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Randomized controlled trial of a brief research-based intervention promoting fruit and vegetable consumption

Ian Kellar[1]* and Charles Abraham[2]

[1]University of Cambridge
[2]University of Sussex, UK

Objective. The present study sought to test the efficacy of a brief research-based, leaflet-like intervention to promote eating the recommended daily intake of fruit and vegetables (RDIFV).

Design. A controlled, pre- post-test experimental study with random allocation and a 1 week self-report behavioural follow-up was conducted.

Method. The intervention employed persuasive communication targeting self-efficacy and intention, and invited participants to form implementation intentions in relation to acquiring and preparing fruit and vegetables for consumption.

Results. Intervention participants had stronger post-intervention intentions to consume the RDIFV, and higher anticipated regret in relation to failing to do so, compared with controls, controlling for pre-intervention scores. At follow-up, the intervention group was found to have eaten more fruit and vegetables and to have consumed the RDIFV more frequently.

Discussion. It is concluded that this study supports the previously reported power of implementation intentions to prompt enactment of intentions, and that a brief research-based leaflet-like intervention could result in immediate enhancement of intentions and anticipated regret, and promote greater fruit and vegetable consumption.

Research suggests that daily consumption of fruit and vegetables reduces the risk of cancer and cardiovascular diseases (Anderson, Hunt, Ford, & Finnigan, 1994; Block, Patterson, & Subar, 1992) The World Heath Organization (1990) recommends a minimum daily intake of 400 g, but only 20% of US adults (Serdula *et al.*, 1995), and only 3% of Scottish adults (Anderson *et al.*, 1994) achieve this minimum. Moreover,

*Correspondence should be addressed to Ian Kellar, General Practice and Primary Care Research Unit, University of Cambridge Institute of Public Health, Forvie Site, Robinson way, Cambridge, CB2 2SR (e-mail: IK261@medschl.cam.ac.uk).

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in the UK, a 5% decline in weekly fruit and vegetable intake was observed between 1992 and 1996 (Ministry of Agriculture, Fisheries, & Food, 1997).

National guidelines regarding the recommended daily consumption of fruit and vegetables (RDIFV) vary (Cannon, 1992), but campaigns promoting consumption of five or more pieces per day have been launched in the USA and European countries (Benito *et al.*, 1991; Brug, Debie, Vanassema, & Weijts, 1995; Netherlands Bureau for Food & Nutrition Education, 1993; United States Dept. of Agriculture, Human Nutrition Information Service, Dietary Guidelines Advisory Committee, & United States Agricultural Research Service, 1995). Despite this investment, rigorous trials of effectiveness are rare (Cox *et al.*, 1998) and results have been described as mixed. In a review, Rayner (1998) found that only 11% of interventions to have been successful in raising fruit and vegetable consumption. Cox *et al.*, suggest that this limited success may be partially due to an underlying assumption that providing information is enough to prompt behavioural change. Research in other areas of health promotion suggests that campaigns that are most effective in changing attitudes and intentions in relation to particular health behaviours are more successful than campaigns that fail to promote such cognitive antecedents (Jemmott & Jemmott, 2000). Thus, greater progress might be made if interventions designed to promote consumption of the RDIFV focused on such cognitive antecedents.

The theory of planned behaviour

The theory of planned behaviour (TPB; Ajzen, 1991) is the most widely applied model of the cognitive antecedents of specific behaviours (Ajzen, 2002). Meta analytic studies have demonstrated considerable empirical support for the model, which, on average, accounts for 27% of the variance in behaviour across studies (Armitage & Conner, 2001). The TPB proposes that behavioural intention and perceived behavioural control (PBC) are the most proximal antecedents of action.

Intention represents the motivational antecedents of behaviour and indicates how much effort a person is likely to devote to performing a behaviour (Ajzen, 1991). PBC refers to the person's appraisal of their ability to perform a behaviour, and is similar to Bandura's construct of self-efficacy (Ajzen, 1998; Bandura, 1998). The two constructs are often strongly correlated, and meta-analytic evidence indicates that both are equally strongly related to intentions and behaviour (Armitage & Conner, 2001). Both constructs are thought to enhance intention, as people are more likely to intend to do things they think they can accomplish. They may also impact on behaviour, when controlling for intention, because greater confidence leads to enhanced effort and perseverance (Bandura, 1977, 1998), and because perceived control reflects actual control (Ajzen, 1991).

At present, there is no consensus regarding the theoretical relationship between self-efficacy and PBC or their distinct operationalizations. Research has indicated that they refer to distinct sets of beliefs which have different effects on behaviour (e.g. Manstead & Van Eekelen, 1998; Sparks, Guthrie, & Shepherd, 1997; Terry & O'Leary, 1995). For example, Terry (1993) argued that perceived self-efficacy refers to internal barriers, such as a lack of skills, while PBC reflects perceptions of internal and external factors which may interfere with performance. This is consistent with Schwarzer's (1992) suggestion that self-efficacy measures are distinguished from PBC items by self-references (e.g. 'easy for *me*'). However, Sparks *et al.* distinguish between the use of particular terms, including 'ease or difficulty', measures of self-efficacy, and 'control' measures of PCB. Other researchers have regarded the two constructs as synonymous (e.g. Godin & Kok,

1996). Ajzen (1988) has acknowledged that PBC was derived from Bandura's work, and Bandura (1998) has argued that self-efficacy encompasses PBC. Arguably, self-efficacy is a more clearly defined construct than PBC (Armitage & Conner, 2001; Bandura, 1977) referring to how easy or difficult the person thinks it will be for them to perform the target behaviour successfully. Consequently, it may be easier to target self-efficacy, than PBC in interventions, however, given the current state of this literature, it may be prudent to operationalize and compare both constructs.

Intention is also determined by the person's attitude towards the behaviour and by their subjective norm (Ajzen, 1991; Fishbein & Ajzen, 1975). Attitudes refer to the person's overall evaluation of the behaviour; whereas subjective norm is based on the person's beliefs about what significant others think they should do. Thus, the TPB proposes that a more positive attitude towards a behaviour (e.g. 'eating four pieces of vegetable and one piece of fruit every day during the next week would be good'), a supportive subjective norm (e.g. 'most people who are important to me think that I should eating four pieces of vegetable and one piece of fruit every day during the next week'), and greater PBC/self-efficacy (e.g. 'for me, eating four pieces of vegetable and one piece of fruit every day during the next week would be easy'), results in a stronger behavioural intention (e.g. 'I intend to eat four pieces of vegetable and one piece of fruit every day during the next week'), which, together with high PBC/self-efficacy, determine the likelihood of that behaviour.

Ajzen (1991) has noted that the TPB could be extended if further constructs are found to enhance the prediction of intention or behaviour, and Fishbein and Ajzen (1975) acknowledge that the theory of reasoned action (and therefore the TPB) treats affect as an undifferentiated aspect of the expectancy value model of attitude. Other theorists have proposed that emotional experiences following a decision can influence motivation by changing the subjective utilities of potential outcomes (e.g. Bell, 1982; Janis & Mann, 1977; Loomes & Sugden, 1982). Loomes and Sugden, for example, highlight the effects of experiencing regret as a result of perceived discrepancies between 'what is' and 'what might have been'. Consequently, the impact of anticipated affect on decision-making may be underestimated by the model of attitudes included in the TPB (van der Pligt, Zeelenberg, van Dijk, de Vries, & Richard, 1998). Drawing upon the work of Janis and Mann (1977), Richard, van der Pligt, and de Vries (1995, 1996), and Richard, de Vries, van der Pligt (1998) have investigated the extent to which measures of anticipated affect and, in particular, anticipated regret (AR) enhance the level of prediction achieved by the TPB. Subsequent research has revealed consistent evidence that AR measures increase the capacity of the TPB to predict intentions. For example, Richard *et al.* (1998, 1995) found that AR had a significant additional effect on behavioural expectations regarding refraining from sexual intercourse and condom use. Similarly, Parker, Manstead, and Stradling (1995) found that AR enhanced the prediction of intentions to commit driving violations (e.g. cutting across other traffic). Richard *et al.* (1996) showed that AR explained additional variance in expectations regarding eating junk food, using soft drugs, and drinking alcohol, and Abraham and Sheeran (2004) found that AR helped to account for strength of exercise intentions. Consequently, it seems plausible that AR might also influence decisions regarding fruit and vegetable consumption.

The TPB has been applied to intending to, and eating, fruit and vegetables. For example, Sparks and Shepherd (1992) found that the TPB accounted for 42% of the variance in intentions to eat organic vegetables. Similarly, Brug, Lechner, and De Vries (1995) found that the theory explained 47% of the variance in intentions to eat fruit, but only 13% of the variance in intentions to eat boiled vegetables. Lien, Lytle, and Komro

(2002) found that 31% of the variance in intentions to eat more fruit and vegetables, but just 7% of the variance in frequency of fruit and vegetable consumption, was explained by the model. However, Povey *et al.* (2000) found that 57.2% of the variance in intentions to eat five portions of fruit and vegetables, and 56.7% of the variance in self-reported fruit and vegetable intake was explained by the model. Thus, while further work could clarify the predictive utility of the TPB as a model of the cognitive antecedents of fruit and vegetable consumption, available evidence suggests that the theory provides a useful and parsimonious description of key motivational antecedents of this behaviour.

Enacting intentions

Intention is a powerful cognitive determinant of behaviour. Sheeran (2002), for example, found that, across six studies of preventive health behaviour, the median percentage of non-intenders who actually undertook the target behaviour was 7%. However, intention is not a sufficient prerequisite of action. Sheeran also found that the median percentage of intenders who did not act was 47%.

Goal theory (Austin & Vancouver, 1996) may help to clarify cognitive processes that account for the ‘gap’ between intention and behaviour (Abraham & Sheeran, 2003; Sheeran & Abraham, 2003). For example, goal theorists agree that many goals entail sequences of hierarchically organized actions, so that envisaging and planning instrumental or preparatory actions (Bagozzi, 1992; Sheeran, Abraham, & Orbell, 1999) is crucial to the enactment of intentions. Eating fruit and vegetables involves acquiring them, and, at least in the case of vegetables, preparing them for consumption in everyday meals. Without such preparation it may be difficult or impossible to act on an intention to eat the RDIFV. Consequently, as well as persuading people to intend to eat the RDIFV, it seems likely that health promoters will need to facilitate planning of the preparation necessary to reach this goal.

Gollwitzer and colleagues (Gollwitzer, 1993; Gollwitzer & Brandstatter, 1997) have shown that intentions are more likely to be enacted if they are translated into ‘implementation intentions’, that specify when and where a particular action is to be undertaken (Gollwitzer & Schaal, 1998; Sheeran, 2002). Gollwitzer’s studies have shown that those who have formed implementation intentions are better able to recall presented descriptions of the means to carry out an action, more likely to identify environmental cues relevant to their planned action, and faster to initiate action in response to situational opportunities. Thus, prompting implementation intention formation in relation to preparatory actions necessary to act on an intention to eat the RDIFV, could help people to translate intentions to eat the RDIFV into goal achievement.

Verplanken and Faes (1999) provide support for the view that implementation intention formation is a prerequisite to healthy eating. Participants in the experimental condition of this study were asked to form implementation intentions by choosing a day during the next 5 days on which they would eat healthily, and by specifying a menu for that day, detailing what they would eat for breakfast, between breakfast and lunch, for lunch, between lunch and dinner, for dinner, and after dinner. They were also asked to keep an eating diary over the next 5 days. Control participants also kept an eating diary. A dietician rated the degree of healthiness of participants’ eating over the specified period and found a mean daily healthiness rating (out of 12) of 6.63 for the experimental group, compared with 5.45 for the control group, $F(1, 98) = 5.70, p < .05$. The present study sought to test the applicability of these ideas to promoting eating the RDIFV by means of a brief intervention that could be widely distributed in leaflet form.

Targeting young people

Successful promotion of RDIFV must involve changing the eating behaviour of young people, as current levels of consumption among 19- to 24-year-olds are the lowest of all adult groups (Henderson, Gregory, & Swan, 2000). In the UK, one third of 18- to 19-year-olds attend universities, and increasing efforts are being made to establish 'health-promoting universities' (Tsouros, Dowding, & Dooris, 1996). Students are in the process of establishing independent eating habits, and successful campaigns to promote eating RDIFV amongst this population, together with school-based and worksite programmes, could have population-level effects. The present study was undertaken in the context of efforts to promote a healthier campus at a UK university.

The present study

The aim of the study was to design and evaluate a brief research-based, leaflet-like intervention using a randomized trial. The intervention attempted to enhance motivation and PBC/self-efficacy in relation to eating the RDIFV using persuasive communication, and, drawing upon the work of Gollwitzer (Gollwitzer, 1999), invited participants to formulate implementation intentions in relation to acquiring fruit and vegetables and preparing meals that would enable consumption of the RDIFV.

Four hypotheses were tested: (1) an extended theory of planned behaviour, including anticipated regret, will provide a good model of the cognitive antecedents of fruit and vegetable consumption amongst students; (2) compared with (no leaflet) controls, students who received the intervention will have higher scores on intention, perceived behavioural control, self-efficacy and anticipated regret; (3) compared with controls, students who received the intervention will eat more fruit and vegetables and be more likely to eat the RDIFV; (4) behavioural differences between the control and experimental groups (specified in Hypothesis 3) will be accounted for by differences in relevant cognitions (specified by Hypothesis 2).

Methods

Participants and procedure

Data were collected from first- and second-year psychology undergraduates. To ensure randomization, intervention and control booklets were placed in a single pile in an order determined by a sequence of random integers generated by a true random number generator (Haahr, 2004). The booklets from this single pile were then distributed in a lecture theatre and laboratory class, and completed under examination conditions. To reduce the risk of cross condition contamination, participants were explicitly requested not to discuss the contents of their booklet with other participants over the following week. No incentives were offered to first-year students; however, second-year students gained course credit by participating. In total, 218 people completed the booklet (115 first-year and 105 second-year students), of whom 15.6% were male and 84.4% were female. At follow-up, 146 people responded; 11.0% were male, and 89.0% were female, with an overall attrition rate of 33%. Ages at follow-up ranged from 18 to 50 years ($M = 21.39$).

Intervention, control task, and measures were piloted in undergraduate psychology classes. Participants received a booklet which included: (a) pre-intervention measures, (b) the intervention or control task, and (c) immediate post-intervention measures. Booklets began with a definition of the RDIFV as follows: 'the Recommended Daily Intake of Fruit and Vegetables (RDIFV) for adults is four serving spoons of vegetables and

one piece of fruit per day. Please take a moment to visualize what this amount is, as the following questions are specifically about this. The term RDIFV refers to the daily consumption of this particular quantity of fruit and vegetables.'

The motivational component of the intervention comprised the following persuasive messages targeting self-efficacy/ perceived behavioural control and intention:

(1) Eating the recommended daily intake of fruit and vegetables is not a difficult task. You can do this very easily. Successfully managing your diet so that you eat the RDIFV is within your control.
(2) 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.

Intervention participants were then asked to plan and record where and when they would buy their supply of fruit and vegetables for the following week. Space was provided for them to write down (a) the place of purchase, and (b) the day of purchase. Participants were also asked to plan meals that would allow them to consume the recommended daily intake of fruit and vegetables and to describe these meals under the headings, 'fruit and vegetables at lunchtime', and 'fruit and vegetables in the evening meal'.

The control task consisted of questions about the questionnaire itself (e.g. 'imagine you are talking to a friend about the experience of completing the questionnaire so far. How easy or difficult did you find it?'). The task took approximately the same time to complete as the intervention.

After completing the control or intervention task, participants completed a second set of cognition measures identical to those they completed before the intervention/ control task. These measures were introduced as follows: 'please answer the following questions. Respond as you are feeling now. Please do not feel obliged to either change or repeat your previous answers. Please do not look back at your previous answers, just respond as you are feeling now'. Observation of participants confirmed that they completed the post-intervention measures without reference to their pre-intervention responses. Follow-up behavioural measures were administered in the same context 1 week later.

Measures

Cognitions were measured on 7-point bipolar (-3 to $+3$) response scales. These were labelled '*strongly agree*, *strongly disagree*' unless otherwise stated.

Attitude towards consuming the RDIFV was measured by six items (e.g. 'for me to eat the RDIFV every day over the next week would be, *not enjoyable, enjoyable/nice*, *nasty*', and, 'it would be beneficial for me to eat the RDIFV every day over the next week'). Pre- and post-intervention Cronbach's α were .80 and .84, respectively. Norms towards consuming the RDIFV was measured by four items (e.g. 'most people who are important to me think I should eat the RDIFV every day over the next week, *strongly agree, strongly disagree'*, and, 'people I know believe that they ought to eat the RDIFV every day over the next week, *definitely no, definitely yes'*). Pre- and post-intervention alphas were .70 and .76, respectively. PBC towards consuming the RDIFV was measured by four items (e.g. 'I feel in complete control of whether or not I eat the RDIFV every day over the next week, *strongly agree*, *strongly disagree'*, and, 'how much control do you have over eating the RDIFV every day over the next week?, *absolutely no control*, *total control'*; $\alpha = .80$ and .86, respectively). Self-efficacy towards consuming the RDIFV was measured by four

items (e.g. 'for me to eat the RDIFV the every day over the next week would be, *difficult, easy*', and, 'if I wanted to, I could easily eat the RDIFV every day over the next week, *very likely, very unlikely*'; $\alpha = .88$ and .88, respectively). Intention to consume the RDIFV was measured by five items (e.g. 'I intend to eat the RDIFV every day over the next week, *definitely no, definitely yes*', and, 'I am going to eat the RDIFV every day over the next week, *definitely no, definitely yes*'; $\alpha = .90$ and .93, respectively). Anticipated regret towards consuming the RDIFV was measured by four items (e.g. 'if I did not eat the RDIFV every day over the next week I would feel regret, *definitely no, definitely yes*', and, 'if I did not eat the RDIFV every day over the next week I would feel worried, *definitely yes, definitely no*'; $\alpha = .87$ and .88, respectively).

Behaviour related to consuming the RDIFV was measured by three items: (a) 'on how many days did you eat at least one piece of fruit over the last week? (write in the number of days)'; (b) 'on how many days did you eat four or more serving spoons of vegetables (100% of the vegetables for the RDIFV) over the last week? (write in the number of days)'; and (c) 'on how many days did you eat the RDIFV (four serving spoons of vegetables and one piece of fruit) over the last week? (write in the number of days)'. These items were completed immediately prior to the intervention and at follow-up 1 week later.

Results

Sample homogeneity and randomization

MANOVAs performed on pre-intervention behaviour, $F(4, 141) = 1.02$, *ns*, and cognition measures, $F(6, 139) = .96$, *ns*, revealed no significant differences between the first- and second-year samples. There was also no differences in gender composition between the two groups, $F(1, 144) = 3.50$, *ns*, suggesting that they formed a homogeneous sample in relation to this evaluation.

MANOVA performed on pre-intervention behaviour, $F(4, 141) = 1.37$, *ns*, and cognition measures, $F(6, 139) = .06$, *ns*, revealed no significant differences between the control and experimental groups. An ANOVA performed on age, $F(1, 141) = .03$, *ns*, and chi-squared tests on gender, $\chi^2(1) = 1.26$, *ns*, and drop-out rate by condition, $\chi^2(1) = 1.77$, *ns*, revealed no significant differences, suggesting that randomization was successful. However, a MANOVA performed on study variables by drop-out status indicated a significant omnibus difference, $F(8, 209) = 2.05$, $p < .05$, and subsequent ANOVAs revealed that, disregarding experimental condition, participants who completed the follow-up questionnaire reported significantly higher pre-intervention intentions, anticipated regret, and fruit and vegetable consumption.

Modelling the cognitive antecedents of fruit and vegetable consumption

Table 1 presents the means, standard deviations, and intercorrelations for follow-up behaviour measures and post-intervention cognitions across the two conditions. Levels of consumption were well below recommended intake levels with the RDIFV being achieved, on average, on 2.7 out of 7 days. This is consistent with previous findings (Anderson *et al.*, 1994; Serdula *et al.*, 1995). Intention, self-efficacy, and attitudes measures were all significantly associated with RDIFV ($rs = .41$–$.55$), however, a somewhat lower correlation was observed for norms ($r = .21$), suggesting that fruit and vegetable consumption may be primarily influenced by attitudes, rather than normative beliefs (Trafimow, 1998). It is also interesting to note that self-efficacy appears to be a stronger correlate of RDIFV than perceived behavioural control (PBC; $rs = .54$

Table 1. Intercorrelations, means, and standard deviations

	1	2	3	4	5	6	7	8	*M*	*SD*
1. RDIF	\								4.28	2.31
2. RDIV	.41**	\							3.07	2.33
3. RDIFV	.63**	.83**	\						2.67	2.23
4. Intention	.52**	.50**	.55**	\					4.79	1.49
5. Attitude	.40**	.39**	.41**	.66**	\				5.69	1.11
6. Norms	.13	.15	.21*	.33**	.23**	\			4.38	1.19
7. PBC	.25**	.29**	.32**	.48**	.41**	.25**	\		5.41	1.28
8. Self-efficacy	.46**	.50**	.54**	.70**	.57**	.26**	.69**	\	4.87	1.52
9. Anticipated regret	.38**	.23**	.34**	.55**	.29**	.26**	.08	.25**	3.18	1.44

***p* = .01 (2-tailed) **p* = .05 (2-tailed). *N* = 146 for T3 correlations, *N* = 218 for T2 correlations. RDIF, recommended daily intake of fruit; RDIV, recommended daily intake of vegetables; RDIFV, recommended daily intake of fruit and vegetables.

and .32, respectively). Since self-efficacy and PBC were strongly correlated ($r = .69$), PBC was excluded from subsequent analyses.

To clarify relationships between post-intervention cognitions and follow-up RDIFV across the two experimental conditions, a four-step hierarchical regression was conducted. Table 2 illustrates the steps in which the variables were entered, beta weights at each step, and the proportion and the change in variance explained. Intention explained 30% of the variance in follow-up RDIFV. Self-efficacy explained an additional 3.4% variance, $F(\text{change}) = 7.25$, $p < .01$, and, unsurprisingly, from a theoretical perspective, attitude and norms did not have an independent effect on behaviour, controlling for intention. Anticipated regret did not add to the variance explained.

Table 2. Hierarchical regression of immediate post-intervention TPB variables onto follow-up recommended daily fruit and vegetable intake measure

Step	Variables entered	β	β	β	β
1	Intention	.55***	.33**	.36**	.32*
2	Self-efficacy		.29**	.30**	.31*
3	Attitudes			−.08	−.08
	Norms			.02	.02
4	Anticipated regret				.06
R^2		.30	.33	.34	.34
R^2 Change		.30***	.03**	.01	.00
Model *F*		61.66***	35.79***	18.02***	14.46***

***p* = .01 (2-tailed) **p* = .05 (2-tailed). *N* = 146 for T3 correlations, *N* = 218 for T2 correlations. RDIF, recommended daily intake of fruit; RDIV, recommended daily intake of vegetables; RDIFV, recommended daily intake of fruit and vegetables.

According to the TPB, intention is the most important antecedent of behaviour, and in this study it was the strongest correlate of follow-up RDIFV. It is interesting, therefore, to examine how other cognitive antecedents were associated with intention. Table 3 presents the results of a three-step hierarchical regression, in which intention was

Table 3. Hierarchical regression of immediate post-intervention specified TPB variables intention to consume recommended daily fruit and vegetable scale

Step	Variables entered	β	β	β
1	Self-efficacy	.70***	.46***	.43***
2	Attitudes		.37***	.31***
	Norms		.12**	.05
3	Anticipated regret			.34***
R^2		.49	.61	.71
R^2Change		.49***	.11***	.10***
Model F		210.11***	109.85***	128.49***

**p = .01 (2-tailed) *p = .05 (2-tailed). N = 146 for T3 correlations, N = 218 for T2 correlations. RDIF, recommended daily intake of fruit; RDIV, recommended daily intake of vegetables; RDIFV, recommended daily intake of fruit and vegetables.

regressed onto post-intervention self-efficacy, attitudes, norms, and anticipated regret. Self-efficacy, attitudes, and anticipated regret had significant beta weights in the final equation accounting for 71% of the variance in intention, $F(5, 212) = 128.49, p < .001$, $R^2 = .71$. Self-efficacy accounted for 49% of the variance in intention, and anticipated regret added 10% to the variance explained by attitude and self-efficacy, $F(\text{change}) = 73.22, p < .001, R^2(\text{change}) = .10$. These findings support Hypothesis 1. The TPB provides a good model of the cognitive antecedents of fruit and vegetable consumption 1 week later. Intention is the strongest predictor of RDIFV, and self-efficacy is the strongest correlate of intention endorsing the TPB as a useful source model on which to base a persuasive intervention designed to increase fruit and vegetable consumption among university students.

Cognitive differences between conditions

Univariate ANOVAs showed that there were no significant pre-intervention differences on intention, self-efficacy, attitudes, norms, or anticipated regret, between the intervention and control group (see Table 4 for means and *F*'s for intention and anticipated regret).

Intervention participants had higher post-intervention intentions to eat the RDIFV (pre-intervention $M = 4.64$, post-intervention $M = 4.95$). Post-intervention intentions were also higher in the intervention than the control group ($M = 4.95$ and 4.63, respectively). Univariate ANCOVAs were used to test the difference between post-intervention means between conditions, controlling for pre-intervention scores. Table 4 shows that the post-intervention difference for intention was significant, $F(1, 215) = 5.33$, $p < .05$. Participants in the intervention condition also showed a post-intervention increase in anticipated regret regarding failing to eat the RDIFV, and had higher regret scores than those in the control group. A univariate ANCOVA, controlling for pre-intervention anticipated regret, shows that the post-intervention difference was significant, $F(1, 215) = 4.55$, $p < .05$. No other significant differences in cognitions were observed. These findings provide partial support for Hypothesis 2. The intervention appears to have promoted intentions to eat the RDIFV and anticipated regret in relation to not eating the RDIFV, but did not have significant effects on self-efficacy.

Behaviour differences between conditions

The intervention group showed an increase in the mean number of days on which participants ate the RDIFV between pre-intervention and 1 week follow-up. Participants

Table 4. Pre- and post-intervention means on TPB components where group differences occurred, tests for pre-intervention differences, and tests for intervention success

		Cell mean by condition		*F*	
	Scale and test	Experimental	Control	Pre-test difference ANOVA	Univariate ANCOVA
RDIFV	Pre	2.63	2.39	.75	6.83**
	Post	3.03	2.28		
RDIF	Pre	4.48	4.36	.16	5.04*
	Post	4.71	3.80		
RDIV	Pre	2.88	2.94	.05	9.36**
	Post	3.31	2.80		
Intention	Pre	4.64	4.54	.24	5.33*
	Post	4.95	4.63		
Anticipated regret	Pre	3.10	3.13	.03	4.55*
	Post	3.29	3.08		

$^{**}p = .01$ (2-tailed) $^{*}p = .05$ (2-tailed). $N = 146$ for T3 correlations, $N = 218$ for T2 correlations. RDIF, recommended daily intake of fruit; RDIV, recommended daily intake of vegetables; RDIFV, recommended daily intake of fruit and vegetables.

also increased the number of days on which they ate the recommended daily intake of one piece of fruit alone and four pieces of vegetables alone. Moreover, the intervention group ate the RDIFV on more days than the control group at follow-up ($M = 3.03$, and 2.28, respectively). This difference constitutes a small to moderate effect size ($d = .34$; Faul & Erdfelder, 1992). The intervention group also ate one piece of fruit ($M = 4.71$, and 3.80), and four pieces of vegetables ($M = 3.31$, and 2.80) on more days than the control group at 1 week follow-up.

Univariate ANOVAs showed that there were no significant pre-intervention differences on any of the behaviour measures (see Table 4 for means). Univariate ANCOVAs showed that three post-intervention behaviour differences were significant when controlling for pre-intervention scores, RDIFV $F(1, 143) = 6.83$, $p < .01$; RDIF (i.e. one piece) $F(1, 143) = 5.04$, $p < .05$; RDIV (i.e. four portions of vegetables) $F(1, 143) = 9.63$, $p < .01$. Thus, the intervention was found to have successfully promoted eating more fruit and vegetables, and the RDIFV, supporting Hypothesis 3.

Is behaviour change accounted for by cognition change?

A univariate ANCOVA showed that the post-intervention difference in RDIFV between the intervention and control groups remained significant when controlling for pre-intervention RDIFV scores, and for post-intervention intention and anticipated regret scores These two additional covariates reduced the *F* score from, $F(1, 143) = 6.83$, $p < .01$, to $F(1, 141) = 5.66$, $p < .05$. The remaining significant difference suggests that the observed change in self-reported behaviour cannot be fully understood in terms of the observed changes in cognitions (i.e. in intention and anticipated regret). Something other than these cognition changes must account for the effect of the intervention on behaviour. The most plausible interpretation is that the implementation intention aspect of the intervention had an affect on behaviour over and above the impact of the motivational component on cognitions. Thus Hypothesis 4 was not supported.

Discussion

The results show that our brief leaflet-like intervention produced significant positive changes in intention to eat the RDIFV, and in anticipated regret in relation to failing to eat the RDIFV (in comparison to controls). The intervention also successfully promoted eating more fruit and vegetables and success in eating the RDIFV during 1-week follow-up. The study demonstrates the applicability of implementation intention formation to health promotion in this area, particularly in relation to the preparatory actions of acquisition and meal preparation. Our data supports the findings of Verplanken and Faes (1999), and illustrates that a similar effect size can be obtained using a less intensive and potentially cost-effective intervention. This is the first trial of a research-based leaflet-like intervention targeting eating RDIFV, and these findings suggest that further field trials should be undertaken.

The TPB was confirmed as a useful model of the cognitive antecedents of fruit and vegetable consumption, with immediate post-intervention measures explaining 34% of the variance in behaviour 1 week later. This compares favourably with the 27% of the variance that is explained, on average, across studies (Armitage & Conner, 2001). Intention was found to be the strongest predictor of behaviour, explaining 30% of the variance in RDIFV 1 week later. The TPB and anticipated regret provided a good model of intentions to eat the RDIFV, explaining 71% of the variance (compared with 38% across studies; Armitage & Conner, 2001), with anticipated regret adding an additional 10% to the prediction of intentions. These results support previous claims that it would be a useful additional construct in the TPB (Abraham & Sheeran, 2004; Richard *et al.*, 1998, 1996), and recommend use of TPB augmented with AR as a parsimonious model of the cognitive antecedents of eating the RDIFV.

The two persuasive messages included in the intervention targeted self-efficacy/PBC (e.g. 'it is not a difficult task. You can do it easily'), and intention (e.g. 'make a firm decision now'). The implementation formation tasks in relation to acquisition and meal preparation promoted rehearsal of how participants would prepare to consume the RDIFV. The intervention enhanced intentions and anticipated regret but not self-efficacy. The failure to enhance self-efficacy is surprising, because similar tasks have been found to promote self-efficacy (Bandura, 1977). For example, Stock and Cervone (1990) report that subdividing a complex task into a series of subgoals leads to higher self-efficacy at task outset and at the point of subtask completion. Further experimental work could clarify whether other persuasive messages and tasks could enhance self-efficacy in relation to eating the RDIFV. It is interesting to note that the intervention increased AR. Although AR and intention were closely related ($r = .55$), previous attempts to manipulate AR have prompted participants to think about how they would feel in the future if they did not act (Richard *et al.*, 1996). Again, further experimental work could clarify what type of persuasive communication affects intention and AR, and when these affects are related or distinct. Unfortunately, despite the impressive correlational TPB literature, the TPB has only infrequently been subjected to experimental test (Hardeman *et al.*, 2002). Consequently, there is little evidence to draw upon when considering which type of persuasive message is likely to have most impact on which cognition. Nonetheless, the simple messages developed for this intervention did successfully promote intention formation which was the strongest cognitive correlate of reported RDIFV consumption at follow-up.

Although the intervention enhanced intentions to eat RDIFV, this did not account for the intervention's affect on subsequent behaviour. It is likely, therefore, that the success

of the intervention was due to implementation intention formation in relation to the preparatory actions of acquiring fruit and vegetables (i.e. when and where I will buy them), and preparing meals with them (i.e. what will I eat at lunchtime and in the evening). The failure of intervention-induced cognition change to account for intervention-induced behaviour change has been observed in other studies (Milne, Orbell, & Sheeran, 2002). Our results highlight the importance of implementation intentions, over and above intention *per se*, and are consistent with the findings of Verplanken and Faes (1999) who found that similar implementation intention formation increased healthy eating.

Our findings support Gollwitzer's proposals (Gollwitzer 1993; Gollwitzer & Brandstatter, 1997; Prestwich, Lawton, & Conner, 2003) by emphasizing the importance of cognitive rehearsal that links intended actions to specified times and contexts. The impact of such interventions derives, not from their capacity to enhance motivation, but from their capacity to prompt intended actions in particular (rehearsed) contexts. We focused our implementation intention formation task on preparatory behaviours, rather than the action itself, as, in relation to eating, it seems unlikely that intentions to eat fruit and vegetables are undermined by other goal priorities at the point that fruit and vegetable rich meals are prepared and ready to eat. The translation of intentions into action is more likely to fail in relation to the prior tasks of shopping and meal preparation. This approach to operationalizing Gollwitzer's proposals could be relevant to other health behaviours. For example, it seems plausible that our approach may be most effective in relation to health goals that require preparatory action, while single health behaviours that need little preparation, such as breast self-examination, would benefit from implementation intentions focused on the action itself (see Orbell, Hodgkins, & Sheeran, 1997). Future experimental work could compare the effects of implementation intention formation in relation to the target behaviour (e.g. specifying when and where fruit and vegetables will be eaten), versus preparatory behaviours (e.g. specifying when and where fruit and vegetables will purchased and prepared), for a variety of health behaviours. It is possible, however, that the practical application of implementation formation interventions may require behaviour-specific adaptations.

Nonetheless, it should not be assumed that targeting intentions is irrelevant to promoting the RDIFV. It may be that beyond a particular motivational threshold implementation intentions are the most effective way to prompt action, although in practice, it will be difficult to know whether any particular target group has reached the required motivational threshold. It would be prudent, therefore, to continue to target intention formation (as well as intention enactment), especially since this can be achieved through simple persuasive messages, as indicated by the present findings.

Although the intervention led to reported behaviour change, it should be noted that the extent to which participants increased their fruit and vegetable consumption falls short of full adherence to current recommended intake levels. This suggests that there is further scope both for improving our leaflet-like intervention, and for interventions that could remove environmental barriers to fruit and vegetable consumption. For example, interventions could also target the availability and price of fruit and vegetable meals in student eating places and the price of fruit and vegetables in university shops.

The present study has some inherent limitations that warrant further investigation. First, although university students constitute a worthwhile target population for RDIFV promotion, it is unclear whether the effects observed in this sample would be replicated in younger people (e.g. in schools), or in a less well-educated (non university) sample.

Moreover, a MANOVA detected a significant difference between those who did and those who did not complete the follow-up questionnaire. Although the distribution of those who did not complete the follow-up did not differ significantly between the intervention and control groups, the overall follow-up sample appears to represent a more motivated and successful group of consumers of fruit and vegetables, than the general student population. In addition, it is worth noting that our sample was predominantly female, and too small to test for potential moderating effects of gender on intervention effect. Further trials sampling other populations are required to clarify the generalisability of our findings. Second, our study focused on initiation of behaviour change over one week. It is unclear how long lasting the observed effects would be. Although action initiation is a prerequisite to maintenance, further work is required to establish the durability of these effects, and whether they could be sustained by use of similar follow-up research-based leaflets. Third, we were limited to self-report measures of behaviour, and, while research suggests that self report measures of the psychological antecedents of diet behaviour, as well as self report measures of diet behaviours are strongly associated with biochemical markers of fruit and vegetable consumption, such as beta-carotene, glycosylated haemoglobin, plasma vitamin C, and potassium excretion (Cappuccio *et al.*, 2003; Sargeant *et al.*, 2001; Steptoe *et al.*, 2003), it would be reassuring to replicate this study using biochemical validation. Future research might also consider the use of diary measures, which may prove a more reliable account of dietary behaviour, being less prone to failures of recall. Fourth, we neglected to determine whether participants were following a non-meat diet. Vegan and vegetarian diets are associated with increased levels of fruit and vegetable intake compared with non-vegetarian diets (Haddad *et al.*, 1999; Haddad & Tanzman, 2003), and as such, participants following such a diet may respond differently to the intervention. There were no pre-intervention differences in fruit and vegetable consumption between our control and intervention group, but we were unable to compare the two conditions in relation to their vegetarian and meat-eating compositions.

These limitations, notwithstanding the present findings, have implications for theory and practice. The success of the intervention demonstrates the potential importance of applying the findings of cognitive research to the promotion of healthy eating, and supports the previously reported power of implementation intentions to prompt enactment of intentions. The study also demonstrated that a brief research-based leaflet-like intervention could result in immediate enhancement of intentions and anticipated regret, and to more frequent consumption of the RDIFV, 1 week later.

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