would be consistent with arguments that the intention–behaviour gap in
the model when used cross-sectionally or prospectively reflects missing variables
within the model (Armitage & Conner, 2001). Researchers investigating behaviour-
change processes underlying interventions such as Fresh Facts may wish to consider
whether behaviour change could be more effectively modelled using theories which
have been developed to extend the theory of planned behaviour, such as the health
action process approach (Schwarzer, 1992) and temporal self-regulation theory (Hall &
Fong, 2007) or through the addition of variables such as goal setting or implementation
intentions to explanatory models.

*The impact of the Fresh Fact intervention on intention, subjective norm,
attitude, perceived behavioural control, and fruit and vegetable intake.* In addition to
exploring the processes underlying behaviour change, this study was designed to
evaluate the impact of the Fresh Facts intervention on fruit and vegetable consumption
and related constructs. It was hypothesised that exposure to the intervention would
result in changes in attitude, subjective norm, perceived behavioural control, intention, and fruit and vegetable intake relative to control. The results of the present study partially support this hypothesis. The results show that the theoretically derived intervention produced significant changes in some, but not all, of the intervention targets. Specifically, participants in the Fresh Facts intervention group demonstrated larger changes in attitude and subjective norm than those in the control group. However, contrary to expectations, the intervention had no effect on intention, perceived behavioural control, or fruit and vegetable intake.

There are two major interpretations for the lack of intervention effects shown in this study. The first is that the intervention was ineffective at changing key constructs and as such could not lead to change in behaviour; the second is that changes in theory-of-planned-behaviour constructs do not lead lead to behaviour change because of a departure from the pathways specified by the model.

The first interpretation is not consistent with the observed pattern of results. The hypothesised mechanisms of action for the Fresh Facts intervention was that change in attitude, perceived behavioural control, subjective norm, or any combination thereof would lead to change in intention, which in turn would lead to an increase in fruit and vegetable consumption in the intervention group. Consistent with this hypothesised pathway for behaviour change, the intervention was designed to target attitude, subjective norm, and perceived behaviour control. As the time x condition interactions show, the intervention was successful in achieving change in two of the three intervention targets: attitude and subjective norm. According to the theoretical framework utilised in this thesis, these changes were expected to have flow-on effects through change in intention and ultimately change in behaviour.
The second interpretation, is partially supported by the observed data. Change in attitude, subjective norm, and perceived behavioural control were not related to change in intention in this study. This suggests that significant changes in attitude and subjective norm did not have flow-on effects to change in intention. Indeed, even if a significant increase in intention were to occur, the assumption that this change would be translated to change in behaviour is not supported by the data presented in the previous section. As already discussed in this chapter, there was no significant association between change in intention and change in behaviour in either study presented in this chapter. Indeed, together change in intention and change in perceived behavioural control accounted for just 2.3% of variance in behaviour change across Time 1 and Time 2 in the randomised controlled trial. Taken together, the magnitude of change in attitude, subjective norm, perceived behaviour control, or all of these together needed to achieve change in intention, and the lack of relationship between change in intention and change in fruit and vegetable consumption constitutes a serious challenge to the rationale for use of the theory of planned behaviour in interventions to achieve increased fruit and vegetable consumption in young adults. Given the similarity between the pattern of results observed in this chapter and some recent studies that have also failed to demonstrate mediation of behaviour change through theory of planned behaviour (Hardeman, et al., 2011; Kellar & Abraham, 2005), researchers should be cautious in assuming that the theory of planned behaviour will provide an adequate model of behaviour change.

It is important to acknowledge that the lack of a relationship between change in fruit and vegetable intake and intention may reflect an artefact or limitation of the present study rather than a wider failing of the theory of planned behaviour. For example, the failure of the theory-based intervention to achieve intervention related
behaviour change may arguably limit the extent to which the theory of planned behaviour can be used to model the behaviour change that occurred in the present sample. However, the applicability of this interpretation is limited by the fact that change in fruit and vegetable consumption was shown to occur across the entire cohort in both studies reported in this chapter. The major interpretations for these cohort effects: the mere measurement effect (Chapman, 2001) and selection bias whereby the whole trial cohort is likely to have stronger motivation to change their behaviour than the population from which they were recruited (discussed in detail in Chapter 8), should have been detected by the path analysis used in both studies in this chapter. For example, the mere measurement effect is thought to occur because the questionnaire administered at pretest reinforces positive beliefs about the behaviour (Falk, 2010; Morwitz & Fitzsimons, 2004). This explanation for the effect would imply that it leads to behaviour change by increasing the strength and valance of intentions. This relationship would be expected to be reflected in a positive association between change in intention and change in behaviour. Given that the theory of planned behaviour must reasonably be expected to model both naturalistic behaviour change and intervention-related change, the failure of the model to account for behaviour change in the present study could be argued to reflect more than just a limitation of the Fresh Facts intervention. The wider implications for the results from the studies presented in this chapter are discussed in Chapter 8.
Chapter 8

General Discussion

The overall aim of the work presented in this thesis was to investigate the application of a social-cognition model of behaviour to the design and evaluation of an intervention to increase fruit and vegetable consumption in the Australian context. The aim was achieved through the implementation and evaluation of a theory of planned behaviour–based intervention to increase fruit and vegetable consumption in young adults. Intervention design, including selection of the target group and theoretical basis of the intervention, was based on reviews of the literature present in the early chapters of this thesis. The middle chapters of this thesis describe the development and piloting of the Fresh Facts intervention. The implementation and evaluation of the Fresh Facts intervention is described in the two studies reported in Chapter 7.

This chapter presents an overview of the major research findings from the present work. It begins with a discussion of results from each of the stages of intervention design and evaluation and concludes with a discussion of the strengths and limitations of the research, and the implications for future work.

Summary of Research Findings

As described in Chapter 1, the research presented in this thesis was conducted in four stages (see Figure 11).
<table>
<thead>
<tr>
<th>Stage 1. Establishing the need for the intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identifying the problem and target population</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stage 2. Selection of a theoretical framework</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical review of theories of health behaviour as they have been applied to prediction and modification of fruit and vegetable consumption</td>
</tr>
<tr>
<td>Assessing and operationalizing the selected theory in the target population</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stage 3. Intervention design and piloting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identification of salient beliefs about fruit and vegetables in the target population</td>
</tr>
<tr>
<td>Design and testing of the proposed intervention in a pilot sample</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stage 4. Intervention implementation and evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluation of the intervention in a randomised parallel group trial design</td>
</tr>
<tr>
<td>Evaluation of the intervention in a randomised control trial design</td>
</tr>
</tbody>
</table>

**Figure 11. Outline of the research conducted in this thesis.**

**Establishing the need for an intervention.** The rationale for this work is outlined in detail in Chapter 2. As discussed in that chapter, patterns of disease have changed dramatically over the past century, with noncommunicable disease now accounting for the majority of morbidity and mortality around the globe. Lifestyle
factors such as diet now account for a substantial proportion of the disease risk in high-income countries such as Australia. This thesis focused on the modification of one aspect of poor diet: inadequate fruit and vegetable consumption. Low fruit and vegetable consumption is responsible for a significant proportion of the Australian burden of disease; this is in large part because of the relationship between fruit and vegetable consumption and cardiovascular diseases, some cancers, and obesity. Despite widely endorsed recommendations to consume at least five servings of vegetables and two servings of fruit each day, many Australians consume very low quantities of fruit and vegetables. As discussed in Chapter 2, fruit and vegetable consumption is particularly low among Australian young adults. This age group consistently fails to consume fruit and vegetables at recommended levels. The low rates of fruit and vegetable consumption observed in Australian young adults provided a clear rationale for the selection of this demographic subgroup as the target population for the work presented in this thesis.

The studies reported in this thesis were all conducted amongst university undergraduates at a large Australian university. The use of a student sample in the present study should be taken into account while interpreting results, as the use of university undergraduates may limit the generalisability of intervention effects. However, given that fruit and vegetable intake is particularly low in young adults, this population represents an important subgroup. Consistent with national surveys, the studies reported in this thesis all found low rates of fruit and vegetable consumption in this population. As discussed in Chapter 2, over 40% of Australian young adults are currently enrolled in tertiary education (Australian Bureau of Statistics, 2009b). As such, the university context provides a valuable opportunity for reaching Australian young adults with health promotion interventions. That said, the use of a university
sample of young adults does result in higher levels of educational achievement, literary, and socio-economic status among participants than would have been expected if young adults had been recruited across other higher educational settings (e.g. vocational training) or through the general community. The lack of sociodemographic variability should be taken into account when interpreting these findings.

It should also be noted that, while researchers have criticised the use of student samples in theory-of-planned-behaviour studies (Elliott & Armitage, 2009; Michie & Abraham, 2004), they have typically done so on the basis that student samples are likely to overestimate the utility of the theory of planned behaviour. As such, the use of a student-based sample may represent a best-case application of the model. As already reported, the studies presented in thesis failed to find support for the use of the model in the explanation of behaviour change. If the theory cannot be applied to behaviour change under ideal circumstances, this may raise even larger doubts for the application of the model to behaviour change in the wider population.

Selection of a theoretical framework. Understanding the factors underlying fruit and vegetable consumption is a key step in the design of an intervention designed to increase intake in any population. The research presented in Chapter 3 formed the basis of a critical overview of work that has sought to provide a framework for predicting and modifying fruit and vegetable intake among healthy individuals. The use of a single theoretical framework in intervention design and evaluation was a major strength of this thesis. Previous research has found that intervention efficacy is related to the use of theory (Webb, et al., 2010). The critical reviews of major theories of behaviour presented in that chapter lead to the selection of the theory of planned behaviour for use in intervention design and evaluation. This theory was chosen on the
basis of substantial evidence indicating that it was the most effective of the reviewed theories at predicting fruit and vegetable consumption in healthy populations and on the basis of evidence indicating that intervention effects in some interventions were mediated by constructs closely related to those included in the theory of planned behaviour, specifically self-efficacy and social norms.

When considering the selection of the theoretical framework for the current intervention it is important to recognise that, on the basis of the systematic review presented in Chapter 3, use of social cognitive theory was also supported for use in intervention design. It is possible that an intervention based on that theoretical approach would have been successful in achieving change in fruit and vegetable consumption. However, few studies have attempted to model behaviour change using social cognitive theory, meaning that it is not possible to determine whether use of that model would have adequately explained behaviour change. Future researchers may wish to consider the use of social cognitive theory when designing interventions to increase fruit and vegetable consumption, especially in light of the research presented in the current thesis.

The research presented in Chapter 4 evaluated the predictive utility of the theory of planned behaviour in the target group, Australian young adults. In general, the research presented in this thesis was consistent with previous work that showed that the theory of planned behaviour can successfully predict or explain fruit and vegetable consumption (Guillaumie, et al., 2010). The prospective study presented in Chapter 4 and the parallel group trial presented in the first section of Chapter 7 both showed that the theory of planned behaviour predicts a substantial proportion of the variance in fruit and vegetable consumption when studied cross-sectionally or prospectively. In the first evaluation of the applicability of the model, reported in Chapter 4, the model accounted
for 54% of the variance in intention to consume fruit and vegetables and 25% of the variance in fruit and vegetable consumption at 1-week follow-up. Attitude, subjective norm, and perceived behavioural control were all significant predictors of intention to consume fruit and vegetables. Intention, but not perceived behavioural control, was a significant predictor of self-reported fruit and vegetable intake at 1 week. This pattern of results was consistent with the results of the parallel group trial. These results compare favourably with previous meta-analyses of the theory of planned behaviour and the prediction of fruit and vegetable intake intention, and with studies which have examined other food choice behaviours in the Australian context such as snacking and breakfast consumption (Green & Kreuter, 2005; Kothe, et al., 2011; Wong & Mullan, 2009).

The completion of this formative research is one of the strengths of the program of research in the current thesis, because it makes clear that the failure of the theory of planned behaviour to predict change in behaviour is not due to the failure of the theory to predict behaviour prospectively. This is in contrast with at least one previous study that suggested that the theory does not model behaviour change, which also found that the model could not be successfully applied to prediction of behaviour in the target population (Hardeman, et al., 2011).

**Intervention design and piloting** Chapter 5 reported the application of the theory of planned behaviour to qualitative reports of the factors underlying fruit and vegetable consumption in a population of Australian young adults. The primary aim for this stage of research was to confirm the applicability of the theory of planned behaviour to the perceptions of their own fruit and vegetable consumption held by Australian young adults in order to identify salient beliefs that should be targeted in a theory of planned-behaviour intervention designed for this population. This study
showed that in addition to providing a good framework for predicting fruit and vegetable consumption of young adults in quantitative studies, the theory of planned behaviour also provides a useful framework for interpreting young adults’ perceptions of their own fruit and vegetable consumption behaviour. The value of the intervention-design and piloting stage of the research project was also reflected in the novel findings generated from the focus-group research. While these findings have importance within the framework of the intervention designed in the present thesis and speak to the applicability of the model to the explanation of fruit and vegetable consumption of young adults, the results also have important independent value. The focus-group study unearthed a number of important barriers to fruit and vegetable consumption—such as perceived peer disapproval and beliefs about the negative health effects of fruit and vegetable consumption that future researchers should consider when working in this, or similar, populations—regardless of whether they choose to work within the framework of the theory of planned behaviour.

The findings from the focus-group study formed the basis for the design of intervention as the beliefs mentioned in the section were all specifically challenged by intervention materials developed in this thesis. The success of this stage of the research is reflected in the very high acceptability ratings given to Fresh Facts intervention materials in the feasibility and acceptability study reported in Chapter 6. As reported there, participants rated the materials designed on the basis of focus-group results as highly relevant, interesting, credible, useful, and logical. While this study did find that most participants reported that they did read intervention emails – it is important to recognise that intervention fidelity may partially explain intervention results in this thesis. Future research should seek to simultaneously evaluate intervention fidelity and efficacy in order to more fully consider this factor.
Implementation and evaluation. Initial evaluation of the impact of the theory of planned behaviour–based intervention on fruit and vegetable consumption were promising, with results showing that participants who were exposed to the Fresh Facts intervention reported an increase in fruit and vegetable consumption between baseline and follow-up. However, as the second study, reported in Chapter 7, showed, these results do not appear to accurately reflect the impact of the intervention on fruit and vegetable consumption or on theory-of-planned-behaviour constructs. The inclusion of a control group in the randomised controlled trial reported in the latter part of Chapter 7 made it apparent that, although fruit and vegetable consumption, subjective norm, and intention all changed between baseline and follow-up, condition was not the cause. Instead, the only significant intervention effects were increases in attitude and subjective norm in the intervention group relative to control.

As discussed in detail in Chapter 7, the theory of planned behaviour failed to generate changes in fruit and vegetable consumption when used in intervention design and failed to account for changes in behaviour across the study cohort. Taken together, this pattern of results suggest that researchers should be cautious when interpreting results of prospective studies as evidence that a particular model is likely to explain behaviour change. The research presented in Chapter 7 would appear to indicate that the use of the theory of planned behaviour in interventions to increase fruit and vegetable consumption in young adults is unlikely to generate designed increases in intake and does not adequately model change in consumption. It would appear that the intervention was successful to the extent that it was highly acceptable to participants and feasible, and that achieved change in the specific targets of the intervention. But it was unsuccessful to the extent that it was assumed, on the basis of theoretical assumptions about the nature of behaviour change as modelled through the theory of
planned behaviour, that change in intervention targets would ultimately impact fruit and vegetable consumption.

**Strengths and Limitations of the Research**

The present study has several methodological strengths and that must be considered in the interpretation of findings.

First, it is important to acknowledge the detection of intervention effects in the present study may have been influenced by the way in which fruit and vegetable consumption was measured. Like most of the intervention studies reported in Chapter 3, the work presented in this thesis relied on self-reported measures of fruit and vegetable intake when assessing change in fruit and vegetable consumption. This limitation, common to most studies of eating behaviour, may have led to bias, such as the over- or underestimation of fruit and vegetable consumption (Resnicow, et al., 2000). However, it is important to note that short measures of fruit and vegetable consumption like the one in the current thesis have performed favourably when compared to the accepted gold-standard method of assessing dietary behaviour: the 24-hour food recall (Peterson, et al., 2008). In turn, studies have found that 24-hour recalls are well correlated with physiological measures of fruit and vegetable intake (Knutsen, Fraser, Linsted, Beeson, & Shavlik, 2001). Importantly, short items such as this one have been found to be less likely to overestimate changes in fruit and vegetable consumption than some commonly used measured of fruit and vegetable consumption, like the NCI Screener (Peterson, et al., 2008). This means that the assessment of change in fruit and vegetable obtained in the current study is likely to more closely reflect actual change in consumption than measures used in many of the interventions reviewed in Chapter 3.
Another potential challenge for the modelling of behaviour change is that of limited variability in key constructs. Statistically speaking, it is difficult to account for variance in a construct when variability in the target construct and hypothesised predictors is limited. In the context of the present thesis, this means that the ability to model behaviour change would have been restricted if there had been low variability in behaviour change and in change in intention, attitude, subjective norm, and perceived behavioural control. However, while it is the case that larger variation in these constructs might be expected in a more sociodemographically diverse sample, the level of variance observed in the current study was sufficient to allow successful modelling of change in behaviour. This means that low variability is unlikely to fully account for the poor performance of the theory in the present context. Even so, it is important to test the applicability of the theory across a range of populations. While outside the scope of the present research, this is an important avenue for future inquiry. In particular, there is a need for research that combines consideration of these sociodemographic factors with consideration of social cognition variables.

It is also important to note that the studies in this thesis did not consider the role of past behaviour, habit, or behavioural prepotency as they relate to fruit and vegetable consumption. While this factor was outside of the scope of the present thesis, there is evidence to suggest that past behaviour, habit, and behavioural prepotency are likely to play a role in explaining behaviour (Hall & Fong, 2007). While past behaviour cannot be manipulated in interventions, it may be useful to consider whether interventions to change habit could increase fruit and vegetable consumption. Consideration of these factors could strengthen future research in this area – especially in light on concerns raised by other researchers about the need to control for these factors when exploring behaviour using social cognition models (Fishbein & Ajzen, 2010; Hall & Fong, 2007).
The work presented in this thesis has a number of methodological and theoretical strengths. These include a number which have already been mentioned: the extensive formative work, the selection of intervention targets and intervention materials using a combination of theory and formative research in the target population, and pretesting of interventional materials to ensure acceptability of intervention materials to the target population.

In addition, the Fresh Facts study was innovative in that it was only the second intervention to evaluate the utility of the theory of planned behaviour in the design and evaluation of interventions to increase fruit and vegetable consumption. Unlike the previous study conducted using this model (Kellar & Abraham, 2005), Fresh Facts was assessed using a measure that is responsive to small (but important) changes in fruit and vegetable consumption between baseline and follow-up. Fresh Facts also extended the previous work through the use of higher intensity intervention materials, maximising the chance of bringing about, and detecting, change in fruit and vegetable consumption as a result of a theory of planned behaviour–based intervention.

From a theoretical perspective, one of the primary strengths of the present work was the evaluation of the theory of planned behaviour in the context of behaviour change. The research presented in this thesis adds to the small body of research that has previously tested pathways of behaviour change, both in fruit and vegetable consumption (reviewed in Chapter 3) and in the theory-of-planned-behaviour literature (e.g., Elliott & Armitage, 2009; Hardeman, et al., 2011). The results of the evaluation of the Fresh Facts intervention add to the body growing body of research suggesting that the theory may not adequately model behaviour change (e.g., Hardeman, et al., 2011). This finding is one that could be evaluated in more detail in future research because it is important to discover how behaviour change might be more adequately...
explained. As discussed in the next section, researchers may wish to consider the role of additional variables in explaining behaviour change.

From a practical perspective, this study clearly shows the advantages of measuring theory-relevant variables when assessing theory-based behaviour change interventions, because the measurement of these variables provides vital information behind the reasons why the intervention may have failed to bring about change in fruit and vegetable consumption. The results clearly show difficulty in achieving change in attitude, subjective norm, and perceived behavioural control of significant magnitude to achieve change in intention. They also challenge the assumption that change in intention is likely to lead to change in behaviour in the present context. This is incredibly valuable information in the evaluation of an intervention like Fresh Facts because it allows the failure of the intervention to be clearly interpreted in light of the problematic theoretical assumptions rather than in light of the intensity or modality of intervention materials. In the absence of detailed information about theoretical constructs, the failure of the intervention might be interpreted as a failure to achieve change in intervention targets (i.e., subjective norm, attitude, perceived behavioural control, or all of these) or as indicating that a more-intense version of the intervention may be required. Conversely, had the intervention failed to bring about changes in intervention targets, the collection of information about the impact of the intervention on those targets would have allowed for interpretation of those results as indicating problems with the intervention specifically rather than with the theoretical model on which it was based.

**Implications for Future Work**

The research presented in this thesis presents a number of important lines of inquiry for future research. Such research should build on the results of the present
work and, where possible, should seek to incorporate the strength of the current approach. Some of the major avenues for future are briefly outlined in this section.

First, both studies reported in Chapter 7 found significant differences in behaviour, intention, subjective norm, and perceived behavioural control between baseline and follow-up. These changes were equally likely to occur in participants in the control condition as in the intervention groups, meaning that the changes do not reflect the impact of the intervention on these factors but rather are more likely some artefact of the study design. While consideration of the drivers of cohort-wide change is outside the scope of the present thesis, investigations of possible interpretations for such change would be a valuable line of inquiry in further study. Given the similarity in the cohort effects across the two studies, it is reasonable to assume increases in these variables were driven by the same factors across the two studies. These two studies recruited participants at substantially different time during the year, so seasonal variation is unlikely to explain the increase in fruit and vegetable consumption in both studies.

One possible interpretation for changes in the fruit and vegetable consumption, which occurred across the entire cohort, is the effect of the measurement of fruit and vegetable consumption and its determinants. It has been repeatedly demonstrated that the use of questionnaires designed to measure theory-of-planned-behaviour variables, particularly intention, increases the performance of behaviour (Armitage, 2009; Falk, 2010; Sherman, 1980). This effect is known as the ‘mere-measurement effect’ (Chapman, 2001), the ‘question-behaviour’ effect (Sprott et al., 2006), or ‘the self-erasing error of prediction’ (Sherman, 1980). This effect has been demonstrated in a range of behaviours across different behavioural domains (e.g., Chandon, Morwitz, & Reinart, 2005; Sherman, 1980; Sprott, et al., 2006) and has been shown to persist
regardless of whether self-report or objective measures of behaviour are used (e.g., Armitage, 2009). It has been suggested that the effect may occur because the measurement of intention may increase the salience of beliefs relating to the target behaviour and that this increase in salience may actually act as an intervention (Falk, 2010; Morwitz & Fitzsimons, 2004). In the case of the research presented in this thesis, such an effect would explain increases in theory-of-planned-behaviour variables and behaviour between Time 1 and Time 2.

In seeking to avoid the mere-measurement effect, some researchers have suggested the inclusion of additional control and intervention groups who do not receive baseline measurement. This is known as a Solomon four-group design (Solomon, 1949). However, such a design requires a large sample at baseline in order to allow for adequate power. Another alternative is to only measure these psychological constructs at posttest. However, this holds the obvious disadvantage of hampering the measurement of the causal pathways through which theory-based interventions are assumed to act. Because investigation of these pathways was a key objective of this thesis, and the lack of studies which investigate this pathway has been criticised as a major weakness in existing literature within theory-based health promotion (Michie & Abraham, 2004), the use of a no-measurement control group was not appropriate in the current context. However, researchers wishing to conduct intervention studies in this field should carefully study the issue of measurement effects.

A second interpretation of this pattern of results related to the nature of participants recruited to the present study. High motivation of participants at baseline has been presented as a possible explanation of cohort-wide change in previous intervention studies (e.g., Kinmonth et al., 2008), and is a limitation of randomised controlled trials across most health domains. In the present study, intention to consume
fruit and vegetables was high at baseline. This high level of motivation could indicate that individuals in the study cohort may have had preexisting motivation to change their behaviour. Indeed, participants who volunteered to participate in the trial did so knowing that the study was investigating fruit and vegetable consumption; this may have led already strongly motivated participants to increase their consumption regardless of exposure to intervention materials. This effect may have acted either independently or in combination with possible measurement effects to lead to increases in fruit and vegetable consumption and related cognitions across the course of the study.

Given the design of the present study and the scope of the research presented in this thesis, it is not possible to determine the influence of either of these possible drivers of cohort wide change. In order to distinguish between these two interpretations, future researchers may wish to investigate the effects of Fresh Facts, or a similar intervention, using a Solomon four-group design (Solomon, 1949) and a study that purposefully recruits individuals who are less motivated to change at baseline. Although it should be noted that recruitment in some studies may be difficult to achieve.

However, as briefly discussed in Chapter 7, it is interesting to note that both of these interpretations would be expected to be modelled by the theory of planned behaviour because the proposed pathways for these effects are similar to that of the expected intervention effects. This suggests that additional factors may be important in driving, and modelling, behaviour change regardless of whether it occurs naturalistically, as a result of the mere-measurement effect, or because of exposure to a theory-based intervention.
Consideration of the theory-based literature within behaviour change shows that even when using a single model, such as the theory of planned behaviour, many researchers make use of additional variables when seeking to explain or modify behaviour (Guillaumie, et al., 2010; Shaikh, et al., 2008). A major justification for the selection of the theory of planned behaviour for use in the current thesis was the need to address assumptions about the utility of the theory, both within the area of fruit and vegetable consumption and within the context of behaviour change more broadly. As such, the inclusion of non-theory-based variables to the design and evaluation of the intervention would have significantly weakened the ability to address these research questions. However, given that the theory of planned behaviour appeared to inadequately model behaviour change in the studies presented in this thesis, future researchers may wish to include additional explanatory variables in models designs to explain change in behaviour.

Researchers have considered a range of variables as possible additions to the theory of planned behaviour. Previous research investigating food choice in young adults has indicated a range of variables that may help to add to the predictive utility of the theory of planned behaviour. These have included include planning (Wong & Mullan, 2009), habit (Pachucki, 2011), and self-regulatory capacity (Green & Kreuter, 2005; Houben & Jansen, 2010; Pachucki, 2011). More broadly, researchers have considered the factors such as moral norms (Godin, Conner, & Sheeran, 2005), anticipated regret (Sheeran & Orbell, 1999), and the role of nonintentional influences on behaviour, such as automatic processes related to planning (Wong & Mullan, 2009), self-regulatory capacity (Kor & Mullan, 2011; Pachucki, 2011), and automaticity of behaviour (Sheeran, 2002; Webb & Sheeran, 2006). The consideration of such additional variables was judged to be beyond the scope of this thesis because reviews
have shown that, at least within the fruit and vegetable consumption literature, the use of combined models, additional variables, or both may actually decrease explanatory power. On average, studies using multiple theoretical approaches have accounted for less variance in behaviour than do studies using a single theory (Guillaumie, et al., 2010). However, it is important to note that, in light of the lack of correspondence between the prediction of behaviour and the prediction of behaviour change in the present work, researchers may wish to consider the explanatory power of these additional variables in the context of their ability of explain behaviour change. Given that the research presented in this thesis clearly demonstrates the inadequacy of the theory of planned behaviour in modelling behaviour change in response to theory derived interventions, researchers must seriously consider what other factors could more accurately account for change in behaviour.

**Conclusion**

Ultimately, the intervention tested here does appear to be effective in changing target cognitions. However, changes in these thought processes do not appear to be effectively translated to change in behaviour. Further research should be conducted to determine whether change in attitude and subjective norm can be effectively translated to change in fruit and vegetable consumption, because the lack of such a link has serious implications for the use of the theory of planned behaviour in health promotion practice and research. Given the association between fruit and vegetable consumption and health, the low rates of fruit and vegetable consumption in Australia constitute a serious public health concern. While developing methods to understand and modify the social cognitive determinants of fruit and vegetable consumption has the potential to lead to increased overall health and a better understanding of health behaviour.
generally, this thesis clearly shows the serious limitations of current research applying these theories.

The choice of the theory of planned behaviour as the theoretical basis for the Fresh Facts intervention was based on a wealth of evidence showing that this theory predicts a large proportion of the variance in fruit and vegetable intake. This literature has led many to recommend the theory for use in intervention design. When proposing that the theory of planned behaviour be used in interventions designed to bring about behaviour change, it is assumed that change in the predictors of behaviour (i.e., intention, subjective norm, attitude, and perceived behavioural control) is likely to lead to change in behaviour. However, the research presented in this chapter suggests that this may not be the case. Instead, there appears to be very little relationship between change in intention and change in behaviour. This finding challenges the theoretical assumptions that form the justification for the use of the theory of planned behaviour in intervention design.

The success of the intervention in achieving change in the targeted determinants of behaviour demonstrates the success of the detailed content and process design reported in the earlier chapters and confirms the applicability of the taxonomy of behaviour change techniques to the design of theory-based interventions. However, the failure of the intervention to achieve change in intention and fruit and vegetable consumption in spite of significant change in both subjective norm and attitude raises issues for the use of the theory of planned behaviour in intervention design. In particular, the research demonstrates the need for further research into the relationship between change in theory-relevant constructs and behaviour change across a range of behaviours. In particular, given the theoretical importance of the link between behaviour change and change in theory-relevant constructs, future research should
focus on the role of the theory of planned behaviour in explaining behaviour change through the addition of further explanatory variables, such as planning and habit.

The current study adds to the body of research by empirically examining the assumption that the theory of planned behaviour can be supported as a model of behaviour change in fruit and vegetable consumption. Findings from this study suggest that, at least in the case of the Fresh Facts intervention, the theory of planned behaviour does not provide an adequate model of behaviour change. This has implications not just for theory-based interventions designed to increase fruit and vegetable intake but also for the use of the theory of planned behaviour in explaining behaviour change more broadly. On the basis of these findings, it would appear that researchers should be cautious in interpreting a model’s strong predictive power as evidence that the model will provide a good model of behaviour change.
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Appendices
Appendix A

Search Criteria

1. Diet/
2. Food Habits/
3. diet*.mp.
4. "food habit".mp.
5. 1 or 2 or 3 or 4
6. 5 and "Humans".sa_suba.
7. Fruit/ or fruit*.mp.
8. vegetable*.mp. or Vegetables/
9. 7 or 8
10. 9 and "Humans".sa_suba.
11. 6 and 10
12. intervention.mp.
14. evaluation*.mp.
15. "health promotion".mp.
16. "health knowledge".mp.
17. "health behaviour".mp.
18. "health behavior".mp.
20. counselling.mp.
22. "meta-analysis".mp.
23. "cost effectiveness".mp.
24. "economic evaluation".mp.
25. "decision analysis".mp.
26. 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25
27. 26 and "Humans".sa_suba.
28. Decision Support Techniques/
29. Cost-Benefit Analysis/
30. Intervention Studies/
31. Evaluation Studies/
32. Health Promotion/
33. Health Education/
34. Health Knowledge, Attitudes, Practice/
35. Health Behavior/
36. Public Health Practice/
37. Counseling/
38. Meta-Analysis/
39. Clinical Trial/
40. 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39
41. 40 and "Humans".sa_suba.
42. 27 or 41
43. 11 and 42
44. 43 and "Adult".sa_suba.
45. remove duplicates from 44
46. limit 46 to english language
Appendix B

Data Extraction Screener

1. First Author: ..............................................................................................................................................................

........................................................................

2. Title:

................................................................................................................................................................................................

........................................................................

3. Is the study described as randomised?
Yes/No/Maybe

................................................................................................................................................................................................

4. Does the paper describe the first outcome evaluation of an intervention?
Yes/No/Maybe

................................................................................................................................................................................................

5. Is the intervention targeted at healthy adults?
Yes/No/Maybe

................................................................................................................................................................................................

6. Is the fruit and vegetable serving/day reported?
Yes/No/Maybe

................................................................................................................................................................................................

7. Include?
Yes/No/Maybe

................................................................................................................................................................................................
Appendix C

Data Extraction Form

Topic: …Fruit and Vegetable Intervention Review ……………………………………

Reviewer’s Name: ………………………………………………………………………

Complete Reference: ………………………………………………………………
…………………………………………………………………………………………
…………………………………………………………………………………………

Related reference: ……………………………………………………………
…………………………………………………………………………………………
…………………………………………………………………………………………

Type of literature:

☐ Published article ☐ Report ☐ Unpublished Article
☐ Abstract/presentation ☐ Book/Chapter ☐ Other…………………

__________________________________________________________________

Description

1. Study Design ☐ RCT

☐ Parallel controlled trial

2. Intervention

☐ Information ☐ Behavioural Changes

☐ Environmental Changes ☐ Laws/Ordinances

☐ Clinical ☐ Medical Health Care Systems

☐ Workplace ☐ Other…………………………

3. Primary Outcome

Describe …………………………………………………………………………………

4. Description of Intervention

What …………………………………………………………………………………

How………………………………………………………………………………
Who……………………………………………………………………………………..
Where…………………………………………………………………………………..
Results………………………………………………………………………………..
Appendix D

Theory of Planned Behaviour Questionnaire

For me to eat 2 servings of fruit and 5 servings of vegetables each day from now on would be: *important|unimportant*

I will try to eat 2 servings of fruit and 5 servings of vegetables each day from now on *definitely false|definitely true*

For me to eat 2 servings of fruit and 5 servings of vegetables each day from now on would be *impossible|possible*

Most people who are important to me think that I _______ eat 2 servings of fruit and 5 servings of vegetables each day from now on *should|should not*

For me to eat 2 servings of fruit and 5 servings of vegetables each day from now on would be: *meaningful|meaningless*

It is mostly up to me whether or not I eat 2 servings of fruit and 5 servings of vegetables each day from now on *strongly agree|strongly disagree*

For me to eat 2 servings of fruit and 5 servings of vegetables each day from now on would be: *beneficial|harmful*

I have _______ over whether or not I eat 2 servings of fruit and 5 servings of vegetables each day from now on *no control|complete control*

Many people like me eat 2 servings of fruit and 5 servings of vegetables each day *extremely unlikely|extremely likely*

For me to eat 2 servings of fruit and 5 servings of vegetables each day from now on would be: *therapeutic|toxic*

I intend to eat 2 servings of fruit and 5 servings of vegetables each day from now on *extremely likely|extremely unlikely*

For me to eat 2 servings of fruit and 5 servings of vegetables each day from now on would be: *pleasurable|painful*

Most people who are important to me eat 2 servings of fruit and 5 servings of vegetables each day *completely true|completely false*

For me to eat 2 servings of fruit and 5 servings of vegetables each day from now on would be: *bad|good*
For me to eat 2 servings of fruit and 5 servings of vegetables each day from now on would be: dangerous|safe

It is expected of me that I eat 2 servings of fruit and 5 servings of vegetables each day from now on extremely unlikely|extremely likely

For me to eat 2 servings of fruit and 5 servings of vegetables each day from now on would be: warranted|unwarranted

I plan to eat 2 servings of fruit and 5 servings of vegetables each day from now on strongly disagree|strongly agree

For me to eat 2 servings of fruit and 5 servings of vegetables each day from now on would be: negative|positive

For me to eat 2 servings of fruit and 5 servings of vegetables each day from now on would be: unintelligent|intelligent

If I wanted to I could eat 2 servings of fruit and 5 servings of vegetables each day from now on definitely true|definitely false

For me to eat 2 servings of fruit and 5 servings of vegetables each day from now on would be: right|wrong

For me to eat 2 servings of fruit and 5 servings of vegetables each day from now on would be: foolish|wise

The people in my life whose opinions I value ________ eat 2 servings of fruit and 5 servings of vegetables each day eat|do not eat

For me to eat 2 servings of fruit and 5 servings of vegetables each day from now on would be: sick|healthy

The people in my like whose opinions I value would ________ of my eating 2 servings of fruit and 5 servings of vegetables each day from now on approve|disapprove

For me to eat 2 servings of fruit and 5 servings of vegetables each day from now on would be: useless|useful
**Attitude items**

For me to eat 2 servings of fruit and 5 servings of vegetables each day from now on would be:

*beneficial|harmful*

For me to eat 2 servings of fruit and 5 servings of vegetables each day from now on would be:

*bad|good*

For me to eat 2 servings of fruit and 5 servings of vegetables each day from now on would be:

*negative|positive*

For me to eat 2 servings of fruit and 5 servings of vegetables each day from now on would be:

*unintelligent|intelligent*

For me to eat 2 servings of fruit and 5 servings of vegetables each day from now on would be:

*foolish|wise*

For me to eat 2 servings of fruit and 5 servings of vegetables each day from now on would be:

*useless|useful*

**Subjective Norm items**

Most people who are important to me think that I _______ eat 2 servings of fruit and 5 servings of vegetables each day from now on.

*should|should not*

It is expected of me that I eat 2 servings of fruit and 5 servings of vegetables each day from now on

*extremely unlikely|extremely likely*

The people in my like whose opinions I value would _______ of my eating 2 servings of fruit and 5 servings of vegetables each day from now on

*approve|disapprove*
Most people who are important to me eat 2 servings of fruit and 5 servings of vegetables each day

*completely true*|*completely false*

The people in my life whose opinions I value _______ eat 2 servings of fruit and 5 servings of vegetables each day

*eat*|*do not eat*

Many people like me eat 2 servings of fruit and 5 servings of vegetables each day

*extremely unlikely*|*extremely likely*

**Perceived Behavioural Control items**

For me to eat 2 servings of fruit and 5 servings of vegetables each day from now on would be

*impossible*|*possible*

If I wanted to I could eat 2 servings of fruit and 5 servings of vegetables each day from now on

*definitely true*|*definitely false*

I have _______ over whether or not I eat 2 servings of fruit and 5 servings of vegetables each day from now on

*no control*|*complete control*

It is mostly up to me whether or not I eat 2 servings of fruit and 5 servings of vegetables each day from now on

*strongly agree*|*strongly disagree*

**Intention items**

I intend to eat 2 servings of fruit and 5 servings of vegetables each day from now on

*extremely likely*|*extremely unlikely*

I will try to eat 2 servings of fruit and 5 servings of vegetables each day from now on

*definitely false*|*definitely true*

I plan to eat 2 servings of fruit and 5 servings of vegetables each day from now on

*strongly disagree*|*strongly agree*
Appendix E

Ethics Approval

The University of Sydney

Human Research Ethics Committee
Web: http://hrec.usyd.edu.au

Marietta Coutinho
Deputy Manager
Human Research Ethics Administration

Telephone: +61 2 9351 8744
Facsimile: +61 2 9351 8777
Email: mcouti@health.usyd.edu.au

Mailing Address:
Level 6
Jane Foss Russell Building - G02
The University of Sydney
NSW 2006 AUSTRALIA

Ref: DC/PR

11 September 2009

Dr Barbara Mullan
School of Psychology
Brennan MacCallum Building - A18
The University of Sydney
Email: Barbara@psych.usyd.edu.au

Dear Dr Mullan

Title: Predicting dietary control: An application of the theory of planned behaviour and of the role of self-regulation across two types of dietary behaviour

Ref. No.: 07-2009/11934

Authorised Personnel: Dr Barbara Mullan
Anna Collins
Emily Kothe

The Human Research Ethics Committee, at its Executive Meeting held on 26 August 2009, considered and approved your request dated 17 August 2009 to modify the above protocol as attached.

The Committee found that there were no ethical objections to the modifications and therefore recommends approval to proceed.

Chief Investigator / Supervisor’s responsibilities to ensure that:

1. All serious and unexpected adverse events should be reported to the HREC as soon as possible.

2. All unforeseen events that might affect continued ethical acceptability of the project should be reported to the HREC as soon as possible.

3. The HREC must be notified as soon as possible of any changes to the protocol. All changes must be approved by the HREC before continuation of the research project. These include:
   - If any of the investigators change or leave the University,
   - Any changes to the Participant Information Statement and/or Consent Form.
(4) All research participants are to be provided with a Participant Information Statement and Consent Form, unless otherwise agreed by the Committee. The Participant Information Statement and Consent Form are to be on University of Sydney letterhead and include the full title of the research project and telephone contacts for the researchers, unless otherwise agreed by the Committee and the following statement must appear on the bottom of the Participant Information Statement. Any person with concerns or complaints about the conduct of a research study can contact the Manager, Ethics Administration, University of Sydney, on (02) 8627 8175 (Telephone), (02) 8627 8190 (Facsimile) or human.ethics@usyd.edu.au (Email).

(5) Copies of all signed Consent Forms must be retained and made available to the HREC on request.

(6) It is your responsibility to provide a copy of this letter to any internal/external granting agencies if requested.

(7) A report and a copy of any published material should be provided at the completion of the Project.

Yours sincerely

[Signature]

Professor D I Cook
Chairman
Human Research Ethics Committee

cc: Anna Collins, email: acoll915@uni.sydney.edu.au
    Emily Kothe, email: ekolthe@psych.usyd.edu.au.

Encl. Approved Request for Modification form
    Approved Nutrition Knowledge Measure, revised
    Approved Fruit and Vegetable Beliefs, revised
    Approved Participant Information Statement, Version 2.10/08/2006
Appendix F

Focus group topic guide

What to you is healthy eating?

What to you is a healthy amount of fruit and vegetables?

Think back to the last time you wanted to make a change relating to your consumption of fruit and vegetables. What kind of barriers or roadblocks did you run into?

What helped you or would have helped you most in making the change?

Suppose you had been told by a health professional (e.g. doctor, dietician) that you are not eating enough fruit and/or vegetables. What would you want to know, or what kind of information would you like to get?

(prompt) There are lots of different ways you could get the types of information you have been talking about. How would you like to get that information?

(prompt) Of all those ways of getting information, which do you feel is the most important?

Suppose a program was developed to help people increase their fruit and vegetable consumption. What would make you want to take part?

We realise that it is hard to stay motivated to change your diet, but what would entice you to keep trying?

(prompt) What would keep you interested?

We are going to be putting together programs to help people increase the amount and type of fruit and vegetables they get in their diet. As we begin this project, what advice do you have for us?
Appendix G

Ethics Approval

The University of Sydney

Human Research Ethics Committee

Web: http://www.usyd.edu.au/ethics/humrec

Gail Brody
Manager
Office of Ethics Administration

Marietta Coutinho
Deputy Manager
Human Research Ethics Administration

Telephone: +61 2 9351 7475
Facsimile: +61 2 9351 8150
Email: gbrody@usyd.edu.au

Telephone: +61 2 9351 7475
Facsimile: +61 2 9351 8150
Email: mcoutinho@usyd.edu.au

Mailing Address:
Level 6
Jane Foss Russell Building – G02
The University of Sydney
NSW 2009 AUSTRALIA

Ref: PB/PE

3 July 2009

Dr Barbara Mullan
School of Psychology
Brennan MacCallum Building – A18
The University of Sydney
Barbara@psych.usyd.edu.au

Dear Dr Mullan

Thank you for your correspondence dated 19 June 2009 addressing comments made to you by the Human Research Ethics Committee (HREC). After considering the additional information, the Executive Committee at its meeting on 25 June 2009 approved your protocol entitled “Understanding healthy eating behaviour in university students”.

Details of the approval are as follows:

Ref No.: 06-2009/11826
Approval Period: June 2009 to June 2010
Authorised Personnel: Dr Barbara Mullan
Ms Emily Kothe

The HREC is a fully constituted Ethics Committee in accordance with the National Statement on Ethical Conduct in Research Involving Humans-March 2007 under Section 8.1.29

The approval of this project is conditional upon your continuing compliance with the National Statement on Ethical Conduct in Research Involving Humans. We draw to your attention the requirement that a report on this research must be submitted every 12 months from the date of the approval or on completion of the project, whichever occurs first. Failure to submit reports will result in withdrawal of consent for the project to proceed.

Chief Investigator / Supervisor’s responsibilities to ensure that:

1. All serious and unexpected adverse events should be reported to the HREC as soon as possible.

2. All unforeseen events that might affect continued ethical acceptability of the project should be reported to the HREC as soon as possible.
(3) The HREC must be notified as soon as possible of any changes to the protocol. All changes must be approved by the HREC before continuation of the research project. These include:
   - If any of the investigators change or leave the University.
   - Any changes to the Participant Information Statement and/or Consent Form.

(4) All research participants are to be provided with a Participant Information Statement and Consent Form, unless otherwise agreed by the Committee. The Participant Information Statement and Consent Form are to be on University of Sydney letterhead and include the full title of the research project and telephone contacts for the researchers, unless otherwise agreed by the Committee and the following statement must appear on the bottom of the Participant Information Statement. Any person with concerns or complaints about the conduct of a research study can contact the Manager, Ethics Administration, University of Sydney, on (02) 8627 8175 (Telephone); (02) 8627 8180 (Facsimile) or ethics@syd.edu.au (Email).

(5) Copies of all signed Consent Forms must be retained and made available to the HREC on request.

(6) It is your responsibility to provide a copy of this letter to any internal/external granting agencies if requested.

(7) The HREC approval is valid for four (4) years from the Approval Period stated in this letter. Investigators are requested to submit a progress report annually.

(8) A report and a copy of any published material should be provided at the completion of the Project.

Yours sincerely,

[Signature]

Associate Professor Philip Beale
Chairman
Human Research Ethics Committee

Copy: Ms Emily Kohne ekohne@psych.usyd.edu.au

Encl. Approved Participant Information Statement
   Approved Description of the study on SCWA
   Approved Participant Consent Form
   Approved Self-report questionnaire
   Approved Focus Group questions
Appendix H

Sample Fresh Facts pilot intervention email

A Fresh Facts Fresh Tip

Emily Kothe emily.kothe@sydney.edu.au
to Emily

Hi Emily,

As part of the Fresh Facts program you'll be receiving five Fresh Facts tips over the next 15 days.

Your first tip is in this email. Keep an eye out for other emails from Fresh Facts for more great Fresh Facts Fresh Tips.

---

Buying fruit and vegetables in season decreases cost and increases quality. Oranges, corn, leeks, peas, pineapples, tangerines, and broccoli are all in season at the moment and are a great way to eat fruit and vegetables on a budget. Remember, buying fruit and vegetables at markets is a great way to get healthy food for great prices.

---

If you have any questions about the Fresh Facts program please email the Fresh Facts research team at ekotha@psych.usyd.edu.au

Remember, Fresh Facts is here to help you increase your fruit and vegetable intake. If you don't want to receive anymore email from Fresh Facts you can withdraw from the study by going to the Fresh Facts website at http://www.lifesguideonline.org and clicking withdraw.

Click here to Reply or Forward
Fresh Facts pilot intervention messages

Note: intervention messages were selected from this list in a random order.

Planning Messages

1. Many people find it easier to remember to eat well if they plan ahead. Making a plan doesn’t have to be hard – why not put some fresh or dried fruit in your bag tomorrow morning? That way you can have a healthy snack to get you through the mid-afternoon hunger pangs.

2. It can be hard to eat healthily if there you don’t have the right food in the house. Next time you go shopping grab some frozen fruits or vegetables. Snap frozen fruit and veggies have the same nutritional value as when they were fresh. They are a great back-up because they can sit in your freezer until you need them.

3. Most people find it easier to include fruit and vegetables in their meals if they plan ahead. Meal planning is a great way to make sure you always have the ingredients you need for the recipes you love. Have a go at planning some fruit and vegetable based meals this week.

Cost

1. Buying fruit and vegetables in season decreases cost and increases quality. Oranges, corn, leeks, peas, pineapples, tangelos, and broccolini are all in season at the moment and are a great way to eat fruit and vegetables on a budget. Remember, buying fruit and vegetables at markets is a great way to get healthy food for great prices.

2. Keep an eye out for tinned, dried, and frozen fruit and vegetables on special. They can be bought in bulk and easily stored – a cheap and convenient way to eat fruit and vegetables on a budget.
3. Homemade soup is a healthy and tasty way to use vegetables on a budget and is a great way to use up leftovers. Make a big batch and freeze leftovers in small lunch-size containers. Add lentils or chickpeas to add bulk and to up the fruit and vegetable content even more.

**Time/Convenience**

1. If you don’t have time for a proper meal, why not have fruit and vegetables on the run? Carrots, apples, celery, and bananas are just some of the great tasting portable snacks that you can eat any time!

2. Some people think they don’t have time to eat well – but putting together a healthy salad only takes a couple of seconds. Just toss together your favourite fresh vegetables with a simple dressing for a quick and easy meal.

3. Even though preparing fruit and vegetables doesn’t take long everyone feels like it spending their time doing something else every once in a while. If you don’t feel like making a fruit salad yourself – why not buy one ready made?

**Ease**

1. Lots of people find their fruit and vegetable consumption can go up if they just make small changes in their life. Why not move your fruit bowl into the middle of your kitchen table, or rearrange your fridge to make fruit and vegetables more accessible.

2. You don’t have to make big changes your whole diet to include fruit and vegetables – it is easy to make a big difference in your fruit and vegetable changes with simple steps.
Add fresh or tinned fruit to your cereal, or make meat go further by adding extra vegetables in a stir-fry or casserole.

3. Don’t feel like you need to change your diet all at once. Making small changes that you can maintain and build on is easier than trying to change your diet in one day. Try eating one more serving of fruit or vegetables today than you did yesterday.

**Cooking skills/Knowledge**

1. If there a fruit or vegetable you’ve always wanted to try but you don’t know how? Have a look online for some simple recipes, http://www.taste.com.au, http://www.gofor2and5.com.au and http://www.harrisfarm.com.au/recipes.asp are all great places to find recipes and most fruits and vegetables are easy to prepare if you just have a go!

2. You should be eating at least five servings of vegetables a day and while that might sound like a lot, it’s actually not. If you cook a simple pasta dish with 1 cup of ready made tomato pasta sauce, a handful of baby spinach, a medium carrot, and six button mushrooms you’ll have eaten your entire vegetable intake for the day! You can make this meal while the waiting for the pasta to cook – just dice the carrot and add to a saucepan with a little bit of oil, once the carrot starts to soften add the mushrooms and pasta sauce and then stir in the spinach just before the pasta is done and you’ve got a great – easy – healthy meal!

3. You don’t have to do much to prepare a most fruits and vegetables – so start simple. Most fruits and lots of vegetables are great raw, and apples, potatoes, carrots, pears, peaches, pumpkin, and beetroot are all great roasted. If you want to try something new have a look for simple recipes online or ask your friends and family about their recipes.
Appendix I

Ethics Approval

RESEARCH INTEGRITY
Human Research Ethics Committee
Web: http://sydney.edu.au/hreoc/
Email: hreoc@sydney.edu.au
Address for all correspondence:
Level 6, Jane Foss Russell Building - 022
The University of Sydney
NSW 2006 AUSTRALIA

Ref. PBPE

1 September 2010

Dr Barbara Mullan
School of Psychology
Brennan MacCallum Building – A18
The University of Sydney
Email: barbara@psych.usyd.edu.au

Dear Dr Mullan

Thank you for your correspondence dated 31 August 2010 addressing comments made by the Human Research Ethics Committee (HREC). The Executive Committee of the HREC, at its meeting of 31 August 2010, considered this information and approved the protocol entitled “An intervention to decrease the risk of Australian young adults: Using emerging internet technologies to increase fruit and vegetable intake”.

Details of the approval are as follows:

Protocol No.: 13088
Approval Period: August 2010 – August 2011
Authorised Personnel: Dr Barbara Mullan
Ms Emily Kethe

Documents approved:
Participant Information Statement Version 2 31/8/10
Participant Consent Form Version 1 7/7/10
Questionnaire and Tasks
Basic Planning Task
Motivational/Educational Messages
Feasibility and Acceptability of the Intervention program
Description of the study on SONA

The HREC is a fully constituted Ethics Committee in accordance with the National Statement on Ethical Conduct in Research Involving Humans March 2007 under Section 5.1.26.

The approval of this project is conditional upon your continuing compliance with the National Statement on Ethical Conduct in Research Involving Humans. N.B. A report on this research must be submitted every 12 months from the date of the approval, or on completion of the project, whichever occurs first. Failure to submit reports will result in the withdrawal of consent for the project to proceed. Your report will be due on 31 August 2011, please put this in your diary.

Deputy Manager: Human Ethics
Ms Marietta Coutinho
T: +61 2 9237 0775
E: human.ethics@sydney.edu.au

Human Ethics Secretariat:
Ms Portia Richmond T: +61 2 9237 0771 E: portia.richmond@sydney.edu.au
Ms Patricia Engelmann T: +61 2 9237 0772 E: patricia.engelmann@sydney.edu.au
Ms Kaye Rehman T: +61 2 9237 0775 E: kaye.rehman@sydney.edu.au

245
Chief Investigator/Supervisor's responsibilities to ensure that:

1. All serious and unexpected adverse events should be reported to the HREC within 72 hours for clinical trials/interventional research.

2. All unforeseen events that might affect continued ethical conduct of the project should be reported to the HREC as soon as possible.

3. Any changes to the protocol must be approved by the HREC before the research project can proceed.

4. All research participants are to be provided with a Participant Information Statement and Consent Form, unless otherwise agreed by the Committee. The following statement must appear on the bottom of the Participant Information Statement: Any person with concerns or complaints about the conduct of a research study can contact the Deputy Manager, Research Integrity (Human Ethics), University of Sydney on +61 2 9351 7676 (Telephone); +61 2 9351 8117 (Facsimile) or rihumanethics@sydney.edu.au (Email).

5. Copies of all signed Consent Forms must be retained and made available to the HREC on request.

6. It is your responsibility to provide a copy of this letter to any internal/external granting agencies if requested.

7. The HREC approval is valid for four (4) years from the Approval Period stated in this letter. Investigators are requested to submit a progress report annually.

8. A report and a copy of any published material should be provided at the completion of the Project.

Please do not hesitate to contact Research Integrity (Human Ethics) should you require further information or clarification.

Yours sincerely,

[Signature]

Associate Professor Philip Beale
Chair
Human Research Ethics Committee

cc: Emily Kothe emily.kothe@sydney.edu.au

Appendix J
The complete intervention materials for the Fresh Facts high frequency intervention are listed in the following pages.
Hi %Preferred Name%%!

Welcome to the FreshFacts email program.

As part of the Fresh Facts program you'll be receiving emails from us over the next 30 days. These emails have information to help you learn more about fruit and vegetable consumption and improve your eating habits.

The program includes important information about fruits and vegetables, tips from other people who have increased their fruit and vegetable consumption in the past, and some activities for you to work on along the way.

Keep an eye out for other emails from FreshFacts over the next month. If you encounter any problems with Fresh Facts please let us know by emailing help@fresh-facts.com

Remember, Fresh Facts is here to help you increase your fruit and vegetable intake. To stop receiving these emails please click here.

Emily Kotha | School of Psychology, University of Sydney | +61 290367268
Hi %%Preferred Name%%

Did you know?

Many people don't know about the links between fruit and vegetable intake and disease.

Did you know that 9% of cancer in Australia is caused by not eating enough fruit and veg?

Eating at least two servings of fruit and five servings of vegetables each day reduces your risk of cancer as well as slashing your risk of stroke, heart attack, and obesity.

Fresh Facts is here to help you increase your fruit and vegetable intake. To stop receiving these emails please click here.

Emily Kane | School of Psychology, University of Sydney | +61290387266
Hi %Preferred Name%

Increasing your fruit and vegetable consumption one step at a time

For most people, increasing fruit and vegetable consumption is about making small changes to their life. You can increase your fruit and vegetable consumption - and improve your health - by making lots of little changes.

A 200ml glass of juice is a serving of fruit. Adding a glass of juice to your diet is an easy and quick way to up your fruit intake. Why not add a glass of juice to your breakfast every day this week?

Remember, each serving of fruit and vegetables you add to your diet is doing you good.
Hi %%Preferred Name%%

Hannah’s TopPick

FreshFacts is all about helping young people improve their diet. To keep you on track we include advice and success stories from other people who’ve done FreshFacts before. Today’s TopPick is from Hannah, 19.

“After FreshFacts, I eat at least 2 fruit and 5 veg every day – and I think everyone should as well.

I really believe that you are what you eat.

When you eat junk you will feel moody, tired and lazy. But if you eat fruit and vegetables you get doses of vitamins that make you feel good.”

Remember, Fresh Facts is here to help you increase your fruit and vegetable intake. To stop receiving these emails please click here.

Emily Kohle | School of Psychology, University of Sydney | +61280387286
Hi %%%Preferred Name%%%  

How do you measure up?

When trying to increase your fruit and vegetable intake it can be helpful to think about the eating habits of other people in your life.

Think about how your friends and family include fruit and vegetables in their lives. How do you measure up?

If there are people in your life who are especially good at eating well, why not ask them how they do it? Talking to others can give you ideas about how to improve your own habits.

Remember, Fresh Facts is here to help you increase your fruit and vegetable intake. To stop receiving these emails please click here.

Emily Kothe | School of Psychology, University of Sydney | +61230367266
Hi %Preferred Name%

Sam’s TopPick

FreshFacts is all about helping young people improve their diet. To keep you on track we include advice and success stories from other people who’ve done FreshFacts before. Today’s TopPick is from Sam, 18

"Eating a variety of fruit and veg is important to maintain optimal health and keeps me from getting sick.

Eating well helps me have a healthy immune system by making sure I get all the vitamins and minerals I need.

It keeps me healthy and makes sure I always look and feel my best."

Remember, FreshFacts is here to help you increase your fruit and vegetable intake. To stop receiving these emails please click here.

Emily Kothe | School of Psychology, University of Sydney | +61290367266
Hi %Preferred Name%

Did you know?

Fresh fruit and vegetables taste great - but they are not the only option. One easy way to increase the amount of fruit and vegetables without having to go to the shops all the time is to eat tinned, frozen, or dried fruits and vegetables.

Did you know that frozen peas are better for you than fresh peas you buy at the supermarket?

Lots of fruit and veg are as good for you - if not better - when you buy them frozen. This is because when foods are snap frozen all the nutrients are locked in. This makes it even easier to eat well.

Remember, Fresh Facts is here to help you increase your fruit and vegetable intake. To stop receiving these emails please click here.

Emily Kothe | School of Psychology, University of Sydney | +61290367266
Hi % Preferred Name %

Lisa's TopPick

FreshFacts is all about helping young people improve their diet! To keep you on track we include advice and success stories from other people who've done FreshFacts before. Today's TopPick is from Lisa, 15.

"Fruit and vegetables are good for your general health. They provide you with much need vitamins and nutrients.

For me, the best way to make sure I eat well is to plan ahead.

I do my shopping online and always vary the variety of fresh, frozen and tinned produce. That way I never end up having to eat five carrots and two apples every day just to meet my two and five.

Having a variety makes it easy."

Remember, FreshFacts is here to help you increase your fruit and vegetable intake. To stop receiving these emails please click here.

Emily Kothe | School of Psychology, University of Sydney | +6129387288
Hi % Preferred Name %

Did you know?

Most people don’t talk about fruit and vegetables with their friends – so they often underestimate the number of people who do consume the recommended quantities of fruit and vegetables.

We surveyed healthy young adults – people just like you – as part of FreshFacts development.

More than 85% of healthy young adults eat fruit and vegetables every day.

If they can do it, you can too!

Remember, Fresh Facts is here to help you increase your fruit and vegetable intake. To stop receiving these emails please click here.

Emily Kothe | School of Psychology, University of Sydney | +61 2 9382 6800
Hi % %Preferred Name % %

Why not try a simple recipe today?

This recipe makes one serving of pasta sauce and includes 5 servings of vegetables. That is enough for the whole day!

FreshFacts Tomato, Mushroom, and Baby Spinach Pasta Sauce

Take 1 cup of tomato pasta sauce (about half a jar), 1 large handful of baby spinach, 1 medium carrot (grated), and about 6 button mushrooms (sliced).

While you’re cooking a serve of your favourite pasta, place the tomato based pasta sauce, mushrooms, and carrot in a saucepan. Simmer over medium heat until the mushroom and carrot are softened. Take off the heat and stir through the baby spinach. Toss through your favourite pasta, season to taste, and ENJOY!

This recipe is quick to prepare and tastes great. For more simple recipes why not ask some friends and family, or look around online.

Remember, Fresh Facts is here to help you increase your fruit and vegetable intake. To stop receiving these emails please click here.

Emily Kotha | School of Psychology, University of Sydney | +61 04 1290 3672 66
Hi %Name%

Did you know?

Maintaining a healthy weight is important for all of us. While lots of diets tell you to eat less - eating more fruit and vegetables helps you manage your health no matter how much you weigh.

Fruit and vegetables are low in calories so are great for weight management and because they are high in fibre and water they help you feel fuller for longer.

If you’re worried about the sugar content of some fruits - you can eat vegetables to make up for eating less fruit.

Remember, Fresh Facts is here to help you increase your fruit and vegetable intake. To stop receiving these emails please click here.

Emily Kothe | School of Psychology, University of Sydney | +61 2 9036 7266
Hi %Preferred Name%%

Scott's TopPick

FreshFacts is all about helping young people improve their diet. To keep you on track we include advice and success stories from other people who've done FreshFacts before. Today's TopPick is from Scott, 18.

“\nWhen I eat fruit and veg I feel much healthier than at other times. I used to not eat enough veges, especially when I was busy. I used to think that eating fruit and veges was a pain. I always put it in the "too hard" basket.\n
Now I know that having it in the house is the main part - if it is there I will eat it.\n
It is cheap and easy it is to eat well. I started talking to people about fruit and veges and now I have lots of new recipes that are quick and easy to prepare.\n
Eating more fruit and vegetables is easier than I thought and makes me feel great.”\n
Remember, Fresh Facts is here to help you increase your fruit and vegetable intake. To stop receiving these emails please click here: Unsubscribe me from this list.

Emily Kothe | School of Psychology, University of Sydney | +61290367266
Hi %Preferred Name%

Compare your lunch with a mate

Why reinvent the wheel? By looking at how people around you include fruit and vegetables in their daily life, you can find ways of improving your own consumption.

Next time you’re eating with a mate, have a look at how they include fruit and vegetables in their diet.

Choose a healthy friend and try eating what they eat - it just might surprise you.

Remember, Fresh Facts is here to help you increase your fruit and vegetable intake. To stop receiving these emails please click here.

Emily Kotha | School of Psychology, University of Sydney | +61290367266
Hi %Preferred Name%!

How much do you know about fruits and vegetables?

Do you know what foods can be included in your daily intake of fruit and vegetables? Are you a champion of fruit and vegetable trivia? Do you know what fruits and vegetables are best for preventing disease?

Test your fruit and vegetable knowledge by taking the FreshFacts challenge.

To take the challenge click here.

Remember, Fresh Facts is here to help you increase your fruit and vegetable intake. To stop receiving these emails please click here.

Emily Kothe | School of Psychology, University of Sydney | +61290367266
Hi '%Preferred Name%',

Kurt’s TopPick

FreshFacts is all about helping young people improve their diet. To keep you on track we include advice and success stories from other people who’ve done FreshFacts before. Today’s TopPick is from Kurt, 18.

"Being healthy is really important to me and my friends. Eating F&V is extremely important for both short and long term health.

When someone eats well it shows that they care about themselves and about their health.

That’s why I make sure I eat lots of F&V every day."

Remember, Fresh Facts is here to help you increase your fruit and vegetable intake. To stop receiving these emails please click here.

Emily Kothe | School of Psychology, University of Sydney | +61293872286
Hi %Name%

Fruit and vegetables - the cheap alternative

There has been a lot of talk lately about the rising cost of produce, but did you know that fruit and vegetables are still cheaper than most other snacks? You can buy a mandarin for just 31 cents, or a whole week's worth of pumpkin for less than 50 cents.

In fact, you can buy a whole week's worth of fruit and vegetables for less than $12. That is less than the price of four cups of coffee.

Fruit and vegetables really are the budget-conscious choice. Remember - buying fruit and vegetables in season is a great way to keep costs low.

Remember, Fresh Facts is here to help you increase your fruit and vegetable intake. To stop receiving these emails please click here.

Emily Kotha | School of Psychology, University of Sydney | +61290367266
Hi %\%Preferred Name\%\%

Just one more serve of vegetables

Sometimes people think that adding fruit and vegetables to their day means they have to change everything about the way they eat. But it doesn’t have to be that way.

Try adding just one more serving of vegetables to your favourite recipe. You can add lettuce to your sandwich, carrot, onion, celery, or tomato paste to your pasta sauce, or some fresh greens to your stir-fry. The possibilities are endless!

If a dish already has recipe already has vegetables you can start by upping the quantity, or by just adding a vegetable based side to your meal.

Remember, Fresh Facts is here to help you increase your fruit and vegetable intake. To stop receiving these emails please click here.
Emily Kote | School of Psychology, University of Sydney | +61290367266
Hi % Preferred Name %

What do health professionals think you should eat?

Scientists and health professionals around the world have worked together to create national and international guidelines for healthy eating.

In Australia, experts agree that you should enjoy a wide variety of nutritious foods, including plenty of vegetables, legumes, and fruit. Australian health professionals recommend eating at least 2 serves of fruit and 5 serves of vegetables.

Eating at least 2 serves of fruit and 5 serves of vegetables will not only help you feel healthy, it will also reduce your risk of experiencing diseases in the long term.

Remember, Fresh Facts is here to help you increase your fruit and vegetable intake. To stop receiving these emails please click here.

Emily Kothe | School of Psychology, University of Sydney | +61 2 9385 7266
Hi % Preferred Name %

Sarah's TopPick

FreshFacts is all about helping young people improve their diet. To keep you on track we include advice and success stories from other people who've done FreshFacts before. Today's TopPick is from Sarah, 18.

"Since I started FreshFacts I've been eating a lot better and I've really noticed the difference it has made to my appearance. Eating more fruit and vegetables makes it easier to control my weight and keeps my skin clear.

Eating plenty of fruit and vegetables helps me looking and feeling my best.

Eating well has given me more energy, nicer skin, and makes me feel happier!"

Remember, Fresh Fruits is here to help you increase your fruit and vegetable intake. To stop receiving these emails please click here.
Emily Kothe | School of Psychology, University of Sydney | +6129357280
Hi %Preferred Name% 

Did you know?

These days, more and more people are worried about the sugar content of the food they eat. Some people even go so far as to avoid fruit because they are worried about eating too much sugar.

Did you know, many fruits are actually quite low in both fructose and sucrose (sugars). You can keep your overall sugar intake low while still enjoying your daily serves of fruit.

Apricots, peaches, nectarines, rockmelon, strawberries, plums, avocados, oranges, and figs all have less than 4 grams of fructose per serve.

When considering the sugar content of fruit it is especially important to think about what you’d be eating instead of the fruit, and to keep in mind that fruit contains essential vitamins, minerals, and fibre, that make them better for you than other snack options.

Remember, Fresh Facts is here to help you increase your fruit and vegetable intake. To stop receiving these emails please click here.

Emily Kothe | School of Psychology, University of Sydney | +61 1290367266
FreshFacts

Hi % Preferred Name %

Using the resources you have: finding great new ways to prepare fruit and vegetables.

Many young people think that they don’t know enough to cook fruit and vegetables well. Have you ever eaten a great fruit or vegetable dish that you wished you could make yourself but you didn’t know how?

Next time you eat meal that you wish you could make yourself - ask how! Your friends and family are a great resource for improving your culinary skills.

Talk to your friends about new ways to cook fruits and vegetables - you can find out tasty ways to cook old favourites or learn about foods you’ve never even heard of. Why not have some friends over for dinner to try out some new recipes?

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Emily Kotha | School of Psychology, University of Sydney | +61 29036 7266
Hi % Preferred Name %

Chris’s TopPick

FreshFacts is all about helping young people improve their diet. To keep you on track we include advice and success stories from other people who’ve done FreshFacts before. Today’s TopPick is from Chris, 18.

“Eating fruit and veg is part of a healthy lifestyle. It helps me maintain good health and keeps me feeling revitalised.

I just take a couple of pieces of fruit and veg for lunch and make sure dinner has veg has well. If I’m not taking lunch to uni I just make sure I get something that has some veges on it - like tomato on a sandwich.

It makes eating right so easy.”

Remember, Fresh Facts is here to help you increase your fruit and vegetable intake. To stop receiving these emails please click here.

Emily Kothe | School of Psychology, University of Sydney | +6129357250
Hi %Preferred Name% %

Your fruit and vegetable plan

Eating the recommended daily intake of fruit and vegetables is not a difficult task. You can do this very easily. Successfully managing your meals so that you eat the 2 servings of fruit and 5 servings of vegetables is within your control.

You can do it, so do it this week. Make a firm decision now that you will eat the recommended daily intake of fruit and vegetables each day this week.

You are more likely to be successful in your intention to eat fruit and vegetables if you make a plan about where and when you will buy fruit and vegetables.

Decide now where and when you will buy your fruit and vegetables for the next week.

You will also be more successful if you decide how you will include fruit and vegetables in your daily meals.

Take a piece of paper and write down an example of the meals you plan to consume the recommended daily intake of fruit and vegetables.

Remember, Fresh Facts is here to help you increase your fruit and vegetable intake. To stop receiving these emails please click here.

Emily Kothe | School of Psychology, University of Sydney | +6129367266
Hi %Preferred Name%

Irina's TopPick

FreshFacts is all about helping young people improve their eating habits. To keep you on track we include advice and success stories from other people who've done FreshFacts before. Today's TopPick is from Irina, 13.

"Eating a variety of fruit and vegetables is important to maintain optimal health. It helps me have a healthy immune system because I get all the vitamins and minerals I need.

Eating right keeps the balance of nutrients right. This keeps me from getting sick.

When I eat right I feel better, healthier, and happier."

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Emily Kothe | School of Psychology, University of Sydney | +61 29038 7286
Hi %Preferred Name%

Did you know?

Most people don't talk about fruit and vegetables with their friends - so they often don't know what other people think they should do. Some people think that people will judge them negatively if they have a healthy diet.

We surveyed healthy young adults - people just like you - as part of FreshFacts development.

Over 80% of young adults think their peers should eat at least 2 servings of fruit and 5 servings of vegetables every day.

Most young people rate fruit and vegetable consumption as important, meaningful and wise.

Remember, Fresh Facts is here to help you increase your fruit and vegetable intake. To stop receiving these emails please click here.

Emily Kothe | School of Psychology, University of Sydney | +61293672566
Hi %\%Preferred Name\%\%  

Jacks's TopPick  

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"I always make sure I eat a variety of fruits and vegetables. It's good for me and makes me feel great. My friends and I eat fruit and veg all the time - being healthy is really important for us all.

Eating well makes sure we stay strong."

Remember, Fresh Facts is here to help you increase your fruit and vegetable intake. To stop receiving these emails please click here.

Emily Kothe | School of Psychology, University of Sydney | +61293857286
Hi %Preferred Name%,

Did you know?

Some people say that fruits and vegetables are hard to store - but storage is a snap if you shop and eat smart.

You can make up your daily intake of fruit and vegetables with a variety of fresh, frozen, tinned, and dried foods.

Choosing from a variety of fruits and vegetables makes storage simple, and can keep costs down.

Remember, Fresh Ferts is here to help you increase your fruit and vegetable intake. To stop receiving these emails please click here.

Emily Kothe | School of Psychology, University of Sydney | +61290367266
Hi %Preferred Name%

Share your knowledge

Over the past month you've learned hints and tricks to help you improve your fruit and vegetable consumption. Now it is time to share what you know.

Now it is time to share what you know. Talk to your friends and family about fruit and vegetables - share FreshFacts messages with them or just have a chat.

By talking to others about fruit and vegetables you can help them to improve their eating habits for the better.

Remember, Fresh Facts is here to help you increase your fruit and vegetable intake. To stop receiving these emails please click here.
Emily Kothe | School of Psychology, University of Sydney | +61290367266
Hi %Preferred Name%!

Thank you for taking part in the FreshFacts email program.

As part of the Fresh Facts program you received emails over the past month. These emails had information to help you learn more about fruit and vegetable consumption and improve your eating habits.

Now that you’ve completed the program it is time to complete the FreshFacts follow-up survey. Once you’ve completed the survey you will receive credit through SONA.

Please click the [here](#) to access the FreshFacts follow-up survey.

Remember, Fresh Facts is here to help you increase your fruit and vegetable intake. To stop receiving these emails please click [here](#).

Emily Kothc | School of Psychology, University of Sydney | +61290367266
The complete intervention materials for the Fresh Facts low-frequency intervention are listed in the following pages.
FreshFacts

Hi %Preferred Name%

Did you know?

Many people don’t know about the link between fruit and vegetable intake and disease.

Did you know that 9% of cancer in Australia is caused by not eating enough fruit and veg?

Eating at least two servings of fruit and five servings of vegetables each day reduces your risk of cancer as well as lowering your risk of stroke, heart disease, and obesity.

Increasing your fruit and vegetable consumption one step at a time

For most people, increasing fruit and vegetable consumption is about making small changes to their life. You can increase your fruit and vegetable consumption – and improve your health – by making lots of little changes.

A 200ml glass of juice is a serving of fruit. Adding a glass of juice to your day is an easy and quick way to up your fruit intake. Why not add a glass of juice to your breakfast every day this week?

Remember, each serving of fruit and vegetables you add to your day is doing you good.

Hannah’s TopPick

“After FreshFacts, I eat at least 2 fruit and 5 veg every day - and I think everyone should as well.

I really believe that you are what you eat.

When you eat junk you will feel moody, tired, and lazy. But if you eat fruit and vegetables you get doses of vitamins that make you feel good.”

Remember, Fresh Facts is here to help you increase your fruit and vegetable intake. To stay receiving these emails please click here: EMAILS

Emily Khaw | School of Psychology, University of Sydney | 04129907298
FreshFacts

Hi %Preferred Name%

How do you measure up?

When trying to increase your fruit and vegetable intake it can be helpful to think about the eating habits of other people in your life.

Think about how your friends and family include fruit and vegetables in their lives. How do you measure up?

If there are people in your life who are especially good at eating well, why not ask them how they do it? Talking to others can give you ideas about how to improve your own habits.

Sam’s TopPick

FreshFacts is all about helping young people improve their eating habits. To keep you on track we include advice and success stories from other people who’ve done FreshFacts before. Today’s TopPick is from Sam, 18.

"Eating a variety of fruit and veg is important to maintain optimal health and keeps me from getting sick.

Eating well helps me have a healthy immune system by making sure I get all the vitamins and minerals I need.

It keeps me healthy and makes sure I always look and feel my best."

Did you know?

Fresh fruit and vegetables taste great - but they are not the only option. One easy way to increase the amount of fruit and vegetables without having to go to the shops all the time is to eat tinned, frozen, or dried fruits and vegetables.

Did you know that frozen peas are better for you than fresh peas you buy at the supermarket?

Lots of fruit and veg are as good for you - if not better - when you buy them frozen. This is because when foods are snap frozen all the nutrients are locked in. This makes it even easier to eat well.

Remember, FreshFacts is here to help you increase your fruit and vegetable intake. To stop receiving these emails please click here: [unsubscribe link]

Emily Nettle | School of Psychology, University of Sydney | +61292372000
Hi %Preferred Name%!

Lisa's TopPick

FreshFacts is all about helping young people improve their eating habits. To keep you on track we include advice and success stories from other people who've done FreshFacts before. Today's TopPick is from Lisa, 19.

"Fruit and vegetables are good for your general health. They provide you with much-needed vitamins and nutrients.

For me, the best way to make sure I eat well is to plan ahead.

I order my food online and always vary the fresh, frozen and tinned produce. That way I never end up having to eat five carrots and two apples every day just to meet my bio and five.

Having a variety makes it easy."

Did you know?

Most people don't talk about fruit and vegetables with their friends - so they often underestimate the number of people who do consume the recommended quantities of fruit and vegetables.

We surveyed healthy young adults - people just like you - as part of FreshFacts development.

More than 65% of healthy young adults eat fruit and vegetables every day.

If they can do it, you can too!

Why not try a simple recipe today?

This recipe makes one serving of pasta sauce and includes 6 servings of vegetables. That is enough for the whole day.

**FreshFacts Tomato, Mushroom, and Baby Spinach Pasta Sauce**

Take 1 cup of tomato pasta sauce (about half a jar), 1 large handful of baby spinach, 1 medium carrot (grated), and about 6 button mushrooms (allowed).

While you're cooking a serve of your favourite pasta, place the tomato based pasta sauce, mushrooms, and carrot in a saucepan. Simmer over medium heat until the mushroom and carrot are softened. Take off the heat and stir through the baby spinach. Toss through your favourite pasta, add salt and pepper to taste, and ENJOY!

This recipe is quick to prepare and tastes great. For more simple recipes why not ask some friends and family, or look around online.

Remember, Fresh Facts is here to help you increase your fruit and vegetable intake. To stop receiving these emails please click here: Unsubscribe me from this list.

Emily Kotha | School of Psychology, University of Sydney | +61290367264

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FreshFacts

Hi %Preferred Name%

Did you know?

Maintaining a healthy weight is important for all of us. While lots of diets tell you to eat less - eating more fruit and vegetables helps you manage your health no matter how much you weigh.

Fruit and vegetables are low in calories so are great for weight management and because they are high in fibre and water they help you feel fuller for longer.

If you’re worried about the sugar content of some fruits - you can eat vegetables to make up for eating less fruit.

Scott’s TopPick

FreshFacts is all about helping young people improve their eating habits. To keep you on track we include advice and success stories from other people who've done FreshFacts before. Today’s TopPick is from Scott.

“When I eat fruit and veg I feel much healthier than at other times. I used to not eat enough veggies, especially when I was busy. I used to think that eating fruit and veggies was a hassle. I always put it in the “too hard” basket.

Now I know that having it in the house is the main part - if it is there I will eat it.

It is cheap and easy to eat well. I started talking to people about fruit and veggies and now I have lots of new recipes that are quick and easy to prepare.

Eating more fruit and vegetables is easier than I thought and makes me feel great.”

Compare your lunch with a mate

Why not talk to the mate? By looking at how people around you include fruit and vegetables in their daily life you can find ways of improving your own consumption.

Next time you’re eating with a mate, have a look at how they include fruit and vegetables in their day.

Choose a healthy friend and try eating what they eat - it just might surprise you.

Remember: FreshFacts is here to help you increase your fruit and vegetable intake. To stop receiving these emails please click here: unsubscribe from the list.

Emily Kilhe | School of Psychology, University of Sydney | +61 2 9357 2336

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FreshFacts

Hi %Preferred Name%%

How much do you know about fruits and vegetables?

Do you know what foods can be included in your daily intake of fruit and vegetables? Are you a champion of fruit and vegetable trivia? Do you know what fruits and vegetables are best for preventing disease?

Test your fruit and vegetable knowledge by taking the FreshFacts challenge.

To take the challenge click here.

Kurt’s TopPick

“Being healthy is really important to me and my friends. Eating F&V is extremely important for both short and long term health.

When someone eats well it shows that they care about themselves and about their health.

That’s why I make sure to eat lots of F&V every day.”

Fruit and vegetables - the cheap alternative

There has been a lot of talk lately about the rising cost of produce, but did you know that fruit and vegetables are still cheaper than most other snacks? A mandarin is just 31 cents, and a whole weeks worth of pumpkin is less than 50 cents.

In fact, you can get a whole weeks worth of fruit and vegetables for less than $12. That is less than the price of four cups of coffee.

Fruit and vegetables really are the budget conscious choice. Remember - buying fruit and vegetables seasonally is a great way to keep costs low.

Remember, FreshFacts is here to help you increase your fruit and vegetable intake. To stop receiving these emails please click here: stop@foodfacts.me/freshfruitandveg

Emily Kofte | School of Psychology, University of Sydney | +61290367266
Hi %Preferred Name%,

Just one more serve of vegetables

Sometimes people think that adding fruit and vegetables to their day means they have to change everything about the way they eat. But it doesn’t have to be that way.

Try adding just one more serving of vegetables to your favourite recipe. You can add lettuce to your sandwich, carrot, onion, celery, or tomato paste to your pasta sauce, or some fresh greens to your stir-fry. The possibilities are endless!

If a dish already has a good already has vegetables you can start by upsizing the quantity, or by just adding a vegetable-based side to your meal.

What do health professionals think you should eat?

Scientists and health professionals around the world have worked together to create national and international guidelines for healthy eating.

In Australia, experts agree that you should enjoy a wide variety of nutritious foods, including plenty of vegetables, legumes, and fruit. Australian health professionals recommend eating at least 2 serves of fruit and 5 serves of vegetables.

Eating at least 2 serves of fruit and 5 serves of vegetables will not only help you feel healthy, it will also reduce your risk of experiencing diseases in the long term.

Lisa’s TopPick

FreshFacts is all about helping young people improve their eating habits. To keep you on track we include advice and success stories from other people who’ve done FreshFacts before. Today’s TopPick is from Sarah, 16:

“Since I started FreshFacts I’ve been eating a lot better and I’ve really noticed the difference it has made to my appearance. Eating more fruit and vegetables makes it easier to control my weight and keeps my skin clear.

Eating plenty of fruit and vegetables helps me looking and feeling my best.

Eating well has given me more energy, nicer skin, and makes me feel happier!”

Reminder: FreshFacts is here to help you increase your fruit and vegetable intake. To stop receiving these emails please click here. [Unsubscribe me from this list]

Emily Kelle | School of Psychology, University of Sydney | +61293857385
Hi %Preferred Name%!

Did you know?

These days, more and more people are worried about the sugar content of the food they eat. Some people even go so far as to avoid fruit because they are worried about eating too much sugar.

Did you know, many fruits are actually quite low in both fructose and sucrose (sugars). You can keep your overall sugar intake low while still enjoying your daily serves of fruit.

Apricots, peaches, nectarines, rockmelon, strawberries, plums, avocados, oranges, and figs all have less than 4 grams of fructose per serve.

When considering the sugar content of fruit it is especially important to think about what you'd be eating instead of the fruit, and to keep in mind that fruit contains essential vitamins, minerals, and fibre, that make them better for you than other snack options.

Using the resources you have: finding great new ways to prepare fruit and vegetables.

Many young people think that they don't know enough to cook fruit and vegetables well. Have you ever eaten a great fruit or vegetable dish that you wished you could make yourself but you didn't know how?

Next time you eat meat that you wish you could make yourself - ask how! Your friends and family are a great resource for improving your culinary skills.

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Chris's TopPick

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Emily Adelaide | School of Psychology, University of Sydney | +61290586786
Hi %%

Your fruit and vegetable plan

Eating the recommended daily intake of fruit and vegetables is not a difficult task. You can do this very easily. Successfully managing your meals so that you eat 2 servings of fruit and 5 servings of vegetables is within your control.

You can do it, so do it this week. Make a firm decision now that you will eat the recommended daily intake of fruit and vegetables each day this week.

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Take a piece of paper and write down an example of the meals you plan eat to consume the recommended daily intake of fruit and vegetables.

Irini’s TopPick

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“Eating a variety of fruit and vegetables is important to maintain optimal health. It helps me have a healthy immune system because I get all the vitamins and minerals I need.

Eating right keeps the balance of nutrients right. This keeps me from getting sick.

When I eat right I feel better, healthier, and happier.”

Did you know?

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Most young people rate fruit and vegetable consumption as important, meaningful and wise.
Hi %%Preferred Name%%

Jacks’s TopPick

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My friends and I eat fruit and veg all the time - being healthy is really important for us all.

Eating well makes sure we stay strong.”

Did you know?

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Choosing from a variety of fruits and vegetables makes storage simple, and can keep costs down.

Share your knowledge

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Now it is time to share what you know. Talk to your friends and family about fruit and vegetables - share FreshFacts messages with them or just have a chat.

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Emily Kotha | School of Psychology, University of Sydney | +61 2 9351 7266
Hi %%Preferred Name%%!

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Emily Kothe | School of Psychology, University of Sydney | +61 29367266
Appendix K

Ethics Approval

HUMAN RESEARCH ETHICS COMMITTEE
REQUEST FOR MODIFICATION

1. Principal Investigator: Barbara Mullan
   Department: School of Psychology
   Address: School of Psychology (A18), The University of Sydney NSW 2006

2. Project Title: An intervention to decrease the risk of Australian young adults: Using emerging internet technologies to increase fruit and vegetable intake.

3. HREC Approval No.: 13068

4. Names of Students/Co-Investigators: Emily Kolhe

5. Project Description:
   Please provide a one paragraph lay summary of your original project.

   Although low fruit and vegetable intake has been linked to an increased risk of cancer, heart attack, stroke, and obesity, little has been done to improve the dietary behaviours of those with the lowest rates of consumption, young adults. Where interventions have been developed they have tended to be expensive and/or have had limited reach. The goal of this project is to develop a novel approach to increasing fruit and vegetable consumption amongst this important population. By combining emerging internet technologies with current psychological theories of health behaviour change this project has the potential to result in important changes in the nutrition behaviour of a vulnerable population.

6. Any previously approved minor amendments? □ Yes  ☑ No
   If YES, please briefly outline

7. Nature of and reasons for amendment(s)
   Please provide details of the changes you propose to make to the project and explain why they are necessary. Please justify any increase in sample size.

   Nature of the proposed amendment
   1. Extension of study time period from 15 days to 30 days.
   2. Increase maximum number of email messages from 15 to 30.
   3. Increase in proposed sample from 200 to 300.
   4. Minor modifications to wording of items in the Fruit and Vegetable Beliefs Questionnaire (see

Modification Form - 26 Oct 2010

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Appendix L

Ethics Approval

ETHICS OFFICE
29 JUN 2011
DATE RECEIVED

PROJECT DETAILS
1. Chief Investigator: Barriers A Mullan
2. Faculty: Faculty of Science
3. Discipline/School: School of Psychology
4. Address: School of Psychology (A18), The University of Sydney NSW 2006
5. Email address: barbara.mullan@sydney.edu.au
6. Phone number: +61 2 9351 6611
7. HREC Approval Number: 12008
8. Project Title: An intervention to decrease the risk of adolescent young adults: Using emerging internal technologies to increase fruit and vegetable intake.

TYPE OF MODIFICATION
9. Please indicate below what type of modification you are requesting and complete the indicated sections.

☐ Addition/removal of researchers (complete sections A and E)
☐ Addition of title to HREC database (complete sections B and E)
☐ Extension of HREC approval (complete sections C and E)
☐ Other modifications (complete sections D and E)

SECTION A - ADDITION/REMOVAL OF RESEARCHERS
10. Removing Staff Member / Student / Research Assistant ☐ Yes ☐ No
If YES, provide the following (if more than one, please copy this table and attach below)

<table>
<thead>
<tr>
<th>Name</th>
<th>Title (e.g. Mr, Ms, Dr, Associate Professor)</th>
<th>Faculty</th>
<th>Discipline/Department</th>
<th>Position (e.g. lecturer, PhD student)</th>
<th>Role in the project</th>
</tr>
</thead>
</table>

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