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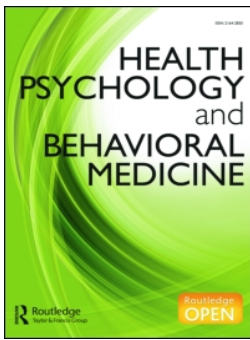
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## Utilising implementation intentions to promote healthy eating in adolescents

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### ABSTRACT

**Objectives:** This study evaluated a school-based behaviour change intervention for adolescents to address unhealthy eating habits that may otherwise “track” into adulthood. **Design:** A behaviour change intervention was conducted utilising implementation intention formation (or if-then planning) for adolescents to achieve two healthy eating goals: (1) including fruit and vegetable in each daily meal, and (2) replacing unhealthy snacks with healthy choices. **Methods:** Participants ( $N = 107$ ) aged between 16 and 18 years were randomised to intervention, active control and passive control conditions. Intervention participants formed implementation intentions for achieving the healthy eating goals; participants in the active control condition completed health-related tasks; and passive control participants read health information. Eating habits and intentions were measured at baseline and 5-month follow-up. **Results:** Findings showed that the intervention was not effective in achieving the healthy eating goals. **Conclusions:** Our findings give some indication that implementation intentions alone may not be a powerful enough means of changing eating behaviour in this age group. We reflect in detail upon the elements of the intervention that may have prevented its success in changing behaviour, for example, its failure to raise motivation, and the target of potentially unsuitable self-regulatory goals. We also discuss our findings, for example, on forming multiple plans and the role of intentions, within the context of current literature.

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### KEYWORDS

Obesity; adolescents;  
implementation intentions;  
behaviour change

## 1. Introduction

In the UK, it is estimated that by 2025, 25% of all children and adolescents under the age of 20 could be obese (McPherson, Marsh, & Brown, 2007). Conditions attributable to overweight and obesity are associated with rising healthcare costs, and it has been reported that over 50% of adults are at increased, high, or very high risk of developing extremely debilitating weight-related health conditions (NICE, 2014). Adolescence has been identified as a critical period for intervention: first, obesity levels in adolescence are an important predictor of adult obesity (Guo & Chumlea, 1999; Guo, Wu, Chumlea, & Roche, 2002) and this implies that unhealthy eating habits remain consistent over time. Second, adolescents

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are at a transitional period from childhood to independence, thus, promoting healthy eating habits at this age has the potential to be sustained into adulthood, influencing long-term health status. Given that the risk of mortality directly accrues as the duration of years lived with obesity increases (Abdullah et al., 2011), the prevention of obesity in adolescents is therefore of vital importance to prevent this “tracking” of obesity into adulthood.

A complex set of factors interact to contribute to weight gain in children and adolescents. Taking action to limit the consumption of energy-dense products and to increase consumption of foods that are low in fat and high in fibre is one such factor that is potentially modifiable and can help to maintain a healthy weight. Profiles of food consumption derived from National surveys clearly demonstrate that children and adolescents fall below recommended guidelines and are therefore at risk for failing to achieve optimal health status. The UK National Diet and Nutrition Survey (NDNS), for example, reported that children and adolescents aged 11–18 years consumed only 2.7–3.0 portions of fruit and vegetables per day; and this age group also consumed the greatest daily amounts of “sugar confectionary” and “chocolate confectionary” of all age groups (Public Health England, 2014). Such data illuminate key behavioural targets that are directly related to the risk of developing obesity (i.e. unhealthy snacking, and fruit & vegetable intake) and should be the focus of healthy eating interventions in this age group.

There are limited strategies for improving nutrition in adolescents (Fitzgerald, Heary, Nixon, & Kelly, 2010). The school setting has been recognised as a useful environment to promote health behaviours (Hawkes et al., 2015), although school-based strategies have tended to focus on either educational interventions or food policy interventions. While educational interventions to improve diet may have a limited effect on behaviour change (Gollwitzer, 1999), interventions that employ effective psychological strategies that aim to directly modify behaviour are more effective in facilitating dietary change (Contento et al., 1995). In order for adolescents to attain sustainable lifestyle changes, there is a need to explore the utility of behaviour change interventions (BCIs) that are guided by psychological theory (Foresight, 2007; NICE, 2014).

Implementation intentions (Gollwitzer, 1999) are a powerful means of translating good intentions into action (Sheeran, 2002). They are specific “if... then” plans of action that specify exactly where, when and how a behaviour will be executed in order to accomplish a particular goal. The process of forming an “if-then” plan creates an association between a specific situation and the desired behavioural response, which then leads to an automatic, swift and efficient behavioural response when the situation is encountered (Sheeran, Webb, & Gollwitzer, 2005; Webb & Sheeran, 2007, 2008). Implementation intentions have been shown to have medium-to-large effect sizes ( $d = .65$ ) in promoting intention realisation and goal attainment across a wide variety of health behaviours (Gollwitzer & Sheeran, 2006) and have successfully regulated eating behaviour in adults (e.g. Fruit and vegetable intake: De Nooijer, de Vet, Brug, & de Vries, 2006; Kellar & Abraham, 2005; Fat intake: Armitage, 2004). A meta-analysis of 23 studies (Adriaanse, Vinkers, de Ridder, Hox, & de Wit, 2010) assessing the impact of implementation intentions on eating behaviour in adults made an important distinction between interventions that aimed to increase healthy eating (i.e. adopt a new behaviour such as fruit and vegetable intake) and those that aimed to decrease unhealthy eating (i.e. change existing eating

behaviour such as unhealthy snacking). Although effective in this domain overall, the impact of implementation intentions on decreasing unhealthy eating was less strong ( $d = .29$ ) than on increasing healthy eating ( $d = .51$ ). For the construction of effective plans, Chapman, Armitage, and Norman (2009) found that an if-then format (i.e. plans that explicitly linked a situational cue with a goal-directed response compared to global plans that did not) had a stronger effect on increasing fruit and vegetable intake. To help construct implementation intentions for replacing unhealthy snacking, Adriaanse, de Ridder, and de Wit (2009) recommend pre-specifying motivational and situational cues for triggering behaviour in the “if-” part of plans. These authors also recommended that plans structured in relation to replacing an unhealthy habit (i.e. replacing an unhealthy snack with a healthy one) rather than planning what not to do (i.e. if [situation], then not [response]) would counteract the risk of ironic effects found for implementation intentions whereby such “negation” implementation intentions may ironically strengthen the situation–response link for unwanted behaviour (Adriaanse, van Oosten, de Ridder, de Wit, & Evers, 2011). To date, no study has evaluated the effect of implementation intentions on either increasing healthy eating or changing unhealthy eating behaviour in adolescents.

The use of implementation intentions as a health behaviour change strategy has been hypothesised to be particularly effective for adolescents due to the beneficial reduction in cognitive demand required, whereby cognitive resources (and therefore self-regulatory capacity) of adolescents are compromised due to ongoing changes in the brain (Blakemore & Choudhury, 2009). There is also evidence for the success of this approach with adolescents in other behavioural domains (Smoking: Conner & Higgins, 2010; and Contraceptive use: Martin, Sheeran, Slade, Wright, & Dibble, 2009, 2011). Furthermore, implementation intention formation has been highlighted as a missing element in obesity prevention interventions (British Psychological Society, 2010), and the utility of this technique for obesity prevention in adolescents warrants further investigation.

The present study evaluates a school-based BCI for adolescents aged 16–18 to achieve two related healthy eating goals: (1) including fruit and vegetable in each daily meal, and (2) replacing unhealthy snacks with healthy options. This study is novel, in that it is the first study conducted in a field setting to assess the impact of implementation intentions on the eating behaviour of an understudied age group. It is designed to provide a stringent test of implementation intentions, in that it employs both passive and active control conditions as a comparison for the intervention. Active control conditions (who receive a comparable task to intervention participants) control for demand characteristics and passive control conditions allow researchers to compare the impact of this effect, thus allowing fair comparison between groups and not exaggerating intervention effects. This design has been employed in past research with implementation intentions (e.g. Armitage, 2009) and is ethically sound scientific practice. This study also incorporates a 5-month follow-up measure, which is relatively uncommon in similar studies (Adriaanse et al., 2010, reported that only 25% of experimental studies reported follow-up periods of five months or longer). We hypothesise that participants who form implementation intentions will consume more fruit and vegetables, and fewer unhealthy snacks at follow-up compared to active and passive control conditions.

## 2. Method

### 2.1. Participants and procedure

Participants were 107 students (65.4% males), aged between 16 and 18 years ( $M = 16.70$ ,  $SD = 0.64$ ) recruited from an independent day school in Sheffield, UK. Participants in two-year classes were invited to take part in the research as part of their General Studies education. A power analysis showed that for three conditions and two lifestyle goals, a total sample size of 90 participants would be sufficient to detect a medium effect size ( $d = 0.50$ ,  $\beta = 0.80$ ,  $\alpha = 0.05$ ). Participants were individually randomly assigned to passive control ( $n = 36$ ), active control ( $n = 36$ ) or intervention ( $n = 35$ ) conditions. Figure 1 presents a CONSORT diagram of allocation of participants to conditions and flow of participants through the study. The study was conducted during regular school hours and, following the head teacher's approval of the study, written informed consent was obtained from participants to use data they provided throughout the study. If participants provided full data at both time points, they could choose to be entered into a prize draw to win one of three £30 high street shopping vouchers. Those who did not provide written consent ( $n = 20$ ) were excluded. This study was approved by a UK University Research Ethics Committee.

Participants attended an initial study session with the researchers during which the study was explained to participants, consent was collected and baseline measures were taken. The intervention (along with passive and active control tasks) for all conditions was delivered in a single session approximately two weeks after baseline data collection. Finally, at 5-month follow-up, participants attended a third session during which follow-up measures were taken.

### 2.2. Measures

Each participant recorded his/her gender and age at baseline. Unless otherwise stated, the following measures were taken at baseline and 5-month follow-up:

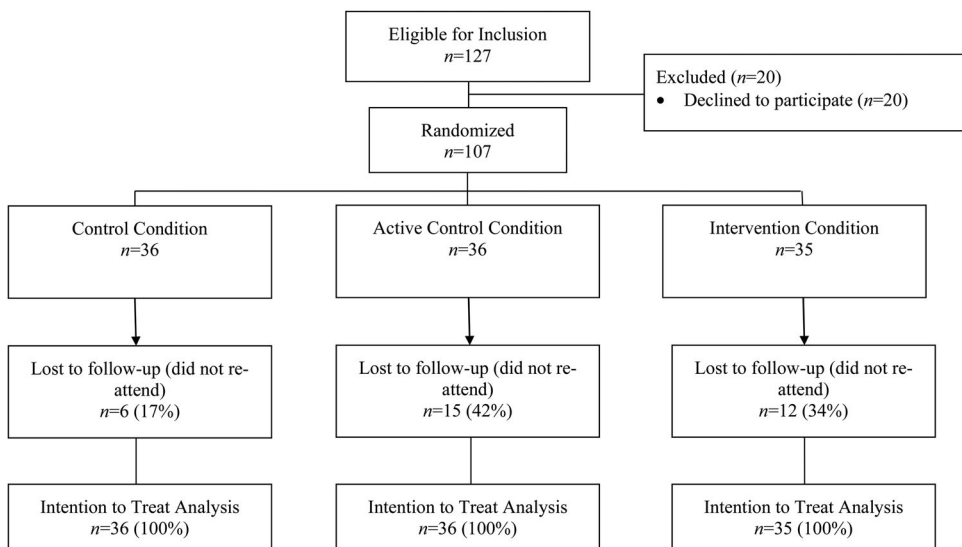


Figure 1. CONSORT flow diagram.

*Self-reported lifestyle habits and intentions.* A brief questionnaire measured self-reported weekly recall of daily fruit and vegetable consumption (“In the last week, on a typical day, how many portions of fruit and vegetables did you eat?” 7-point scale: 0–5, more than 5, this item was accompanied by a table of examples of portion sizes), and snack intake (“In the last week, on how many days did you eat snacks such as crisps, cakes or biscuits, fizzy drinks or chocolate?” 0–7). Participants were asked to rate on 7-point scale their intentions in relation to the lifestyle goals (e.g. “I intend to eat fruit and vegetables every day”).

*Nutritional knowledge.* To check participants’ knowledge about the impact of diet on health, nutritional knowledge was assessed at baseline from responses to 20 questions taken from standard tests (Parmenter & Wardle, 1999) resulting in a single knowledge score (range = 0–65).

*Body mass index (BMI).* To indicate the weight-profile of the sample, measures of height and weight were taken using portable stadiometer and electronic scales. BMI values were calculated from standardised age/gender BMI charts.

*Behaviour change intervention.* The single-intervention session took place in the school setting two weeks after baseline data collection. Participants individually completed paper-based tasks depending on their condition; all tasks were designed to be age-appropriate and look appealing. After completing tasks, participants left the room whenever they were ready. According to the taxonomy of behaviour change techniques (BCTs) for physical activity and healthy eating behaviours (CALO-RE; Michie et al., 2011), our intervention and active control conditions both included the following techniques: “Provide information on consequences of behaviour in general” and “Goal setting (behaviour)”. The intervention condition differed from the active control condition only in the inclusion of “action planning” (i.e. the formation of implementation intentions).

*Intervention condition.* The cover page of the intervention task booklet provided recommendations to lead a healthier lifestyle (“To help you lead a healthier lifestyle, it is recommended that you eat a healthy diet, including plenty of fruit and vegetables, and cutting out foods high in fat and sugar”), motivational information about why this was important (“Leading a healthy lifestyle is important because it helps to avoid long-term health conditions later in life that are linked to your habits now”), and made the following suggestion to participants:

“WHY NOT PLAN to eat healthily over the next 6 months by eating more fruit and veg, and cutting down on unhealthy snacks?”

The booklet was divided into two sections representing the lifestyle goals of this intervention: (1) “Plan to eat more fruit and vegetables every day in the next 6 months”, and (2) “Plan to snack more healthily in the next 6 months”. The participants were presented with instructions in each section, asking them to make a series of plans in relation to the healthy eating goal, for example,

“Most people know we should be eating more fruit and vegetables, but most of us still aren’t eating enough! Think about some fruits and vegetables that you like and are easily available to you. Choose from fresh, frozen, tinned, dried or juiced (and remember potatoes don’t count!)”

Participants were then asked to form implementation intentions in relation to each goal and were provided with detailed instructions for achieving this. For planning to eat fruit

and vegetables every day in the next six months, for example, participants were provided with the following instructions:

“We would like you to plan exactly HOW you will eat your choice of fruit or vegetables every day. Research has shown that planning is more effective if you first identify a situation, and then decide what you will do in that situation. For each meal you eat during the day, plan in as much detail as possible exactly where you will be, at what time, and what you will eat or drink to include fruit and vegetables. You might, for example, plan to add sliced banana to your cereal at breakfast, or include a vegetable in your evening meal.”

Participants were then provided with speech bubbles (adapted from a method used by Sheeran, Aubrey, & Kellett, 2007), and examples of how to complete them, that guided them through planning to eat fruit and vegetables at specified mealtimes (breakfast, lunch, and evening meal) in the form “IF it is (time) ... and I am (place) ... eating (meal) ... THEN I will ...”. Participants were then asked to repeat their plans aloud to themselves and visualise themselves carrying out their plans.

For snacking, participants were required to enter their choice of healthy snack if they felt like eating a snack in three pre-specified scenarios (taken from Adriaanse et al., 2009) constructed as: IF I am (1) ‘watching TV alone at home; (2) chatting with friends at school; (3) feeling bored, and I feel like eating a snack, THEN I will eat ...

Intervention questionnaires were checked for compliance with the task and all participants made the specified plans.

*Active control condition.* The active control condition was presented with a booklet that appeared to be identical to the intervention booklet, to control for demand characteristics between these conditions. The cover sheet was identical to the intervention booklet and the same two sections were also presented. Participants read the same instructions asking them to make plans to achieve the healthy eating goals; however, the content and presentation of the questionnaire then differed from the intervention booklet. Participants were asked to list fruit and vegetables they enjoyed, complete a fruit and vegetable themed word search, list healthy snacks they liked, and solve healthy snack themed anagrams.

*Passive control condition.* Participants in the passive control condition were instructed to simply read a sheet of healthy lifestyle information, taken from a UK NHS source (National Health Service Choices, 2014). This was presented as a single sheet of paper and was clearly different from intervention and active control booklets.

### 3. Results

#### 3.1. Analysis

Of the 107 participants recruited to the study, 33 (31%) participants did not complete the measures at 5-month follow-up. For these participants, missing data at follow-up were substituted for individual baseline values, assuming no change over time. “Last-observation-carried-forward” is a stringent method for dealing with missing data as it does not advantage intervention participants. This method allowed us to conduct intention-to-treat (ITT) analyses to retain power. We ran “completers” analyses with participants who provided data at both time points ( $N = 74$ ) to corroborate our ITT findings. Data analysis is presented in three stages. First, the success of randomisation to control,

active control and intervention conditions was tested. Second, attrition biases were tested (i.e. completers vs. non-completers). Third, the effect of the intervention on our outcome measures was assessed.

### 3.2. Randomisation check

We compared participants in the three conditions on the same baseline variables (age, gender, BMI, knowledge, snacking, fruit and vegetable intake, and intentions). The multivariate test on the continuous variables was not significant,  $F(14, 188) = 1.227, p = .259$ ; and no significant univariate effects were found. Chi-square tests on dichotomous variables indicated no difference between the groups for gender  $\chi^2(2, n = 103) = 0.483, p = .786$ ; and age  $\chi^2(6, n = 107) = 10.116, p = .120$ . This indicates that group randomisation was successful.

### 3.3. Representativeness check

Attrition was tested by comparing completers ( $n = 74$ ) with non-completers ( $n = 33$ ) on baseline variables. A multivariate analysis of variance was conducted to compare the groups on continuous variables (as above). The multivariate test was not significant,  $F(6, 95) = 1.463, p = .199$ . One of the univariate  $F$  ratios reached significance: intentions to increase fruit and vegetable intake:  $F(1, 105) = 6.196, p = .014$ . Completers reported significantly higher intentions to increase their fruit and vegetable intake ( $M = 5.92, SD = 1.41$ ) than participants completing baseline measures only ( $M = 5.08, SD = 1.90$ ). Chi-square tests on dichotomous variables indicated no difference between the baseline and follow-up groups on gender,  $\chi^2(1, n = 103) = 0.327, p = .568$ ; and age  $\chi^2(3, n = 107) = 5.683, p = .128$ . A chi-square test on group  $\times$  attrition also showed that there was no significant differential drop out across the conditions:  $\chi^2(2, n = 107) = 5.564, p = .62$ . Thus, the completers sample ( $n = 74$ ) adequately represents the population from which it was drawn.

### 3.4. Intervention effects

To test intervention effects, a series of 3 (intervention vs. active control vs. passive control)  $\times$  2 (baseline vs. follow up) ANCOVAs were conducted, controlling for baseline reports of each dependent variable (DV). Table 1 presents means and SDs in each condition for our DVs at baseline and follow-up.

*Fruit and vegetable intake.* A 3  $\times$  2 ANCOVA was conducted on follow-up fruit and vegetable intake across conditions, controlling for baseline intake. The corrected model was significant,  $p < .001$ , and the effect of group on follow-up F&V intake, taking baseline intake into account was significant:  $F(2, 103) = 3.90, p = .023$ . Participants in the passive control condition reported significantly higher daily fruit and vegetable intake at follow-up compared to the intervention or active control conditions. The completers analysis ( $N = 74$ ) showed that the passive control condition reported higher daily fruit and vegetable intake at follow-up (Mean F&V portions for: Intervention = 3.6, Active control = 3.9, Passive control = 4.2); however, the differences between conditions at follow-up were non-significant,  $F(3, 70) = 2.16, p = .123$ .

**Table 1.** Means and standard deviations by group for F&V and snack intake at baseline and follow-up.

	Passive control		Active control		Intervention	
	Mean	SD	Mean	SD	Mean	SD
BL F&V	3.54	1.44	3.78	1.56	3.24	1.50
FU F&V	4.11	1.39	3.72	1.49	3.28	1.50
BL Snack	4.24	2.03	4.98	1.76	5.05	2.10
FU Snack	4.42	2.10	4.80	1.80	4.91	2.11

Notes: BL, baseline; FU, follow-up; Snack, weekly snack intake; F&V, daily fruit and vegetable intake; SD, standard deviation.

*Snacking.* A  $3 \times 2$  ANCOVA was conducted on follow-up snacking intake across conditions, controlling for baseline intake. The corrected model was significant,  $p = .000$ ; however, the effect of condition on follow-up snacking intake, controlling for baseline intake was not significant:  $F(2, 103) = .065$ ,  $p = .937$ . The completers analysis ( $N = 74$ ) also showed no difference between conditions in snacking at follow-up,  $F(3, 70) = 0.03$ ,  $p = .973$ .

*Intentions.* The effect of implementation intentions relies on good intentions towards achieving a goal (Verplanken & Faes, 1999). Given the low mean ratings of intention for our DVs across conditions (intentions for: F&V = 5.61, Snacking = 4.03), we conducted further ITT analysis by categorising our intentions variable into low and high, based on the above mean values. We ran two separate  $3$  (intervention, active control, and passive control)  $\times 2$  (high vs. low intentions at baseline) ANOVAs to test whether follow-up values for each of our DVs was associated with intention strength at baseline in each condition. For F&V intake, the corrected model was significant,  $p < .001$ . Participants in all three conditions reported higher rates of F&V intake if they reported high intentions. However, the group  $\times$  intention category interaction was not significant:  $F(2, 101) = .501$ ,  $p = .607$ . Again, for snacking, the corrected model was significant,  $p = .028$ . Participants in all three conditions reported higher rates of snacking at follow-up if they reported low intentions to reduce snacking at baseline. However, the group  $\times$  intention category interaction was not significant:  $F(2, 101) = 1.97$ ,  $p = .145$ .

#### 4. Discussion

We conducted a school-based behaviour change intervention with adolescents aged 16–18 utilising implementation intention formation to achieve two healthy eating goals between baseline and 5-month follow-up. Contrary to our expectations, we found that implementation intentions were not effective in achieving the healthy eating goals. Comparison across conditions revealed that changes in fruit and vegetable intake in the passive control condition were significant between baseline and follow-up, suggesting that implementation intentions were not only ineffective in increasing consumption but also that spontaneous changes over time observed in this condition appeared to be superior in achieving the desired behaviour change. Although unhealthy snacking was reduced at follow-up in the intervention condition, the difference between groups at follow-up was not significant.

We present here a number of explanations for the failure of our intervention to change behaviour. First, in line with similar research (e.g. De Nooijer et al., 2006), our data show that participants with stronger intentions, across all conditions, were more likely to report

greater changes in their behaviour over time. Gollwitzer (1999) describes implementation intentions as being subordinate to goal intentions, and this suggests that if our participants had not formed strong intentions towards the behavioural goals specified in our intervention, it is unlikely that they would perform goal-directed behaviour regardless of study condition. In other words, for those participants who had not formed a goal intention towards the behavioural goals, forming implementation intentions may have been a redundant and inappropriate method for changing behaviour. Although motivational information (in the form of providing information on the consequences of behaviour in general) was provided in active control and intervention conditions to promote the formation of intentions, it could be that our intervention failed to increase motivation in participants and therefore the conditions under which implementation intentions are known to be more effective, were missing. In support of our findings, however, implementation intentions have been shown to change counter-intentional habits (Adriaanse et al., 2009) and in relation to fruit intake, implementation intention effects were not dependent on goal intention at baseline (De Nooijer et al., 2006). Our findings imply that, for fruit and vegetable intake, the strategies that were spontaneously employed by the passive control group (who did not receive motivational information or form implementation intentions) were more successful in increasing consumption over time, without intervention.

Second, our selected behavioural goals may have been inappropriate for achieving healthy eating in this sample. It could be that these behaviours did not represent key self-regulatory failures for healthy eating and alternative behaviours should have been selected. Our rationale for selecting snacking and fruit and vegetable intake was twofold: first, these behaviours have been shown to be particular features of adolescent diets that are problematic for healthy eating (Public Health England, 2014). Second, research demonstrates how implementation intentions can be utilised in enacting these goals under different circumstances (see for example, Adriaanse et al., 2010). Our intervention was limited, in that it was not tailored to individual self-regulatory problems in consuming a healthy diet; however, we believe that these components are important targets for BCIs, to improve diet quality in adolescents. Fruit and vegetable intake in our sample at follow-up (3.7 portions per day) was still well below recommended levels of intake for this age group (although our sample was not unusual compared to UK national averages reported in the latest NDNS: Public Health England, 2014) and our frequency data on unhealthy snacking (4.7 days per week) suggest that eating unhealthy foods is a frequent and normative behaviour in adolescents. Diets high in fat, SFA, and in excess of energy put adolescents at greater risk of chronic health problems in adulthood (Siri-Tarino, Sun, Hu, & Krauss, 2010) and the consumption of sufficient quantities of fruit and vegetables is recommended for the prevention of chronic diseases such as heart disease, cancer, diabetes, and obesity (WHO, 2004).

Third, findings from the literature regarding the effectiveness of making multiple implementation intentions on unhealthy eating habits in adults may be applicable here. It has been reported, for example, that implementation intentions are only effective in relation to the achievement of a single goal (Dalton & Spiller, 2012; Verhoeven, Adriaanse, Ridder, Vet, & Fennis, 2013). We justified the inclusion of multiple plans in our intervention based on the rationale that making plans to eat healthily requires the formation of a series of related goals, and this reflects more accurately real-life goal striving, rather than a

contrived focus on a single goal. However, according to the above findings, the formation of multiple if-then plans may have drawn our participants' attention to the difficulty in carrying out the goal and therefore undermined commitment and in turn, goal success. Specifically, forming multiple implementation intentions for reducing snacking may have been particularly ineffective in our sample, since there is already evidence that making such plans is less effective in decreasing unhealthy eating (Adriaanse et al., 2010).

There are a number of methodological limitations in the present study that are noteworthy. First, the study was conducted in only one independent school and therefore we cannot make concrete inferences about the generalisation of the results to adolescents attending other schools in other geographical areas. Our sample was also fairly lean compared to the UK national figures. There is no indication in our data; however, as discussed above, to suggest that the eating habits of our sample were any better or worse than another group of adolescents. Second, our attrition rate was moderate and there was differential attrition across groups. We attempted to make provision for this within our data handling and analysis. Third, we were unable to make detailed comparisons of diet composition between groups over time due to our limited measure of food intake. Recording food intake can be burdensome to participants, especially where eating habits are unstructured, as they are in adolescents (Livingstone, Robson, & Wallace, 2004) and food intake is commonly underreported in this age group (Vance, Woodruff, McCargar, Husted, & Hanning, 2009). It is vital that quality data are collected about food intake; therefore, future replication of this intervention may be usefully improved by utilising reliable methods of data collection for assessing eating habits. Recent studies including Technology Assisted Dietary Assessment (TADA: Khanna et al., 2010; Six et al., 2010) and "My Meal Mate" (Carter, Burley, Nykjaer, & Cade, 2012) have developed applications that show potential for use with this age group. Finally, our follow-up time period was relatively lengthy compared to similar studies (Adriaanse et al., 2010) and the positive effects of the intervention may have been diluted. One similar study (De Nooijer et al., 2006) showed a positive effect of implementation intentions on increasing fruit intakes after 1.5 weeks. The present study is limited, in that we did not take interim measures between intervention and 5-month follow-up; including this method would have given insight into the short- and long-term effects of the intervention, including fluctuations in motivation.

Despite the shortcomings of this study, our findings corroborate a number of studies conducted in the adult population that illustrate the conditions under which implementation intentions are less effective in bringing about behaviour change (e.g. de Vet, Oenema, Sheeran, & Brug, 2009; Jackson et al., 2005). Although we have discussed a number of explanations for the lack of effect, eating habits in adolescents are complex, and this intervention addressed, with one behaviour change strategy, only individual cognitive factors influencing food choice, and not wider environmental and social factors such as exposure to energy-dense foods, the increasing sedentary nature of modern lifestyles and the influence of family habits. These broader factors pose extremely significant barriers to change that require complex and multi-component interventions delivered both within and beyond the school setting. While multi-component interventions are likely to be more effective than those employing single behaviour change strategies, it is also important to guard against diluting intervention effects by including strategies that are ineffective (Martin, Chater, & Lorenzatto, 2013) and further research is needed to

elucidate the effective components and behavioural targets of BCIs for obesity prevention in adolescents.

In conclusion, adolescence is a critical period for intervention and we believe that this population is a priority group for developing effective interventions to address unhealthy eating habits that may otherwise “track” into adulthood. Implementation intentions alone may not be a powerful enough means of changing behaviour and should be combined with other effective BCTs as components of interventions that address both individual cognitive factors and broader influences on obesity-related behaviour in adolescents.

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