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Identifying the 'if' for 'if-then' plans: Combining implementation intentions with cue-monitoring targeting unhealthy snacking behaviour

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Implementation intentions aimed at changing unwanted habits require the identification of personally relevant cues triggering the habitual response in order to be effective. To facilitate successful implementation intention formation, in the present study, planning was combined with cue-monitoring, a novel way to gain insight into triggers for unhealthy snacking. It was tested whether keeping a cue-monitoring diary and tailoring implementation intentions accordingly improves plan effectiveness. A 2 Monitoring (cue-monitoring, control) × 2 Planning (implementation intention, goal intention) between subjects design was adopted. Participants (N = 161) monitored their unhealthy snacking behaviour for a week using either a cue-monitoring or a control diary. Participants then formulated a goal intention or an implementation intention tailored to their personal cue. Snacking frequency and caloric intake from unhealthy snacks were examined using a seven-day snack diary. The results did not indicate an interaction but yielded a main effect of Monitoring. Cue-monitoring either or not combined with implementation intentions reduced unhealthy snacking behaviour compared with control. Findings emphasise the effectiveness of cue-monitoring, suggesting that on the short term, cue-monitoring suffices to decrease unhealthy snacking, without additional benefit from planning. Future research should examine whether supplementing cue-monitoring with implementation intentions is required to establish long-term behaviour change maintenance.

Keywords: implementation intentions; habits; monitoring; unhealthy snacking behaviour; behaviour change

As the prevalence of lifestyle-related diseases such as obesity, type 2 diabetes and cancer is increasing rapidly (World Health Organization [WHO], 2003a), many interventions aim to educate people about what constitutes a healthy diet and motivate them to eat more healthily (Korinth, Schiess, & Westenhoefer, 2009). Still, unhealthy food consumption, such as unhealthy snacking, continues to increase (Piernas & Popkin, 2010). One explanation for this failure to refrain from eating unhealthy foods is the finding

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that this behaviour is largely habitual (Van't Riet, Sijtsema, Dagevos, & De Bruijn, 2011; Verhoeven, Adriaanse, Evers, & De Ridder, 2012; Verplanken, 2006). Consequently, educating and motivating people to eat more healthily is essential but likely insufficient to promote behaviour change (Verplanken & Wood, 2006).

Habits are viewed as the process in which a specific context automatically generates a particular behaviour (Gardner, in press). When a behavioural action with the aim to achieve a particular goal is performed repeatedly in a stable context or in the presence of a specific cue, a mental association is created between this cue and the response. As a result, the impulse to engage in the behavioural response is induced automatically upon encountering the particular cue. This entails that the habitual behaviour is performed efficiently, unintentionally, outside of awareness and with little controllability (Aarts & Dijksterhuis, 2000; Bargh, 1994). Hence, opposing such automatic impulses is inherently difficult, even when someone adopts a strong intention to do so, for example, when he or she intends to eat more healthily (Webb & Sheeran, 2006).

A promising strategy to facilitate people in counteracting unwanted habits is the use of implementation intentions (Gollwitzer, 1999). Implementation intentions are specific if-then plans specifying in advance where, when and how to act in order to act upon one's goal intention ('If situation X arises, then I will perform behaviour Y!'; Gollwitzer, 1999). The increasing body of literature showing the effectiveness of implementation intentions is impressive (e.g. Bélanger-Gravel, Godin, & Amireault, 2013; Fennis, Adriaanse, Stroebe, & Pol, 2011; Gollwitzer & Sheeran, 2006; Webb, Sheeran, & Luszczynska, 2009), including promoting new behaviours, such as eating more fruit and vegetables (e.g. Wiedemann, Lippke, & Schwarzer, 2011) as well as changing unwanted habits (e.g. promoting recycling habits; Holland, Aarts, & Langendam, 2006). Also when aiming to change unhealthy snacking behaviour, this strategy is found to be successful (e.g. Adriaanse, De Ridder, & De Wit, 2009; Adriaanse, Vinkers, De Ridder, Hox, & De Wit, 2011; Armitage, 2004; Verplanken & Faes, 1999). A recent meta-analysis showed that implementation intentions aimed at reducing unhealthy snacking were effective, yielding a medium effect size (Cohen's d = .29; Adriaanse, Vinkers, et al., 2011). In terms of calories, studies found a decrease in daily caloric intake from unhealthy snacks of approximately 90–125 kilocalories (Adriaanse et al., 2009, 2010; Sullivan & Rothman, 2008), a change that may be considered clinically relevant (Hill, Wyatt, Reed, & Peters, 2003). These substantial effects and its simple format make implementation intentions a promising tool for health interventions targeting unhealthy snacking (Hagger & Luszczynska, 2014).

Although applying implementation intentions to change one's routines seems relatively simple, research indicates that formulating effective plans targeting counter-intentional behaviours may not be straightforward as this requires substantial insight into one's behaviour (Adriaanse et al., 2009; Hagger & Luszczynska, 2014). Specifically, when trying to change existing unwanted habits, typically, implementation intentions specify the trigger of the habitual behaviour in the 'if' part of the plan, while indicating an alternative response in the 'then' part (Adriaanse et al., 2009). For example, when aiming to change the unhealthy habit of eating chocolate when watching television, the following implementation intention could be formulated: 'If I am watching television, then I will eat an apple!' The critical cue (watching television) formerly inducing the unwanted habit (eating chocolate) will become associated with a more desirable response (eating an apple), while inhibiting the association with the unwanted

response simultaneously. As a result, the cognitive advantage of the habitual response is eliminated, providing people the opportunity to act upon their intention to eat more healthily again (Adriaanse, Gollwitzer, De Ridder, De Wit, & Kroese, 2011). Specifying the right *personally relevant critical cue* that is inducing the unwanted response is thus essential for effective implementation intentions (Adriaanse et al., 2009).

Formulating implementation intentions targeting existing habitual behaviours in general is therefore rather difficult. Aiming to change unhealthy snacking habits is however particularly complex: while most habitual behaviours are directly triggered by an apparent specific situational cue, counteracting unhealthy snacking behaviour is complex because snacking habits are induced automatically in response to a variety of different cues (Adriaanse et al., 2009; De Graaf, 2006; Verhoeven, Adriaanse, De Ridder, De Vet, & Fennis, 2013). Not only straightforward situational cues (where/when) could induce unhealthy snacking, such as a specific time of the day, also more subjective internal cues can trigger this behaviour, such as feeling bored or experiencing social pressure. When aiming to decrease unhealthy snacking, it is important to target the actual underlying reason 'why' people perform the behaviour, i.e. the 'motivational cue', in order to fight the habitual behaviour (Adriaanse et al., 2009). Specification of the personally relevant motivational cue in the 'if' part of the plan thus is required for implementation intentions to successfully compete with existing habits (Adriaanse et al., 2009).

Unfortunately, people generally have poor introspection into the reasons for their own behaviour (Nisbett & Wilson, 1977). In particular, when people are in a 'cold' reflective state, as they usually are when making plans, people often underestimate the effect of visceral states, such as hunger or emotions, on their behaviour (Loewenstein, 1996), making the specification of relevant cues rather difficult (Adriaanse et al., 2010). Moreover, in case of habitual behaviours, introspection into cues triggering the habitual response is likely to be even more problematic as habitual behaviours are inherently automatic and executed with little awareness (Bargh, 1994). Identifying cues that habitually trigger unhealthy snacking is thus a demanding challenge. However, as accurate cue specification is a necessary precondition for formulating effective plans, the complications associated with the identification of critical cues is a serious limitation to the effectiveness of implementation intentions. Indeed, research has indicated that people often experience difficulties in formulating specific implementation intentions of good quality when targeting complex behaviours (De Vet, Gebhardt, et al., 2011; De Vet, Oenema, & Brug, 2011). Correspondingly, it has been suggested that implementation intentions are more effective when formation is facilitated by a trained professional rather than left to the target users themselves (e.g. Hagger & Luszczynska, 2014).

In view of the above outlined problems, the present paper investigates whether adding a self-help strategy that may promote insight into critical cues triggering unhealthy snacking may aid the subsequent formation of implementation intentions. Based on meta-analytical evidence demonstrating that the effectiveness of health interventions significantly improves when monitoring is added to another behaviour change technique (Michie, Abraham, Witthington, McAteer, & Gupta, 2009) the present paper investigates whether combining implementation intentions with cue-monitoring may aid the effectiveness of such plans.

Different types of monitoring exist (e.g. Burke, Wang, & Sevick, 2011; Webb, Chang, & Benn, 2013). Typically, monitoring is used to examine one's goal striving

progress (Carver & Scheier, 1998), e.g. by monitoring weight or blood glucose. Monitoring may also be performed at a behavioural level. For instance, eating behaviour can be monitored by reporting the type and amount of food consumed (Burke et al., 2011). Such monitoring strategies are central in weight loss interventions and dietician's practices, and research has consistently showed its effectiveness when targeting weight loss (for a systematic review, see Burke et al., 2011). Yet, for the purpose of aiding the formation of effective implementation intentions, a novel type of monitoring was deemed more relevant; *cue-monitoring*. With cue-monitoring, we refer to closely observing unhealthy snack intake in relation to specific situational and motivational circumstances, thereby reflecting upon the critical cues triggering the unwanted responses. It was expected that cue-monitoring would enhance insight into one's personal triggers for their unhealthy snacking behaviour. Moreover, it was hypothesised that adding a cue-monitoring component prior to the formulation of if-then plans would help people to feel more capable to change one's behaviour in their unhealthy snacking situation and, most importantly, to enhance implementation intention effectiveness in reducing unhealthy snacking.

Method

Participants

Two hundred and twenty students from a university campus in the Netherlands who responded affirmatively to the question 'Would you like to eat fewer unhealthy snacks?' were recruited to participate in the study in exchange for €15 or course credit. Of these participants, 175 completed the entire study (i.e. filled out each measurement; 80%). In line with previous studies (e.g. Adriaanse et al., 2009; Verhoeven et al., 2013) participants who were underweight (N = 13, which could indicate a possible eating disorder, BMI < 18.5; WHO, 2003b) were excluded from the analyses[1] as well as one person who was an outlier on mean calories per day (>3 *SD* above the mean). This resulted in a total sample of 161 participants (62% women) with an average age of 20.86 years (*SD* = 2.93, range: 17–33) and an average BMI of 22.20 (*SD* = 2.64, range: 18.52–37.25). An overview of the correlations, mean scores and standard deviations of the variables under study can be found in Table 1.

Design

The present study adopted a 2 Monitoring (cue-monitoring, control) × 2 Planning (implementation intention, goal intention) between subjects design.

Procedure

Upon recruitment, participants were first asked to sign an informed consent form and to fill out the baseline questionnaire (T0) assessing demographic variables, intention and habit strength. Participants were then alternately assigned to one of the four conditions and received a monitoring diary corresponding to their condition (detailed below under Manipulations) as well as instructions on how to use it. In case multiple participants joined the study at once, they were provided with the same monitoring diary to preclude any suspicion as there was an evident difference in diary thickness between conditions. Participants monitored their unhealthy snacking behaviour for one week.

Table 1. Correlations, mean scores and standard deviations of variables under study.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Age T0 (1)	–													
BMI T0 (2)	.26**	–												
BMI T1 (3)	.26**	.93**	–											
BMI T2 (4)	.27**	.94**	.98**	–										
Intention T0 (5)	−.04	.18*	.21**	.21**	–									
Intention T1 (6)	.00	.14†	.18*	.17*	.60**	–								
Intention T2 (7)	.12	.29**	.31**	.31**	.54**	.67**	–							
SRHI T0 (8)	−.03	.07	.19	.11	−.01	.04	.13	–						
SRHI T1 (9)	−.00	.01	.07	.06	.05	.11	.12	.71**	–					
SRHI T2 (10)	.06	−.09	−.01	−.02	−.11	−.05	.02	.70**	.76**	–				
Insight into cues T1 (11)	.02	.06	.10	.08	.12	.29**	.18*	.12	.20*	.07	–			
Capability to change T1 (12)	−.06	.07	.05	.06	.16*	.24**	.14†	.05	.01	−.05	.56**	–		
Daily caloric intake T2 (13)	−.16*	−.06	−.02	.00	−.08	−.09	−.08	.20*	.26**	.28**	−.03	−.04	–	
Daily snacking frequency T2 (14)	−.14†	−.13	−.06	−.07	.01	−.09	−.05	.24**	.23**	.22**	−.01	−.04	.63**	–
Mean	20.86	22.20	22.22	22.15	4.84	5.19	4.98	3.66	3.90	3.79	4.24	4.27	345.80	1.67
SD	2.93	2.64	2.57	2.51	1.48	1.47	1.51	1.05	1.10	1.08	.96	1.23	225.15	.80

**Correlation is significant at the .01 level (two-tailed).
*Correlation is significant at the .05 level (two-tailed).
†Correlation is marginally significant at the .10 level (two-tailed).

After this week (T1), participants returned the diary and completed a planning exercise in accordance with their condition (see Manipulations), which was introduced as an exercise that could help them to change their unhealthy snacking behaviour. Immediately after the planning exercise, participants completed the first follow-up questionnaire assessing the same variables as in the baseline questionnaire as well as insight gained from monitoring their snacking behaviour and monitoring diary adherence. Then, all participants received a snack diary to register their unhealthy snack consumption for seven days. After this week (T2), participants handed in the snack diary and filled out the final follow-up questionnaire assessing the same variables as in the baseline questionnaire as well as snack diary adherence. After filling out the T2 questionnaire, participants were reimbursed, thanked and debriefed.

Manipulations

Monitoring manipulation

Cue-monitoring. Participants in the cue-monitoring condition received an extended version of a seven-day paper snack diary that has previously been used and has been developed in collaboration with a registered dietician (e.g. Adriaanse et al., 2009). In this diary, participants were asked to report their snack intake and to reflect upon the snacking situation and the most important reason for taking the snack. Participants were instructed to fill out the diary every time they consumed a snack, within an hour after snack consumption and could report up to six snacking occasions per day. A snack was defined as any unhealthy food consumed in between the regular meals (breakfast, lunch and dinner) containing a high amount of unhealthy ingredients such as sugar, salts and fat. Healthy snacks like fruit and vegetables were not monitored.

For each snacking occasion, participants reported (a) what snack and how much of that snack they had consumed in appropriate units (e.g. 'pieces' or 'handful') based on a list of 14 options (e.g. 'small cookie' or 'crisps'), (b) the particular situation they were in at that moment, including time and date, context (e.g. at home), activity (e.g. watching television) and company (e.g. alone) and (c) their most important reason (i.e. the motivational cue) for their snack intake based on a list of 22 different reasons (e.g. 'As a way to cope with negative emotions'). The 22 specified options were based on reasons for unhealthy snacking behaviour most often indicated in previous studies that assessed reasons for unhealthy snacking (unpublished data; Adriaanse et al., 2009, 2010) and supplemented with reasons identified in former research regarding psychological motivations to eat unhealthily (i.e. Jackson, Cooper, Mintz, & Albino, 2003). Next to internal cues, situational factors such as the time of day were also represented among the motivational cues as in some cases, these may also serve as a motivational trigger (e.g. 'the time of day, as chosen at [b]'). An option 'other' was also included. Participants were instructed to carefully think about and indicate their most important reason for each snacking episode.

Control. Similar to the cue-monitoring diary, the control diary started with instructions on how to use the diary and the definition of unhealthy snacking. However, in this diary, participants only filled out the subjective question 'How many unhealthy snacks did you eat today' on seven-point scales from 1 (*very little*) to 7 (*a lot*) at the end of the day. This question was repeated for each day in one week. The control diary was

employed to ascertain that possible effects are not due to merely reflecting on one's snack consumption (rather than reflecting on *reasons* for snacking).

Planning manipulation

Implementation intention. In the implementation intention condition, participants were informed that forming a specific if-then plan would help them to eat fewer unhealthy snacks and received elaborate step-by-step instructions to formulate a plan. Participants were told that they were first going to identify their most important snacking situation. They were instructed to take into account the monitoring process from last week and think about their most important trigger for unhealthy snacking. They were then requested to describe the situation in which they encountered this trigger (five blank lines were presented on the form) and then to describe the feelings they experienced in this situation. To aid plan formation, participants then summarised their most important trigger in three words and were instructed to write it down in an 'if' sentence (accompanied with the example 'If I am feeling bored in the evening'). Next, participants were instructed to think about a solution to deal with their snacking situation and were given examples of possible solutions. They were requested to think about their snacking situation and to describe how they could deal with their trigger for unhealthy snacking. To aid plan formation, participants summarised their solution in three words and were then instructed to write it down in a 'then' sentence (e.g. 'Then I will take an apple'). Finally, participants received a pre-printed format of an 'if-then' sentence and were instructed to fill out their complete plan accordingly. They were instructed to repeat their plan a couple of times to themselves, to imagine themselves acting out their plan (cf. Knäuper, Roseman, Johnson, & Krantz, 2009) and to write down their plan once more.

Goal intention. In the goal intention condition, participants were informed that forming a goal intention would help them to eat fewer unhealthy snacks. Participants were instructed to write down their goal intention to eat fewer unhealthy snacks and to repeat it a couple of times to themselves. A goal intention control condition is regarded a standard control condition to demonstrate the effectiveness of implementation intentions over and above formulating one's goal intention (e.g. Adriaanse, Gollwitzer, et al., 2011; Adriaanse, Vinkers, et al., 2011).

Measures

The assessed variables described in the present study are part of a larger questionnaire which can be requested from the authors.

T0 Questionnaire

Demographic variables. In order to examine the sample's demographic variables and to conduct a randomisation check, participants were requested to indicate their height and weight (to calculate BMI), age, gender and whether they had been engaged in another study on snacking behaviour recently.

Intention. To control for intention as this is an important prerequisite for implementation intention effectiveness and to determine that this would not change due to the manipulations, intention to eat fewer unhealthy snacks was assessed using three items (i.e. 'I want/plan/intend to eat fewer unhealthy snacks'), Cronbach's α = .89. Participants rated their answers on seven-point scales from 1 (*totally disagree*) to 7 (*totally agree*).

Habit strength. Habit strength was included as an alternative dependent variable. Participants were asked to fill out the 12-item Self-Report Habit Index (SRHI; Verplanken & Orbell, 2003) adapted to assess the habit to eat unhealthy snacks (e.g. 'Eating unhealthy snacks is something I do automatically'), Cronbach's α = .88. Participants rated their answers on 7-point scales from 1 (*totally disagree*) to 7 (*totally agree*).

T1 Questionnaire

Similar to T0, weight, intention (Cronbach's α = .93) and habit strength (Cronbach's α = .89) were assessed.

Insight into cues for unhealthy snacking. Insight into cues for unhealthy snacking was measured with six items, (e.g. 'It is now very clear to me what my trigger is for taking an unhealthy snack'), Cronbach's α = .79. Answers were rated on a seven-point scale from 1 (*completely disagree*) to 7 (*completely agree*).

Capability to change unhealthy snacking. Capability to change unhealthy snacking was assessed using five items (e.g. 'I feel like I now know where to begin with changing my snacking behaviour' and 'Eating unhealthy snacks is something I can change with the plan I have made'), Cronbach's α = .89. Answers were rated on a seven-point scale ranging from 1 (*completely disagree*) to 7 (*completely agree*).

Monitoring diary adherence. Participant's adherence to filling out the monitoring diary was assessed with the item 'How conscientiously did you fill out the diary?' Answers were rated on seven-point scales from 1 (*not at all conscientiously*) to 7 (*very conscientiously*).

T2 Questionnaire

Similar to T0 and T1, weight, intention (Cronbach's α = .94) and habit strength (Cronbach's α = .89) were measured.

Snack diary adherence. Snack diary adherence was measured similar to Monitoring diary adherence at T1.

Snacking behaviour

Snacking behaviour was measured with a seven-day snack diary (cf. Adriaanse et al., 2009; Verhoeven et al., 2012) in which participants filled out a snacking scheme for each snacking occasion. Two dependent variables were derived from this snack diary: *snacking frequency* represents the number of the filled out snacking schemes on average

per day. *Caloric intake* from unhealthy snacks was calculated by multiplying the number of each reported snack by the number of calories in an average portion of that snack, averaged per day. In each snacking scheme, people marked the type of snack they consumed from a list of 14 commonly consumed snacks (e.g. cookie or crisps). For each of the selected snacks, they were additionally asked to report the number of portions they consumed in appropriate units (e.g. 'pieces' for cookie and 'handful' for crisps). Participants were instructed to fill out the snack diary after snack consumption and could report up to six snacking occasions per day. Participants were instructed that if they consumed multiple snacks in one snacking situation (i.e. within 30 min), they could fill it out in the same snacking scheme. Also in this diary, a snack was defined as any unhealthy food consumed in between the regular meals containing a high amount of unhealthy ingredients. The number of calories per snack was derived from the calorie checker from the Dutch Nutrition Centre (2010).

Results

Drop-out analysis and randomisation check

To examine differences between participants who did or did not complete the study, separate analyses of variance (ANOVAs) with study completion as independent variable and age, BMI, intention to eat fewer unhealthy snacks or snack habit strength at baseline were conducted. No differences were indicated between completers and non-completers (all p's $> .36$). Separate Chi-squared tests with study completion as an independent variable and gender and recent engagement in another study on snacking behaviour as a dependent variable also indicated no differences ($p > .20$).

To analyse whether randomisation was successful, separate ANOVAs were conducted with condition as independent variable and age, BMI, intention to eat fewer unhealthy snacks and snack habit strength at baseline as dependent variables. No significant differences were found (all p's $> .21$). Separate Chi-squared analyses with gender and recent engagement in another study on snacking behaviour as a dependent variable also indicated no difference ($p > .21$). Randomisation was thus successful.

Descriptive statistics

Participants reported to be motivated to eat fewer unhealthy snacks, to have a moderately strong habit to eat unhealthy snacks and to eat on average 346 kilocalories from unhealthy snacks over 1.67 snacking occasions per day (for comparable amounts of daily caloric intake, see Adriaanse et al., 2010; Sullivan & Rothman, 2008; Verhoeven et al., 2012). See also Table 1. Participants reported high monitoring diary adherence ($M = 6.12$, $SD = .61$) and snack diary adherence ($M = 6.04$, $SD = .66$).

Participants in the cue-monitoring conditions most often indicated 'craving tasty food' (27.75% of all indicated cues) as their reason for unhealthy snacking, followed by 'enjoying a social situation' (14.73%; *gezelligheid* in Dutch). In the implementation intention conditions, participants described cues regarding, for example, craving tasty food or feeling bored in the 'if' part of the plan. Alternative behaviours in the 'then' part applied to, for instance, eating something healthy (such as a piece of fruit) or distracting oneself.

Control analyses

To examine whether the manipulations did not differentially affect participants' goal-intention, a repeated measures ANOVA was conducted with Time as a within subjects variable, Monitoring and Planning as between subjects variables and intention (T0; T1; T2) as a dependent variable. Importantly, no main effects of Monitoring or Planning and no interaction effects were found, all p's > .10. However, a main effect of Time was observed, $F(2, 314) = 5.84$, $p = .003$ and $\eta_p^2 = .04$. Simple effects analyses indicated that, compared with baseline (T0), all participants increased their intention after the monitoring phase (T1), $F(1, 160) = 11.23$, $p = .001$ and $\eta_p^2 = .07$, and decreased their intention at the final follow-up after having filled out the snack diary (T2), $F(1, 160) = 4.95$, $p < .03$ and $\eta_p^2 = 03$. See Table 1 for means and standard deviations.

Main analyses

Snacking frequency

First, the effects of Monitoring and Planning on snacking frequency were examined, using an ANOVA with Monitoring and Planning as independent variables and snacking frequency (measured at T2) as a dependent variable. The analyses revealed no main effect of Planning ($p = .71$), nor an interaction effect of Monitoring by Planning ($p = .96$). However, a significant main effect of Monitoring was found, $F(1, 157) = 7.97$, $p = .005$ and $\eta_p^2 = .05$, indicating that participants in the cue-monitoring condition reported significantly fewer unhealthy snacking situations per day ($M = 1.49$, $SD = .75$) compared with participants in the control condition ($M = 1.84$, $SD = .82$).

Caloric intake

A similar ANOVA using caloric intake from unhealthy snacks as dependent variable (measured at T2) also showed no main effect of Planning ($p = .82$), nor an interaction effect of Monitoring by Planning ($p = .35$). However, a marginally significant main effect of Monitoring was observed, $F(1, 157) = 3.47$, $p = .06$ and $\eta_p^2 = .02$, indicating that participants in the cue-monitoring condition had a marginally significant lower daily caloric intake from unhealthy snacks ($M = 312$, $SD = 202$) compared with participants in the control condition ($M = 377$, $SD = 243$).

Insight into cues

An ANOVA was conducted with Monitoring and Planning as independent variables and insight into cues (measured at T1 after the monitoring phase) as a dependent variable. The analyses indicated no main effect of Monitoring, $p = .25$ or Planning, $p = .19$. A marginally significant interaction effect of Monitoring by Planning was observed, $F(1, 157) = 3.34$, $p = .07$ and $\eta_p^2 = .02$. Simple main effect analyses were conducted to examine the interaction effect. Within the implementation intention conditions, no additional effect of Monitoring was found ($p = .62$), indicating no differences between participants in the planning conditions with or without cue-monitoring. Yet, within the goal intention conditions, a main effect of Monitoring was observed, $F(1, 79) = 4.07$, $p = .05$ and $\eta_p^2 = .05$. Within the goal intention conditions, the cue-monitoring diary condition

reported more insight into cues (M = 4.38, SD = .88) than the control diary condition (M = 3.93, SD = 1.08). Additionally, if we examine the interaction effect within the cue-monitoring conditions, no effect was found for Planning (p = .70), showing no differences in insight into cues between cue-monitoring with and without planning. Within the control diary conditions, however, a main effect of Planning was observed, $F(1, 80) = 4.36$, p = .04, η_p^2 = .05. Within the control diary conditions, participants who formulated an implementation intention showed greater insight into cues (M = 4.40, SD = .95) compared with the goal intention condition (M = 3.93, SD = 1.08). Findings indicating that keeping a cue-monitoring diary, conducting the planning exercise, or both, enhanced insight into cues for snacking.

Capability to change

An ANOVA was conducted with Monitoring and Planning as independent variables and capability to change (measured at T1 after the monitoring phase) as a dependent variable. The analyses showed no main effect of Monitoring (p = .94), yet a main effect of Planning was observed, $F(1, 157) = 6.29$, p = .01 and η_p^2 = .04, qualified by a marginally significant interaction effect of Monitoring by Planning, $F(1, 157) = 3.31$, p = .07 and η_p^2 = .02. Simple main effects indicated no main effect of Monitoring within the goal intention conditions (p = .21), indicating no differences between cue-monitoring and control monitoring within the goal intention conditions for capability to change. Also, no effect was found within the implementation intention conditions (p = .20), showing no differences between participants who preceded their implementation intention formation with cue-monitoring or control monitoring. When examining this interaction effect within the cue-monitoring conditions, also no main effect of Planning was observed (p = .62), indicating that cue-monitoring followed by an implementation intention or a goal intention did not affect the capability to change. Yet, within the control diary conditions, a main effect of Monitoring was found, $F(1, 80) = 9.10$, p = .003 and η_p^2 = .10. Within to control-monitoring condition, participants in the implementation intention condition felt more capable to change their unhealthy snacking (M = 4.70, SD = 1.30) than participants in the goal intention condition (M = 3.88, SD = 1.17).

Habit strength

A repeated measures ANOVA with Monitoring and Planning as between-subjects variables, Time as a within-subjects variable, and habit strength (T0; T1; T2) as a dependent variable indicated a main effect of Time, $F(2, 310) = 7.08$, p = .001 and η_p^2 = .04, qualified by an interaction effect of Time by Monitoring, $F(2, 310) = 4.63$, p = .01 and η_p^2 = .03 (other main or interaction effects were absent, $p > .12$). Simple effect analyses indicated a main effect of Time between T0 (baseline) and T1 (after the monitoring phase), $F(1, 157) = 13.61$, $p < .001$ and η_p^2 = .08, qualified by a Time by Monitoring interaction effect, $F(1, 157) = 6.52$, p = .01 and η_p^2 = .04. While the control diary conditions remained stable from T0 to T1 (p = .48, M = 3.77, SD = 1.07), in the cue-monitoring diary conditions, habit strength increased, $F(1, 77) = 28.10$, $p < .001$ and η_p^2 = .27, from on average 3.59 (SD = 1.04) to 3.99 (SD = 1.12). Between T1 and T2 (follow-up), no interaction effect (p = .99) but a marginally significant main effect of Time was observed, $F(1, 159) = 3.50$, p = .06 and η_p^2 = .02, suggesting that all

conditions slightly reduced their habit strength, see Table 1. An ANOVA indicated that, similar to baseline (see randomisation check), this did not result in differences between conditions at T2 (all $p > .22$).

Discussion

In the present study we examined whether cue-monitoring, a novel way to gain insight into triggers for unhealthy snacking, enhances the effectiveness of implementation intentions when fighting unhealthy snacking behaviour. Contrary to the expectations, the results showed no main effect of planning, nor an interaction effect of planning with monitoring. However, a main effect of cue-monitoring was found: people who had kept a cue-monitoring diary had a lower snacking frequency and a slightly lower caloric intake from unhealthy snacks compared with people who had kept a control diary. The findings suggest that cue-monitoring may be a helpful tool in changing unhealthy snacking behaviour.

Participants reported to have gained more insight into cues for unhealthy snacking behaviour not only after cue-monitoring, but also after implementation intention formation. It is important to note, however, that the insight questionnaire was administered after the planning manipulation, and the implementation intention exercise also instructs people to reflect upon their snacking behaviour, including their most important trigger for unhealthy snacking (for the 'if' part of the plan). In this way, participants are likely to experience improved insight into such cues to some extent, even though this is based on retrospective memory. Our questionnaire also taps into such perceived insight into cues, which, therefore, is likely to be affected by the implementation intention instructions as well. Additionally, the insight scale regarding capability to change unhealthy snacking was logically affected by making a plan to do so, which was not improved by cue-monitoring. Future research regarding cue-monitoring should therefore include measures that more accurately reflect insight gained during the monitoring phase.

Remarkably, no effects of forming implementation intentions on reducing unhealthy snacking behaviour were found. While ample research provide evidence for the effectiveness of such plans (e.g. Fennis et al., 2011; Holland et al., 2006; Webb et al., 2009; Wiedemann et al., 2011), even when fighting unhealthy snacking (Adriaanse et al., 2009), other studies did not find evidence for its effectiveness, suggesting that this strategy might as of yet not be ready to be implemented as an intervention (e.g. De Vet, Oenema, Sheeran, & Brug, 2009; Jackson et al., 2005). This observation is in accordance with our rationale outlined in the introduction, stating that making good implementation intentions to fight undesired habits may be difficult (De Vet, Gebhardt, et al., 2011; De Vet, Oenema, et al., 2011) and that successful implementation intention formation is hard to accomplish when they are self-administered without guidance (e.g. Hagger & Luszczynska, 2014).

Other possible reasons could also explain the absent main effect of implementation intentions, as well as the lack of an interaction between implementation intentions and cue-monitoring. For one, the current study adopted very strict control conditions. All participants were highly motivated to eat fewer unhealthy snacks, were encouraged to reflect upon their snacking behaviour (even participants in the control diary condition monitored their snack intake to some extent) and were instructed to formulate a strong intention to eat fewer unhealthy snacks. These control exercises might have induced

favourable behaviour change as well. To illustrate, a recent study demonstrated that daily reporting on one's unhealthy snack consumption already results in diminishing unhealthy snacking, without being instructed to do so (Maas, Hietbrink, Rinck, & Keijsers, 2013). In this way, (additional) effects of formulating implementation intentions might have been unobserved as this possibly did not exceed the effect of reflecting upon one's snacking. Secondly, participants who cue-monitored their snacking behaviour may have used the insight into the cues triggering their unhealthy snacking behaviour to formulate spontaneous plans, limiting the possibility to observe (additional) effects of our experimentally induced implementation intentions (e.g. Gollwitzer & Brandstätter, 1997). Thirdly, monitoring has consistently been found to be a powerful tool in weight loss interventions (Burke et al., 2011), as well as in an experimental study regarding snack intake (Maas et al., 2013). Possibly, the substantial effects of cue-monitoring do not further benefit from additional strategies such as planning, which in particular might explain the lack of an interaction effect. To examine these possible explanations, future research could replicate the present study, while additionally including a control group without any form of monitoring. Additionally, a measure for spontaneous planning could be included to examine this possibility (see e.g. Brickell & Chatzisarantis, 2007).

Notwithstanding the absence of an interaction effect, it remains to be examined whether merely cue-monitoring continues to be sufficient when aiming to achieve long-term effects. While awareness, knowledge and motivation – which are expectedly influenced by cue-monitoring – are usually essential but insufficient to establish behaviour change, creating new automatic behaviours and desired habits might be more promising to ascertain behaviour change maintenance (Verplanken & Wood, 2006). Cue-monitoring is not expected to facilitate the development of favourable automatic habitual behaviours. Indeed, the findings from the present study indicate that people who had kept a cue-monitoring diary, at follow up did not differ in their snack habit strength compared with people who did not cue-monitor. In fact, the only difference observed was an increase in habit strength in the cue-monitoring conditions after the monitoring phase. This finding, however, is likely to be a result of increased awareness, rather than an actual increase in habitualness. By reflecting upon their behaviour during the snacking occasion, participants likely became more conscious about their snacking behaviour and hence reported a higher score on the self-report measure for habit strength. The findings for habit strength thus do not mirror the effectiveness of cue-monitoring on snacking behaviour. Yet, while cue-monitoring is not expected to develop new automatic behaviours, implementation intentions can establish desirable habitual behaviours by creating new cue-response associations. Research over longer time periods is needed to examine whether cue-monitoring might benefit from implementation intentions in order to establish long-term behaviour change maintenance.

Using cue-monitoring as a strategy to reduce unhealthy snacking has several advantages compared with other behaviour change techniques. Filling out a cue-monitoring diary is a strategy that people can easily do themselves, without depending on professional supervision or commercial weight loss programmes (Luszczynska, Sobczyk, & Abraham, 2007). Moreover, cue-monitoring is a tool that to a large extent could overcome the problem of poor insight (Loewenstein, 1996; Nisbett & Wilson, 1977) when aiming to gain more knowledge about such habitual behaviours. In the present study, participants in the cue-monitoring conditions were instructed to fill out their diary

during or immediately after their snacking occasion (i.e. within an hour), thereby limiting the effects of poor retrospection and making people aware of their situation while they are in a 'hot' state. Additionally, cue-monitoring is easy to use, accessible and can be implemented cost-effectively in large-scale health interventions.

Some limitations of the present study should also be noted. Firstly, the effects were examined over a limited time period and more research is needed to address long-term effects. Secondly, the current sample size might have been insufficient to detect differences with a small effect size. With the current sample, a power of .80 was achieved to detect effects with small to medium magnitude (holding an effect size of $\eta^2 = .46$). Hence, smaller effects could have been overlooked and future research is needed to preclude this possibility. Additionally, we assessed unhealthy snacking behaviour by means of a snack diary and such self-report measures may be vulnerable to inaccurate or incomplete data. Nevertheless, snack diaries are viewed as a high-quality and sophisticated measure of eating behaviour (Adriaanse, Vinkers, et al., 2011; De Castro, 2000). Fourthly, the effect sizes found in the present study were rather small. It should be noted, however, that all participants were highly motivated to change their unhealthy snacking behaviour and the effects in the present study were obtained on top of the effects that might have been induced by the strict control conditions, e.g. reflecting upon one's snacking behaviour and explicitly adopting a strong goal intention. Finally, the results can, as of yet, not be generalised to common populations as only students were included who received a monetary incentive or course credit. Future research should examine the effects of cue-monitoring and planning in community samples as well, if possible without such extrinsic rewards.

To conclude, although cue-monitoring was expected to be a helpful strategy to facilitate people in tailoring implementation intentions to their individual snacking situations, cue-monitoring did not improve the effectiveness of such plans. Yet, it was found to be an effective strategy in itself and the findings suggest that cue-monitoring may successfully change unhealthy snacking behaviour. More research is needed to examine the effectiveness of cue-monitoring, solely and in combination with planning, especially for behaviour change maintenance in the long run.

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Note

1. Note that including participants who are underweight resulted in similar findings.

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