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Fruitful plans: Adding targeted mental imagery to implementation intentions increases fruit consumption

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Forming implementation intentions ('If I encounter situation X, then I will perform behaviour Y!') increases the probability of carrying out goals. This study tested the hypothesis that mental imagery targeting key elements of implementation intentions further increases goal achievement. The residents of a student residence were assigned the goal of consuming extra portions of fruit every day for 7 days and randomly assigned to one of four conditions: control (active rehearsal), implementation intentions, goal intention mental imagery or mental imagery targeted to the implementation intentions. Among low fruit consumers, but not high fruit consumers, fruit consumption at follow-up was higher in the targeted mental imagery group than in the other group, with the lowest fruit consumption in the control group. The findings suggest that it may be beneficial to use targeted mental imagery when forming implementation intentions.

Keywords: implementation intentions; mental imagery; goal achievement; fruit consumption; health behaviour; diet

Introduction

Despite even the best of intentions and positive attitudes, people frequently fail to attain their goals. The relationship between intentions and behaviour is modest, as intentions on average explain only 20–30% of the variance in behaviour (Gollwitzer, 1999). Various challenges such as conflicting goals, adverse self-states, and a lack of time, skills and effort can hinder goal attainment (for a review, see Gollwitzer & Sheeran, 2006). The implications of the failure to translate intentions into action have prompted a wealth of research aiming to detect remedies for the detrimental gap between intentions and behaviour. Some of this research points to the importance of effective planning of the steps necessary to turn intentions into action.

Implementation intentions

Implementation intentions, or action plans, constitute a form of planning that aims to bridge the gap between intentions and behaviour (Gollwitzer, 1993, 1999).

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Implementation intentions are 'if–then' plans that state *when*, *where* and *how* one intends to carry out a goal ('If situation Y arises, then I will perform goal-directed behaviour Z!') (Gollwitzer, 1999). This differs from the basic goal intention, which only states the desired end result (i.e., 'I intend to do X!'). For example, in order to strengthen the basic goal intention, 'I want to mail the letter', one could form the implementation intention: 'If I see the blue mailbox on my walk to school tomorrow, then I will put the letter in the mailbox'. Here, the implementation intention specifically determines the circumstances that will lead to the completion of the goal (i.e. to mail the letter) by defining *when* ('on my walk to school tomorrow'), *where* ('the blue mailbox') and *how* ('I will put the letter in the mailbox') one will act. 'If–then' plans thereby link an anticipated opportunity to act with a specific goal-directed response (Gollwitzer, 1999). A meta-analysis of 84 studies by Gollwitzer and Sheeran (2006) revealed medium–large effect sizes of implementation intention interventions on goal attainment.

Implementation intentions are hypothesised to promote goal achievement through two psychological mechanisms: (1) heightened activation of critical cues and (2) increased strength of critical cue-response links (Gollwitzer & Sheeran, 2006; Webb & Sheeran, 2008). These mechanisms are derived from both the 'if' and the 'then' components of an implementation intention. The 'if' component of an implementation intention strategically identifies a future opportunity to act and the critical cues in the anticipated environment (i.e. 'blue mailbox'). In forming an implementation intention, an individual consciously selects and elaborates on specific situational cues that will – through their increased cognitive accessibility – alert him or her to an opportunity to perform the goal-oriented behaviour. The 'then' component of the implementation intention describes the appropriate goal-directed response that should follow the 'if' cues, also known as the cue-response link (i.e., 'put the letter in the mailbox'; Gollwitzer, 1999). Specifying one's intentions in this if–then contingency format establishes a causal link between the two plan components, the critical cue and the cue-response link (Sheeran, 2002). Establishing this cue-response link leads to the planned action being executed automatically when the critical cues are encountered (e.g., Aarts & Dijksterhuis, 2000; Aarts, Dijksterhuis, & Midden, 1999; Brandstätter, Lengfelder, & Gollwitzer, 2001; Gollwitzer & Brandstätter, 1997; Webb & Sheeran, 2007). It is the increased cognitive accessibility of critical situation cues and the stronger cue-response link that have been shown to simultaneously mediate the effect of implementation intentions on behaviour (Webb & Sheeran, 2008). In sum, research has convincingly demonstrated that implementation intentions operate purely on a cognitive level and are not mediated by motivational effects (e.g. Aarts et al., 1999; Brandstätter et al., 2001; Webb & Sheeran, 2007).

Mental imagery

Mental imagery is a technique that has also been shown to increase the chances of goal-attainment (Driskell, Copper, & Moran, 1994; Pham & Taylor, 1999). In mental imagery, individuals mentally mimic perceptual, motor and emotional experiences, resulting in mental representations of the imagined objects, situations, emotions and actions in multiple sensory modalities including vision (Atance & O'Neill, 2001; Lang, 1979; Moran, 2004). Two types of mental imagery have been identified, with

varying implications for goal achievement: outcome imagery and process imagery. Outcome imagery is focussed on the experience of achieving one's goal, such as the positive feelings and benefits of successful completion and thus is primarily a motivational strategy for increasing goal achievement. For example, outcome imagery for a weight loss goal might involve focussing on how happy one will be with one's new body shape or with comfortably fitting into old clothes. In contrast, process imagery (or 'process simulation', Pham & Taylor, 1999) is focussed on the steps one must take to reach this desired outcome, such as imaging oneself taking an exercise class at the gym. In contrast to outcome imagery, process imagery is mainly a cognitive planning strategy (Escalas & Luce, 2004; Pham & Taylor, 1999; Taylor & Pham, 1999). In sum, mental imagery can have motivational as well as cognitive effects depending on what the imagery is targeting – outcome or process (e.g. Pham & Taylor, 1999).

It is thought that process imagery strengthens cognitive links between actions and outcome (Escalas & Luce, 2004), potentially because it primes and rehearses the required action, leading to vivid, cognitively accessible mental representations of relevant situational cues as well as the goal-directed behaviour (Lang, 1979; Moran, 2004; Murphy, Nordin, & Cumming, 2008). As this study is concerned with planning behaviour, the remainder of this discussion will utilise the more general term 'mental imagery' to refer exclusively to process imagery.

Research supports the finding that mental imagery increases goal achievement (e.g. Johnson & Sherman, 1990; Martin & Hall, 1995; Pham & Taylor, 1999; Stephens, 1993). A meta-analysis of 35 studies that reviewed the effects of mental imagery on performance found moderate average effect sizes with larger effects for tasks involving more cognitive components (Driskell et al., 1994).

Present research

The processes assumed to underlie the effects of both implementation intentions and of mental imagery are markedly similar: In forming an implementation intention, an individual predetermines *when*, *where* and *how* to perform the actions required to achieve a specific goal, effectively strengthening the cue-response link. Process imagery involves a similar type of planning, as the individual mentally simulates the specific steps necessary to reach the goal and forms and rehearses a concrete action plan. Surprisingly, given their striking similarities, the empirical research literatures on these two planning strategies have yet to be integrated. Taylor and Pham's (1996) paper is the sole piece of literature to suggest that these two self-regulatory strategies may facilitate goal attainment in a similar manner. The authors also empirically compared the effectiveness of implementation intentions and process imagery: Both significantly improved rates of goal completion as compared with goal intentions alone and with outcome imagery. It follows that strategically instructing individuals to mentally image the critical cues and intended action, i.e. the key elements of implementation intentions, might further increase goal achievement.

Increasing fruit intake among first-year college students in residences

Nutrition guidelines such as the 2005 Dietary Guidelines for Americans recommend two or more cups (four or more servings) of fruit per day for adults over 18 years

of age (U.S. Department of Health and Human Services, 2005). Strong, Park, Anderson, Winett, and Davy (2008) found that dietary patterns of college students generally met health recommendations, but were low in fruits, vegetables and whole grains. Chung and Hoerr (2005), for example, found average daily servings of fruits to be only 1.9 and 2.0 for male and female college students, respectively. It is likely that first-year university students in residences, adjusting to a new environment as well as the increased academic pressures of higher education, are prone to unhealthy eating habits. They are thus a worthwhile target for interventions aiming to increase fruit consumption.

A study conducted by Armitage (2007) already demonstrated that implementation intentions alone effectively increased fruit consumption among college students living in a residence. Fruit intake in the implementation intention group increased by an average of more than one portion of fruit per day measured over a 2-week period. This study examines whether an even larger increase in fruit consumption can be achieved if the implementation intentions are supplemented by targeted mental imagery. Our design contained four conditions: control (active rehearsal), implementation intentions (II), goal intention mental imagery (goal intention MI) and mental imagery targeted on the key elements of the implementation intention (II-targeted MI).[1] Students were assigned the goal to eat extra portions of fruit each day for the next 7 days. It was hypothesised that participants in the II-targeted MI condition would eat more fruit than those in the other conditions, with the lowest fruit consumption in the control condition. To test whether the experimental manipulations were mediated by the participants' motivation to eat more fruit, variables derived from Ajzen's (1991) theory of planned behaviour were assessed directly after the experimental interventions at baseline. As noted earlier, research has demonstrated that implementation intentions operate purely on a cognitive level and are effective independent of motivational effects. Furthermore, because the mental imagery in the II-targeted MI condition is targeted to the implementation intentions, which is supposed to strengthen planning (i.e. functions like process imagery), we expect this condition to operate at a purely cognitive level (i.e. like implementation intentions themselves), i.e. not to be mediated by motivation. We rather assume that the imagery further increases the cognitive accessibility of the critical cues and further strengthens the cue-response link. We assume this to be the case because of Lang's (1979) argument that rich multisensory mental imagery increases the accessibility of mental representations of stimuli and actions, a claim that has been supported by a number of empirical studies (e.g. Carroll, 1978; Johnson & Sherman, 1990). Blair, Ma and Lenton (2001) call mental imagery 'a particularly powerful method of priming because of its similarity to a real experience' (p. 829). Imaging the cue-response link should strengthen the link because imaging an action (i.e. what one will do when encountering the cues) is, according to the theory of functional equivalence (Hall, 2001), thought to be equivalent to actually performing the action. The empirical support for this equivalence hypothesis has been provided, for example, by Kosslyn, Ganis and Thompson (2001) who found that the same neural activity is observed in the brain for imaged as for actual stimuli. Thus, mentally imaging the cue-response link is like a rehearsal of the real action and should therefore enhance goal achievement beyond what forming an implementation intention alone does. By focussing the imagery on the key elements of implementation intentions, we are not just combining implementation intentions with mental imagery, but are rather trying to capitalise on the mechanisms through which

implementation intentions have been shown to exert their efficacy. Because the accessibility of the critical cues and the strength of the cue-response link have been shown to drive the efficacy of implementation intentions, we argue that targeting the mental imagery on exactly these two elements has the greatest potential to further increase the effectiveness of implementation intentions.

In contrast, given that the mental imagery in our goal intention MI condition will not be targeted specifically to the key elements of the implementation intentions but rather involves imaging the goal intention, this condition might be susceptible to motivational effects. We will thus test the prediction that the II-targeted MI condition will not be mediated by motivation, while the mental imagery in the goal intention MI condition might. Finally, Chapman, Armitage and Norman (2009) and others (e.g. Jackson et al., 2005) found that their implementation intention effects were moderated by the extent to which people ate fruit at baseline: They found larger intervention effects among low than among high fruit consumers, concluding that low fruit consumers are more responsive to interventions than individuals who already eat the prescribed amount of fruit (presumably because the latter have less room to improve and take advantage of the acquired planning strategy). We therefore predict to find stronger effects among individuals with low fruit consumption at baseline.

Method

Participants

Participants were first-year students living in a student residence of a large North American university. This residence had a cafeteria in which students ate most of their meals and where fruit was readily available. Written informed consent was obtained from participants. Ethics approval was obtained from the university's Research Ethics Board.

Procedure

Participants were recruited at a table set up at the entrance of the residence cafeteria. Students who signed up were then sent an e-mail that provided a link to the online baseline assessment (Day 1). After a demographic questionnaire, the website explained what one 'portion' of fruit constitutes and then asked participants to report how many portions of fruit they ate per day on average during the past 7 days (baseline assessment). Participants were then assigned the goal to consume extra portions of fruit every day for the next 7 days and were subsequently randomly assigned to one of the four conditions. Finally, the constructs of the theory of planned behaviour were assessed to allow testing whether the experimental manipulations had an effect on participants' *motivation* to eat more fruit. On Day 7, participants were e-mailed the link to another website, which prompted them to report their average daily fruit consumption over the past 7 days (follow-up assessment). Subsequently, the questions assessing the degree to which participants mentally imaged various aspects of the goal intention and extent to which they discussed the study with other students in the residence were asked.

Design and conditions

The experiment employed a 2 × 4 design. The factors were 'fruit consumption' (low, high) and condition (control, II, goal intention MI, II-targeted MI). At baseline (Day 1), participants in all conditions were assigned the goal to 'consume extra portions of fruit each day for the next 7 days, starting today'.

Participants randomised to the *control condition* were not provided with a plan-making strategy. They were instead only told to repeat their goal intention (to 'consume extra portions of fruit each day for the next 7 days') to themselves. We tried to equalise the number of times the goal intention and critical cues are verbalised across the four conditions by having them mentioned or repeated for a total of seven times in each condition so that participants would become equally familiar with the goal and critical cues. In the *control condition*, participants were given the goal intention (1), asked to say to themselves: 'I will consume extra portions of fruit each day for the next seven days.' (2), asked to repeat this intention two more times to themselves (4), and asked to type the intention into the spaces provided three times (for a total of 7). The instructions read: 'We would like you to consume extra portions of fruit each day for the next seven days, starting today. Please say to yourself: ''I will consume extra portions of fruit each day for the next seven days''. Please repeat this intention two more times to yourself. Then please write this intention down three times in the spaces below'.

In the *implementation intention condition* (II), participants were given the goal intention (1), were asked to say to themselves: 'I will consume extra portions of fruit each day for the next seven days'. (2), were asked to repeat this intention one more time to themselves (3), were instructed to provide concrete if–then plans for the goal intention (4), and were asked to write down three specific if–then plans by identifying critical contexts in which to carry out the goal, and how to do so in each context (7). Their instructions read: 'We would like you to consume extra portions of fruit each day for the next seven days, starting today. Please say to yourself: ''I will consume extra portions of fruit each day for the next seven days''. Please repeat this intention one more time to yourself. 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 example, you might find it useful to state: ''IF I see the orange juice bottles in the cafeteria at lunch, THEN I will take one and drink it with my lunch''. So please write in the spaces below three of such very specific plans of when and where you will obtain and then consume extra portions of fruit each day for the next seven days. Please use the ''If..., then...'' format, like in the example'.

In the *goal intention mental imagery* condition (goal intention MI), participants were given the goal intention (1), were asked to say to themselves: 'I will consume extra portions of fruit each day for the next seven days'. (2), were asked to repeat this intention one more time to themselves (3), were instructed to write this intention down three times in the spaces provided (6), were informed that mental imagery is an effective strategy to help ensure achievement of a goal, and were given mental imagery instructions in the form of the goal intention, i.e. to mentally image themselves consuming extra portions of fruit for the next 7 days (7). Their instructions read: 'We would like you to consume extra portions of fruit each day for the next seven days, starting today. Please say to yourself: ''I will consume extra portions of fruit each day for the next seven days''. Please repeat this intention one more time to yourself. Research has shown that you are more likely to actually carry

out this intention if you ''mentally image'' performing the intention in a very vivid manner! We would like you to do a mental imagery exercise in order to improve your chances of achieving the goal: Please mentally image yourself consuming extra portions of fruit each day for the next seven days. Make sure to use all of your senses in your mental imagery of this intention: Notice how the fruits or fruit juices look, feel, taste, and smell. Notice how it sounds when you bite into them or when you drink them. Really take a moment to close your eyes and image this intention'.

In the *condition in which mental imagery was targeted on the key elements of the II* (II-targeted MI), participants were given the goal intention (1), were asked to say to themselves: 'I will consume extra portions of fruit each day for the next seven days'. (2), were given the exact same instructions as in the implementation intention condition first by instructing them to provide concrete if–then plans for the goal intention (3), were instructed to write down three specific if–then plans by identifying critical contexts in which to carry out the goal, and how to do so in each context (6), and were systematically instructed to mentally image the implementation intention in the if–then format (7). That is, the mental imagery instructions in this condition focussed participants specifically on mentally imaging the critical cues (i.e. the critical cues indicating an opportunity to eat a fruit) and the cue-response link (i.e. the action of taking or eating the fruit when the critical cues are encountered). The mental imagery part of their instructions read: 'Research has shown that you are even more likely to actually carry out the intention to consume extra portions of fruit each day for the next seven days if you ''mentally image'' each of your three IF–THEN plans in a very vivid manner! We would like you to do a mental imagery exercise in order to improve your chances of achieving the goal: For each of the three IF–THEN plans you have written above, image when (e.g. time of day) and where (e.g. exact place in the cafeteria) you notice the fruit. Notice how the fruit looks like: its shape, size, and color. Image how you reach for it every time you see the fruit at this location (i.e. every day). Image how you will hold the fruit or juice in your hands, and how it looks, feels and smells in front of you. Continue to image how and where you will proceed to bite into the fruit or to drink the fruit juice, noticing how it tastes and what sound it makes. Really take a moment to close your eyes and image each of your three IF–THEN plans in this very detailed and vivid manner! Make sure to use all of your senses in your mental imagery of your IF–THEN plans'. Please note the difference between goal intention MI and II-targeted MI: The former instructs individuals to mentally image the goal intention, while the MI in the latter condition particularly targets the critical cues and cue-response link.

Measures

Baseline and follow-up fruit consumption assessment

At baseline (Day 1), participants were provided with a definition of a 'portion of fruit': *A portion of fruit is, for example, one apple, one glass of fruit juice, one banana*, 1/2 *cup of smaller fruits* (*e.g. grapes, raspberries*), 1/4 *cup of dried fruits* (*e.g. raisins, apricots*). Then, they were asked a single, open-ended item to assess their 7-day retrospective average fruit consumption adapted from Chapman et al. (2009): 'In the past seven days, how many portions of fruit have you consumed on average per day?' Participants were asked the exact same question at follow-up, 7 days later (Day 7). Concurrent validity, $r = 0.66$, $p < 0.01$, with the fruit and vegetables section of

Margetts et al.'s (1989) food frequency questionnaire has been reported by Chapman et al. for this question.

Diet restrictions

Participants were asked at baseline whether they had any diet restrictions that would limit their ability to increase their fruit consumption.

Theory of planned behaviour constructs

The following four variables were assessed with three questions each, on seven-point rating scales: Attitude ($\alpha = 0.85$) (e.g., 'What is your attitude regarding consuming extra portions of fruit each day for the next 7 days?' *Unfavourable to favourable*), behavioural intentions ($\alpha = 0.74$) ('How much do you intend to consume extra portions of fruit each day for the next 7 days?' *Not at all to very much*), perceived control ($\alpha = 0.85$) (e.g., 'How confident are you that you will be able to consume extra portions of fruit each day for the next 7 days?' *Not at all to very much*), and subjective norm ($\alpha = 0.67$) (e.g., 'Most people who are important to me would probably want me to consume extra portions of fruit'. *Strongly disagree to strongly agree*). The questions were taken from Armitage (2007), with slight modifications made to adapt the questionnaire to our study.

Extent and quality of mental imagery

Eight questions assessed the extent and nature of mental imagery that participants engaged in. These were partly adapted from the ease of imagination scale by Ellen and Bone (1991). The first four questions assessed the degree of mental imagery of the different components of the goal intention or implementation intention (cues and cue-response link): (1) To measure the extent to which participants imaged the critical cues, they were asked: 'When you were given the goal of consuming extra portions of fruit each day for seven days to what extent did you visualize the fruits you would consume?' Five response options were given: *no image at all*, *vague and dim*, *moderately clear and vivid*, *clear and reasonably vivid* and *perfectly clear*. (2) Participants were also asked to provide a rating as to what extent they mentally imaged the different SITUATIONS (stressed in capital) in which they would get or consume extra fruit, which they rated on a seven-point (1–7) scale (*minimally to very much*). (3) To measure the extent to which participants imaged the cue-response link, the next question asked about the extent to which they mentally imaged themselves PHYSICALLY reaching for the fruits and (4) eating/drinking the fruits, respectively. Both were also assessed on a seven-point scale (*not at all to very much*). The responses to these four questions were summarised to an index by summing up the scores and dividing the total by four ($\alpha = 0.72$).

To control for systematic influence of individual differences in the ability to mentally image in general, the next four items on the questionnaire asked participants to rate the vividness, detail, clarity and ease of their mental imagery. Each question allowed for ratings on a seven-point rating scale. The vividness of participants' mental imagery was assessed with the question, 'How VIVID was the mental image that you had of yourself consuming the fruits?' (*not at all vivid to very vivid*). Clarity of mental imagery was assessed with the question, 'How CLEAR

was the mental image that you had of yourself consuming the fruits?' (*not at all clear to very clear*). Detail of the mental imagery was assessed with the question, 'How DETAILED were the images that you had of yourself consuming the fruits?' (*not at all detailed to very detailed*). Finally, ease of mental imagery was assessed with the question, 'How easy or difficult was it for you to create these images?' (*extremely easy to extremely difficult*). The responses to these four questions were then summarised into an index ($\alpha = 0.73$).

Manipulation check mental imagery

Participants in the MI and the II + MI conditions were asked subsequently to the imagery instructions: 'Please check off whether you were able to image this intention (your if–then plans): yes, somewhat, no'.

Extent of discussion

At follow-up, participants were asked to what extent they discussed the study with other students in the residence: 'To which extent did you discuss this study with other students in the New Residence Hall?' (seven-point scale from *not at all to a great deal*).

Interval between baseline and follow-up

The number of days elapsed between participants' completion of the baseline and the follow-up questionnaire was recorded so that it could be statistically controlled for in the analyses. This was necessary because although we sent out the e-mail 7 days after the initial e-mail, not all participants completed the survey right away. Of participants, 71% completed the follow-up assessment within the 7-day interval, while the remainder (29%) took 8–12 days to complete it.

Results

Participants

Two-hundred and sixty-three e-mail addresses were collected. One e-mail address was not valid and therefore the study e-mail did not reach the recipient. Of the 262 students who received the e-mails, 247 completed the baseline questionnaire, for a response rate of 94.3%. Of these, 238 also completed the follow-up questionnaire, rendering a drop out rate of 3.64%.

Participants were excluded from analysis if one of the following applied to them: not following the instructions to form goal intentions or implementation intentions (as visible from what they had typed in as goal intention or implementation intention; these were one participant in the control condition, one in the II condition and one in the II + MI condition); having discussed the study with other students in the residence despite having been instructed not to do so (six participants); having diet restrictions that limited them from increasing their fruit intake (eight participants); having logged in to the study website on two different days so that we could not be sure whether they modified their initial fruit consumption report (three participants); having implausibly high values (like 15, 21, etc.) for the average daily fruit consumption (11 participants). The cutoff was set to three standard

deviations above the mean, which corresponds to 10 portions of fruit per day. Participants who reported daily fruit consumption rates larger than 10 might have misunderstood that the question referred to average daily (rather than total for the week) fruit consumption. Finally, for the two conditions containing mental imagery, only participants who reported that they had been able to mentally image the goal intention were retained in the analyses. Thirty participants (15 in each condition) who stated that they had not been able to comply were excluded. Thus, data from $N = 177$ participants were used for analysis.

These participants were on average 18.28 years old (SD = 0.72) and 67 (37.9%) were male. 71.8% described their race/ethnicity as 'White', 10.7% as 'Asian', 6.2% as South Asian, 2.8% as Hispanic, and 8.5% as 'other'.

Manipulation checks goal intention and mental imagery

All but one participant in the control condition and all participants in the MI condition wrote down the goal intention three times, as instructed. All but one participant in the II condition and all but one participant in the II-targeted MI condition wrote down three implementation intentions in if–then format, as instructed. As mentioned above, the three participants who did not follow the instructions were excluded from analysis.

Manipulation check mental imagery

Participants in the II-targeted MI condition were instructed to form implementation intentions and subsequently guided to specifically image the critical cues and the cue-response link in their implementation intentions. To check whether the manipulation was successful, we ran a univariate ANOVA on the dependent variable 'extent of mental imagery of the critical cues and cue-response link'. Results showed a significant effect of condition, $F(3, 172) = 2.64$, $p < 0.05$, $\eta_p^2 = 0.04$. A follow-up planned contrast revealed that imagery of critical cues and cue-response link was highest in the II-targeted MI condition ($M = 4.08$, SD = 1.09), and lowest in the control condition ($M = 3.46$, SD = 1.08), with the II and the goal intention MI conditions in between (II: $M = 3.80$, SD = 1.06; goal intention MI: $M = 3.77$, SD = 1.02), $F(1, 172) = 7.05$, $p < 0.009$, $\eta_p^2 = 0.04$. Thus, as expected, targeted mental imagery was highest in the II-targeted MI condition.

To test whether indeed the two conditions containing MI instructions (goal intention MI and II-targeted MI) engaged in a larger extent of MI in general, we compared the two conditions containing no mental imagery instructions (control and II) with the two that did (goal intention MI and II-targeted MI). The results showed that, as expected, participants reported a larger extent of mental imagery in the goal intention MI and II-targeted MI conditions than in the control and II conditions, $F(1, 167) = 4.35$, $p < 0.04$, $\eta_p^2 = 0.03$.

Effects of condition on fruit consumption

Figure 1a and b shows the means of fruit consumption at baseline and at follow-up separately for low and high fruit consumers. At baseline, participants were eating on

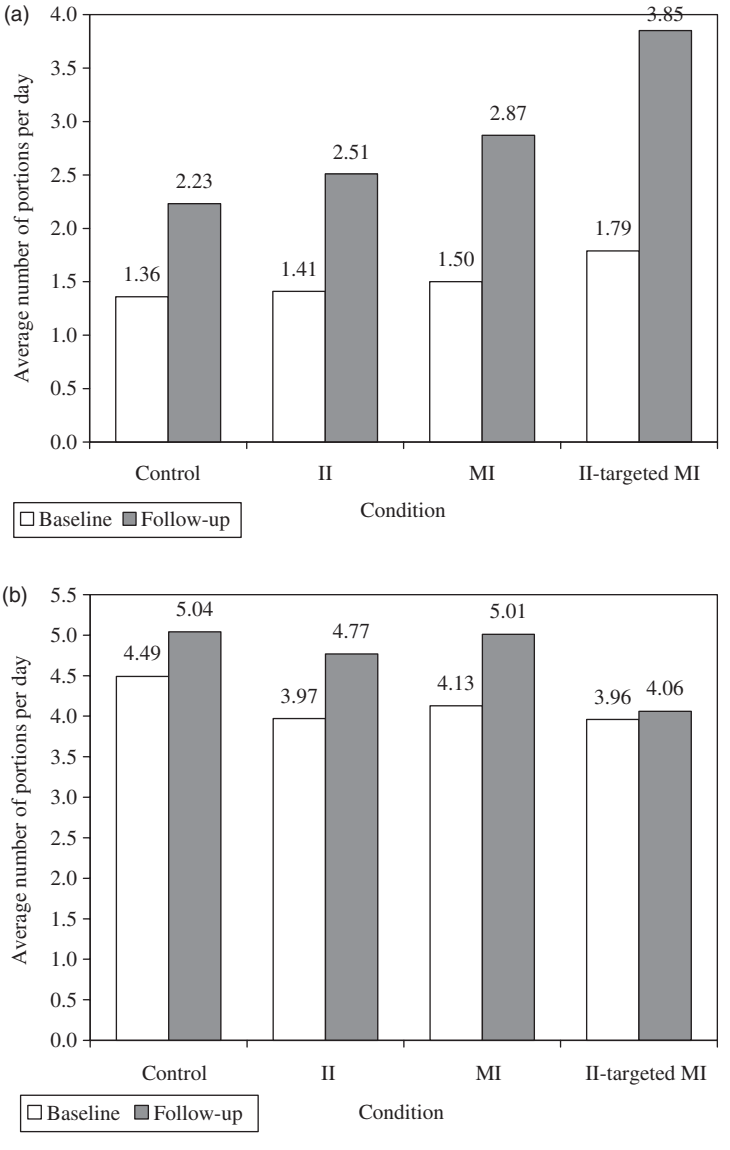

Figure 1. Average number of portions of fruits consumed per day at baseline and follow-up by condition: (a) low fruit consumers (0–2 at baseline) and (b) high fruit consumers (more than 2 at baseline).
Notes: II, implementation intentions; MI, goal intention mental imagery; II-targeted MI, mental imagery targeted to the implementation intentions.

average 2.64 portions of fruit per day (SD = 1.66). Baseline fruit consumption did not differ by condition ($F < 1$).

In all analyses below, we controlled for the length of the interval (in days) between baseline and follow-up by entering this variable as a covariate. This was controlled for to ensure that interval length could not systematically affect the follow-up fruit consumption reports about the past 7 days. Because we were

expecting that baseline fruit consumption would moderate the effectiveness of the interventions, we grouped participants into low and high fruit consumers by using a median split of fruit consumption at baseline. The median average daily fruit consumption at baseline was two portions, so the sample was divided into low fruit consumers (0–2 portions, 99 participants) and high fruit consumers (more than 2 portions, 78 participants).

The effects of the mental imagery and implementation intention interventions were tested using repeated measures analysis with baseline and follow-up fruit consumption as repeated measures within subjects factor (time) and condition (control, II, goal intention MI, II-targeted MI) and degree of fruit consumption (low vs. high) as between subjects factors. This analysis revealed a significant interaction between time, condition and fruit consumption, Pillai's $F(3, 168) = 2.62$, $p < 0.05$, $\eta_p^2 = 0.05$.

Decomposing the interaction showed that, as expected, fruit consumption at baseline moderated the effects: Fruit consumption was only significantly affected by condition among low fruit consumers, Pillai's $F(3, 94) = 2.85$, $p < 0.04$, $\eta_p^2 = 0.08$, but not among high fruit consumers, $F < 1$. Furthermore, planned contrasts show that the pattern of means for the low fruit consumers was as predicted: The participants in the control condition ate less fruit at follow-up than the participants in the II and goal intention MI conditions, and these participants ate less fruit than the participants in the II-targeted MI group, $F(1, 94) = 8.27$, $p < 0.005$, $\eta_p^2 = 0.08$. As expected, fruit consumption did not differ between the II condition and the goal intention MI condition ($F < 1$). The II-targeted MI group ate significantly more fruit than the control condition, $F(1, 94) = 7.87$, $p < 0.006$, $\eta_p^2 = 0.08$, as well as the II and goal intention MI conditions, $F(1, 94) = 1.90$, $p < 0.03$, $\eta_p^2 = 0.05$.

Effects on motivation

We tested the prediction that the II-targeted MI condition will have no effects on motivation (attitude, behavioural intentions, social norms and perceived control), while the mental imagery in the goal intention MI condition does. We ran four separate univariate ANOVAs, where the independent variable was condition and the dependent variables were participants' attitude, behavioural intentions, subjective norms and perceived control, respectively. The overall F-test was significant for attitude and for intention, $F(3, 94) = 4.10$, $p < 0.009$, $\eta_p^2 = 0.12$ and $F(3, 94) = 5.04$, $p < 0.003$, $\eta_p^2 = 0.14$. Follow-up planned contrasts revealed that participants in the goal intention MI condition had higher intentions and tended to have more positive attitudes than participants in the other three conditions (intentions: $M = 5.95$ ($SD = 0.59$) vs. $M = 5.32$ ($SD = 0.98$), $F(1, 94) = 5.92$, $p < 0.01$, $\eta_p^2 = 0.06$; attitudes: $M = 6.40$ ($SD = 0.63$) vs. $M = 5.94$ ($SD = 1.06$), $F(1, 94) = 3.10$, $p < 0.08$, $\eta_p^2 = 0.03$). It thus seems that the effects in the goal intention MI condition could partially be due to increased motivation (intention and attitude), while the effects in the other conditions might not. We conducted mediation analyses to test this possibility.

Mediation analyses

We tested for mediation only for the variables intention and attitude because no sizeable differences by condition were found for the other two motivation variables.

Table 1. Pearson correlation matrix for key variables.

	Follow-up fruit consumption	Attitude	Intention	Control	Social norms
Baseline fruit	0.59**	0.22**	0.26**	0.21**	0.06
Follow-up fruit		0.13	0.27**	0.21**	−0.02
Attitude			0.70**	0.52**	0.40**
Intention				0.61**	0.27**
Control					0.04

Note: $^{**}p < 0.01$.

Preacher and Hayes (2008) recommend the bootstrapping method as the most accurate method of obtaining confidence limits for specific indirect effects in mediation analyses. Confidence intervals (CIs) that do not include zero are significant. We used an SPSS macro designed by Preacher and Hayes (2008) that allows for statistical control of covariates. The increase in fruit consumption was the dependent variable and baseline fruit consumption was entered as covariate to control for baseline level. The results of the mediation analysis were not significant for intention. However, the results of the mediation analysis for attitude show that, as compared with the other three conditions, the follow-up fruit consumption in the goal intention MI group was partially mediated, albeit only weakly, by a more positive attitude towards the goal (95% CI for bias corrected indirect effect: 0.001, 0.435, $N = 98$, 1000 resamples, point estimate $b = 0.09$). There is thus some (weak) support for the notion that goal intention MI is partially mediated by motivation, while the other three conditions are not.

Discussion

The aim of this study was to assess if implementation intentions would lead to higher rates of goal achievement when paired with targeted mental imagery. It was hypothesised that participants who formed implementation intentions and mentally imaged their key elements (critical cues and the cue-response link) would eat more fruit than those who only formed implementation intentions or only imaged the goal intention, and that fruit consumption would be lowest in the control condition, in which participants only rehearsed the goal intention. The results showed the expected pattern for low but not high fruit consumers. The manipulation checks confirmed that the mental imagery of critical cues and cue-response links was highest in the II-targeted MI condition, suggesting that the higher fruit consumption in this group could be due to the targeted mental imagery increasing the cognitive accessibility of the critical cues and strengthening the cue response link, which, in turn, has been shown in many implementation intention studies to mediate the effects of implementation intentions on goal achievement (e.g. Webb & Sheeran, 2008).

Fruit consumption did not differ between the II and the goal intention MI conditions. Comparisons of motivation showed that participants in the goal intention MI condition had higher intentions and tended to have more positive attitudes to eat extra fruit than participants in the other conditions, and the results of mediation analyses suggest that the effects of goal intention MI might partially be

due to increased motivation. Potentially, this condition contained elements of outcome imagery (e.g. imaging how good the fruit would taste).

Like Chapman et al. (2009) this study found that the effects were moderated by the extent to which people ate fruit at baseline, as the expected pattern of results was only found among low fruit consumers. A lot of the people in the high fruit consumer group might already have been too close to the ceiling of what can be expected as achievable fruit consumption per day to benefit from the effects of implementation intentions with targeted mental imagery.

This study found only a small effect between the follow-up fruit consumption of the control condition and that of the II and goal intention MI conditions. This is surprising given the large number of applied studies, conducted in similar settings, which have found larger effects of implementation intention instructions. Specifically, Armitage (2007), upon which the paradigm of this study is partly based, demonstrated that the formation of implementation intentions led to significantly higher rates of goal achievement as compared to controls. A reason that might account for why our control condition showed relatively high increases in fruit consumption as compared with the II condition is that it contained a higher amount of goal rehearsals than in the Armitage study. While we wanted to ensure that the saliency of the goal was equivalent across all conditions so that the effects in the experimental conditions could not be explained by higher saliency of the goal, perhaps the rehearsals rendered the control condition too strong for the relative ease and simplicity of our goal – simply picking up a fruit in the cafeteria and eating it meant goal achievement, for example. The present goal did neither present many opportunities for planning, nor did it pose many challenges to overcoming self-regulatory obstacles so that implementation intention instructions could possibly not demonstrate their usual potential and forming a simple goal intention and the cognitive saliency achieved through the several rehearsals was sufficient for goal achievement (Gollwitzer, 1999; Gollwitzer & Brandstätter, 1997; Sheeran et al., 2005). Also, students in Armitage' study lived in a student residence in which they were responsible for their own food purchases and preparations, likely rendering the goal of consuming more fruits more challenging and sensitive to the effects of planning through implementation intentions.

Limitations and future research

Imagery-enriched implementation intentions may be an easy and inexpensive way to promote goal achievement. However, a portion of our participants (30 participants) stated that they were not able to follow the imagery instructions, which indicates that there are individual differences in the ability to image (which is also known from the literature) and that this may thus not be a strategy that can be used effectively by everyone.

The use of a 7-day recall instead of assessing fruit consumption daily is a potential limitation of the study. The reasons why we chose to assess fruit consumption after 7 days rather than daily are twofold. First, we feared that a daily assessment would lead all groups to become very self-conscious of their fruit consumption, resulting in ceiling effects that would then cover existing effects of the experimental manipulations. Second, we wanted to limit the participant's burden and minimise drop out (daily assessments would have required daily logs for 14 days; 7 for the

baseline assessment and 7 for the follow-up assessments). There is no reason to assume that recall or reporting biases would be different between experimental groups and we are thus less concerned that the relatively long recall interval systematically affected the results.

Furthermore, the follow-up time frame in this study was short (7 days). However, recent research (Chapman, Armitage, & Norman, 2009) has shown that the simple formation of an implementation intention lead to increased fruit and vegetable consumption that was sustained for 3 months (see also Luszczynska, 2006). Given that our manipulation consists of a strengthened form of implementation intentions (i.e. II-targeted MI), there is a reason to believe that the effects shown in this study could lead to even longer lasting behaviour change.

Overall, the present findings suggest that it may be beneficial to use targeted mental imagery when forming implementation intentions. Some past implementation intention research instructed participants to visualise themselves while enacting the implementation plan (e.g. Adriaanse, de Ridder, & de Wit, 2009; Gollwitzer & Brandstätter, 1997), suggesting that these researchers may expect imagery to enhance the effectiveness of implementation intentions. This study tested explicitly whether systematically instructing individuals to image the key elements of implementation intentions enhances the effectiveness of implementation intentions. An interesting point to consider in future research might be whether a formal use of implementation intentions (i.e. if–then format) is still necessary when providing people with targeted MI instructions.[2]

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Notes

1. Our design did not employ (1) a condition in which participants used only targeted MI and (2) a condition in which participants formed implementation intentions combined with goal intention MI. The reason for (1) is that it is inherently difficult (albeit practically possible) to operationalise a targeted MI only condition because the process of targeting critical cues and the cue-response link results in a wording that is quite similar to the II-targeted MI condition (as in both cases people have to be instructed to image the critical cues and the cue response link). Because of the similarity in the wording, we decided not to use a targeted MI only condition. The reason for (2) is that the forming of the II would have led participants to image not the goal intention but rather the II, rendering the condition equal to the II-targeted MI condition. These constraints, in our view, show how closely cognitively intertwined II and MI processes are or can be.
2. We thank an anonymous reviewer for raising this question.

References

Aarts, H., & Dijksterhuis, A. (2000). Habits as knowledge structures: Automaticity in goal-directed behavior. *Journal of Personality and Social Psychology, 78*, 53–63.

Aarts, H., Dijksterhuis, A., & Midden, C. (1999). To plan or not to plan? Goal achievement or interrupting the performance of mundane behaviors. *European Journal of Social Psychology, 29*, 971–979.

Adriaanse, M.A., de Ridder, D.T.D., & de Wit, J.B.F. (2009). Finding the critical cue: Implementation intentions to change one's diet work best when tailored to personally relevant reasons for unhealthy eating. *Personality and Social Psychology Bulletin, 35*(1), 60–71.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*, 179–211.

Armitage, C.J. (2007). Effects of an implementation intention-based intervention on fruit consumption. *Psychology and Health, 22*, 917–928.

Atance, C.M., & O'Neill, D.K. (2001). Episodic future thinking. *Trends in Cognitive Science, 5*, 533–539.

Blair, I.V., Ma, J.E., & Lenton, A.P. (2001). Imagining stereotypes away: The moderation of implicit stereotypes through mental imagery. *Journal of Personality and Social Psychology, 81(5)*, 828–841.

Brandstätter, V., Lengfelder, A., & Gollwitzer, P.M. (2001). Implementation intentions and efficient action initiation. *Journal of Personality and Social Psychology, 81*, 946–960.

Carroll, J.S. (1978). The effect of imagining an event on expectations for the event: An interpretation in terms of the availability haunstic. *Journal of Experimental Social Psychology, 14*, 88–96.

Chapman, J., Armitage, C., & Norman, P. (2009). Comparing implementation intention interventions in relation to young adults' intake of fruit and vegetables. *Psychology and Health, 24*(3), 317–332.

Chung, S.J., & Hoerr, S.L. (2005). Predictors of fruit and vegetable intakes in young adults by gender. *Nutrition Research, 25*, 453–463.

Driskell, J.E., Copper, C., & Moran, A. (1994). Does mental practice enhance performance? *Journal of Applied Psychology, 79*, 481–491.

Ellen, P.S., & Bone, P.F. (1991). Measuring communication-evoked imagery processing. *Advances in Consumer Research, 18*, 806–812.

Escalas, J.E., & Luce, M.F. (2004). Understanding the effects of process-focused vs. outcome-focused thought in response to advertising. *Journal of Consumer Research, 31*, 274–285.

Gollwitzer, P.M. (1993). Goal achievement: The role of intentions. In W. Strobe & M. Hewstone (Eds.), *European review of social psychology* (Vol. 4, pp. 141–185). Chichester: Wiley.

Gollwitzer, P.M. (1999). Implementation intentions: Strong effects of simple plans. *American Psychologist, 54*, 493–503.

Gollwitzer, P.M., & Brandstätter, V. (1997). Implementation intentions and effective goal pursuit. *Journal of Personality and Social Psychology, 73*, 186–199.

Gollwitzer, P.M., & Sheeran, P. (2006). Implementation intentions and goal achievement: A meta-analysis of effects and processes. *Advances in Experimental Social Psychology, 38*, 69–119.

Hall, C. (2001). Imagery in sport and exercise. In R.N. Singer, H. Hausenblas & C.M. Janelle (Eds), *Handbook of sport psychology* (2nd ed., pp. 529–549). New York, NY: John Wiley & Sons.

Jackson, C., Lawton, R., Knapp, P., Raynor, D.K., Conner, M., Lowe, C., et al. (2005). Beyond intention: Do specific plans increase health behaviors in patients in primary care? A study of fruit and vegetable consumption. *Social Science and Medicine, 60*, 2383–2391.

Johnson, M.K., & Sherman, S.J. (1990). Constructing and reconstructing the past and the future in the present. In E.T. Higgins & R.M. Sorrentino (Eds.), *Handbook of motivation*

and social cognition: Foundations of social behavior (pp. 482–526). New York: Guilford Press.

Kosselyn, S.M., Ganis, G., & Thompson, W.L. (2001). Neural foundations of imagery. *Nature Reviews: Neuroscience, 2*, 635–642.

Lang, P.J. (1979). A bio-informational theory of emotional imagery. *Psychophysiology, 16*, 495–512.

Luszczynska, A. (2006). Effects of an implementation intentions intervention on physical activity after MI mediated by the use of planning strategy. *Social Science and Medicine, 62*, 900–980.

Margetts, B.M., Cade, J.E., & Osmond, C. (1989). Comparison of a food frequency questionnaire with a diet record. *International Journal of Epidemiology, 18*, 868–873.

Martin, K.A., & Hall, C. (1995). Using mental imagery to enhance intrinsic motivation. *Journal of Sport and Exercise Psychology, 17*, 54–69.

Moran, A. (2004). *Sport and exercise psychology: A critical introduction*. Hove, East Sussex, UK: Routledge.

Murphy, S., Nordin, S.M., & Cumming, J. (2008). Imagery in sport, exercise and dance. In T. Horn (Ed.), *Advances in sport and exercise psychology* (3rd ed., pp. 279–324). Champagne, IL: Human Kinetics.

Pham, L.B., & Taylor, S.E. (1999). From thought to action: Effects of process-versus outcome-based mental simulations on performance. *Personality and Social Psychology Bulletin, 25*, 250–260.

Preacher, K.J., & Hayes, A.F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods, 40*, 879–891.

Sheeran, P. (2002). Intention-behaviour relations: A conceptual and empirical review. In W. Strobe & M. Hewstone (Eds.), *European review of social psychology* (Vol. 12, pp. 1–30). Chichester: Wiley.

Sheeran, P., Webb, T.L., & Golluitzer, P.M. (2005). The interplay between goal intentions and implementation intentions. *Personality and Social Psychology Bulletin, 31*, 87–98.

Stephens, R. (1993). Imagery: A strategic intervention to empower clients. Part I: A review of research literature. *Clinical Nurse Specialist, 7*, 170–174.

Strong, K.A., Park, S.L., Anderson, E., Winett, R, & Davy, B.M. (2008). Weight gain prevention: Identifying theory-based targets for health behavior change in young adults. *Journal of the American Dietetic Association, 108*(10), 1708–1715.

Taylor, S.E., & Pham, L.B. (1996). Mental simulation, motivation, and action. In P.M. Gollwitzer & J. Bargh (Eds.), *The psychology of action: Linking cognition and motivation to behavior* (pp. 219–235). New York: Guilford Press.

Taylor, S.E., & Pham, L.B. (1999). The effect of mental simulation on goal-directed performance. *Imagination, Cognition and Personality,* 18, 253–268.

U.S. Department of Health and Human Services and U.S. Department of Agriculture. (2005). *Dietary guidelines for Americans* (6th ed.). Washington: US Government Printing Office.

Webb, T.L., & Sheeran, P. (2007). How do implementation intentions promote goal attainment? A test of component processes. *Journal of Experimental Social Psychology, 43*, 295–302.

Webb, T.L., & Sheeran, P. (2008). Mechanisms of implementation intention effects: The role of goal intentions, self-efficacy, and accessibility of plan components. *British Journal of Social Psychology, 47*(3), 373–395.