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Research article

Less is more: The effect of multiple implementation intentions targeting unhealthy snacking habits

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Abstract

Implementation intentions have been shown to effectively change counter-intentional habits. Research has, however, almost solely been concerned with the effectiveness of a single plan. In the present research, we investigated the behavioral and cognitive implications of making multiple implementation intentions targeting unhealthy snacking habits and its underlying processes, linking multiple habitual snacking cues to healthy alternatives. Study 1 revealed that formulating multiple implementation intentions was not effective in decreasing unhealthy snacking, whereas formulating a single plan successfully induced behavior change. By using a lexical decision task in Study 2, it was found that when making a single plan, but not multiple plans, the healthy alternative became cognitively more accessible in response to a critical cue prime than the habitual response. However, when making additional plans in an unrelated domain, the negative effects of making multiple plans were absent. In sum, the current findings suggest that formulating multiple implementation intentions is ineffective when changing unwanted behavior. These reduced effects of multiple implementation intentions do not occur when making the plan but are rather due to interference in the enacting phase of the planning process. Copyright © 2013 John Wiley & Sons, Ltd.

For a variety of behaviors, many people have a hard time translating their good intentions into action (Webb & Sheeran, 2006). One of the major reasons why having a strong goal intention is mostly insufficient to accomplish behavior change is that many of the behaviors we aim to adjust are habitual in nature (e.g., Aarts & Dijksterhuis, 2000; Ouellette & Wood, 1998). Changing counter-intentional habits, even when being highly motivated to do so, is inherently difficult, as habits are induced automatically and thus entail actions that are performed unintentionally and with little controllability (Bargh, 1994). Fortunately, recent findings show that habit change is not impossible and can be accomplished with the use of implementation intentions (e.g., Holland, Aarts & Langendam, 2006).

Implementation intentions are simple if-then action plans that specify when, where (if), and how (then) to act (Gollwitzer, 1999). In the case of changing habits, implementation intentions typically specify a critical cue that normally triggers the unwanted habitual response in the "if-part" and an alternative behavior in the "then-part" of the plan. The effectiveness of such specific "if-then" action plans in altering counter-intentional habits has been demonstrated in several domains including habits related to recycling behavior (Holland et al., 2006), smoking (Webb, Sheeran & Luszczynska, 2009), nonsustainable consumption behavior (Fennis, Adriaanse, Stroebe & Pol, 2011), and unhealthy snacking behavior (Adriaanse, De Ridder & De Wit, 2009; Adriaanse, Vinkers, De Ridder, Hox & De Wit, 2011b; Verplanken & Faes, 1999). Until recently, research regarding changing unwanted habits has been concerned mostly with the effectiveness of formulating a *single* implementation intention (e.g., Adriaanse et al., 2009), in which a behavioral response is specified for one specific situation. The effect of making multiple plans—targeting behavior change in diverse situations—compared with a single one has, however, largely been ignored. In the present research, we aim to examine the effects of multiple implementation intentions when trying to change counter-intentional habits.

It is important to gain insight into the effects of multiple if-then plans targeting behavior change in multiple situations simultaneously, because many of the behaviors we perform on a daily basis are performed in several situations and in response to a variety of triggers. It is therefore likely that, when someone adopts the goal to change a particular behavior, habitual responses that conflict with this goal are induced in multiple situations, and in fact, multiple unwanted habits exist. When aiming to change such habits, making multiple implementation intentions—one for each situation in which the unwanted behavior is triggered—may therefore considerably enhance successful goal pursuit. To illustrate, a person aiming to reduce his or her unhealthy snack intake may have a habit of consuming unhealthy snacks when feeling bored and also when watching television and when being at a party. In order to increase the chances to act upon one's goal (i.e., eating fewer unhealthy snacks), ideally, an implementation intention

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should be formulated for each situation in which the unwanted habit is elicited (i.e., when feeling bored, when watching TV, and when being at a party). In this way, opportunities for successful goal pursuit would be maximized.

Intuitively, it makes sense to assume that when trying to change unwanted behaviors, making multiple implementation intentions will be more effective than a single plan. Indeed, several studies indicated that people changed their behaviors after having formulated multiple plans (e.g., Armitage, 2004; Achtziger, Gollwitzer & Sheeran, 2008; Koestner, Lekes, Powers & Chicoine, 2002). However, to the best of our knowledge, no studies have explicitly examined the assumption that multiple plans addressing a variety of critical cues will lead to a stronger decrease of the unwanted behavior compared with a single plan addressing only one cue. The literature on the effect of multiple implementation intentions compared with a single plan concerns the initiation of new behaviors only; and for this type of behavior change, the limited number of studies yields mixed evidence. Results from two correlational studies suggest that the number of implementation intentions is positively related with goal attainment in the domain of fruit and vegetable intake (Wiedemann, Lippke & Schwarzer, 2011a) and exercise behavior (Wiedemann, Lippke, Reuter, Ziegelmann & Schüz, 2011b). Yet, a prospective study targeting physical activity showed that the number of plans was only related to behavior initiation when the additional plans were of high specificity, which was relatively rare (De Vet, Oenema & Brug, 2011). These results suggest that, at least when specific plans are formulated, multiple plans might be beneficial for goal attainment. Nevertheless, they should be interpreted with care, as the correlational nature of these studies precludes conclusions about causality. It may even be possible that both the number of plans and success in goal pursuit were affected by a third variable such as that people with better self-regulation skills are able to formulate more plans and are also more successful in goal pursuit.

The only study in which the number of plans was experimentally manipulated (Dalton & Spiller, 2012) targeted a variety of daily behaviors (not differentiating between the initiation of new behaviors and changing old ones) and demonstrated that people formulating multiple plans, addressing multiple goals, were actually less successful in their goal pursuit. Although this study does allow for drawing causal inferences, importantly, multiple plans were specified for *different* goals, and therefore, it could not be tested whether making multiple plans for the same goal, rather than pursuing multiple goals simultaneously, was ineffective. Taken together, the limited number of studies that have been conducted in this area thus shows inconsistent results regarding the implications of making multiple implementation intentions.

Moreover, when looking at other research that might provide useful insight in the potential effects of multiple implementation intentions, the intuitive appeal of making multiple plans is tempered even further. It has, for example, been suggested that the effects of multiple implementation intentions may be "diluted", which entails that each implementation intention will be less beneficial compared with when they are formulated in isolation (Webb, 2006). One of the proposed reasons for this dilution is that weaker cue–response associations, that is, the link between the critical cue ("if"-part of the implementation intention) and the alternative response ("then"-part) for the alternative behavior may be established (Webb, 2006). In line with this suggestion, research in cognitive psychology shows a similar phenomenon known as the "fan effect" (e.g., Anderson & Reder, 1999), which describes the interference of associated information and shows that information is less accessible as the amount to be remembered increases. The outlined literature suggests that multiple plans may lead to weakened associations between the critical cue and the desired alternative response. It remains unclear, however, whether such reduced effects would also occur for the situation described in the present paper: when formulating multiple implementation intentions each addressing a different critical cue rather than making multiple plans for the same critical cue (when interference of plans is very likely; Gollwitzer, 2006; Vinkers, Adriaanse, Kroese & De Ridder, under review).

The cognitive associations that may possibly be affected when formulating multiple plans are of importance, as they are considered to be the essential working mechanism behind implementation intention effectiveness (Aarts, Dijksterhuis & Midden, 1999; Adriaanse, Gollwitzer, De Ridder, De Wit & Kroese, 2011a). Specifically, habitual behaviors are characterized by their increased accessibility in response to a critical cue: when a critical situation is encountered, the habitual response has a cognitive advantage over the alternative behaviors for this situation, as it is more accessible than the alternative behavior (Adriaanse et al., 2011a). Yet, when formulating implementation intentions, the link between the critical cue and the habitual response is inhibited, while a new link with the alternative response is established (Adriaanse et al., 2011a). As a result, the situation no longer automatically induces the habitual response, thus removing the cognitive advantage of the habitual behavior, and thereby making room for deliberative goal pursuit (Adriaanse et al., 2011a). Therefore, if the cognitive effects are weakened when multiple plans are formulated, the effectiveness of implementation intentions could be severely hindered and are likely to affect behavior as well.

If making multiple implementation intentions would indeed be less effective in establishing behavior change, it is essential to examine why multiple plans are less beneficial. Such reduced effectiveness could result during the two crucial phases of the planning process. It is possible that problems arise during the formulation phase of the planning process. Making multiple plans might produce higher cognitive load, thereby reducing the extent to which each plan is encoded in this stage of the planning process (Webb, 2006). Alternatively, it could be that not making multiple plans itself induces the absence of effects but rather the related information that causes interference when acting upon these plans (Anderson & Reder, 1999; Webb, 2006).

THE PRESENT STUDY

In the present study, we aim to investigate the effects of making multiple implementation intentions, examining behavioral (Study 1) as well as cognitive (Study 2) implications. Moreover, in the second study, we explore the underlying processes by examining whether problems occur as a result

of formulating multiple implementation intentions or acting upon multiple plans. In order to examine this most stringently, optimizing the possible effectiveness of multiple plans, participants in this condition were explicitly instructed to formulate implementation intentions serving the same goal, while specifying different cues and alternative responses. Specifying similar critical cues or alternative responses would increase the potential for interference or dilution effects (Gollwitzer, 2006; Webb, 2006). Therefore, making multiple yet noncompeting plans increases the chance that multiple plans will be effective.

We focus on changing unhealthy snacking habits as the behavior of interest, as the consumption of unhealthy snacks is typically triggered in diverse situations. In addition, many people have the intention to eat less unhealthy snacks (Kumanyika et al., 2000), which is important because implementation intentions are effective only if people are highly motivated (e.g., Sheeran, Webb & Gollwitzer, 2005). Moreover, as unhealthy snacking behavior has been found to be largely habitual (e.g., Verhoeven, Adriaanse, Evers & De Ridder, 2012; Verplanken, 2006), intentions to change this behavior are very suitable to be fueled with implementation intentions (Adriaanse, et al., 2009). With regard to the multiple plan condition, we decided to focus on the formulation of *three* plans, as many studies on health interventions stimulate people to make up to three implementation intentions (e.g., Jackson et al., 2005; Koestner et al., 2002; De Vet, Oenema, Sheeran & Brug, 2009). Moreover, a pilot study indicated that participants who were motivated to change their unhealthy snacking habits were generally able to specify up to three unhealthy snacking habits (i.e., three situation–habitual response links).

On the basis of the suggested "dilution" effect (Webb, 2006) and the "fan" effect (Anderson & Reder, 1999) described earlier, we expect in the first study that multiple implementation intentions will be less effective in changing undesired habitual behaviors compared with making a single plan. In addition, in the second study, we expect that the formulation of multiple plans will create weaker cognitive associations between the critical cue and the alternative response compared with a single plan, implying that the habitual unhealthy snack will still be more accessible. In order to examine the underlying processes, an additional condition is adopted in which participants formulate multiple plans for an unrelated domain (e.g., academic achievement) next to the snacking plan. Two competing hypotheses were formulated. For one, and similar to making multiple related plans, it could be expected that when additional unrelated plans are formulated, reduced mental associations for each implementation intention are established with the healthy alternative. This would indicate that the problems arise in the formulating phase of the planning process. Alternatively, it could be that not making multiple plans *per se* but rather the interference of information in the content of the multiple plans causes problems when acting upon these plans. In the latter case, probably no adverse effects will be demonstrated when additional plans are formulated for an unrelated domain. As the information is less likely to cause interference, the related implementation intention might be just as effective.

STUDY 1

In Study 1, the behavioral effects of making multiple implementation intentions were addressed. To examine changes in unhealthy snacking behavior, both the number of unhealthy snacking occasions and caloric intake from unhealthy snacks were addressed to rule out that participants snack less often (as the implementation intentions target specific snacking occasions) but compensate during other snacking occasions and therefore end up consuming the same amount of kilocalories.

Method

Participants

Sixty-five female students who were not underweight (body mass index [*BMI*] $>$ 18.50; WHO, 2003) and who responded affirmatively to the question "Would you like to eat less unhealthy snacks?" participated in exchange for €10 or a course credit. Two participants were excluded from the analyses because they did not complete the entire study. The final sample thus consisted of sixty-three participants with a mean age of 21.65 years ($SD = 1.67$) and a mean BMI of 21.33 ($SD = 1.63$; range: 18.60–24.84).

Design

The experiment had a 2 (time: baseline versus follow-up; within-subjects) $\times$ 3 (condition: one implementation intention versus three implementation intentions versus control; between-subjects) mixed design.

Procedure

At baseline, participants were requested to fill out a questionnaire measuring intention, habit strength, and demographic variables (i.e., age, weight, and height). Then, participants monitored their unhealthy snacking behavior and their snacking situations by using a "monitoring diary" for 3 days. This monitoring phase was included to ensure that people were optimally prepared to identify three different snacking situations that could be specified as critical cues in the implementation intentions. Next, an appointment was made with each participant to come to the laboratory and hand in their monitoring diary. Participants were asked to fill out several questionnaires and were then randomly assigned to one of the three conditions. Depending on their condition, participants were given instructions to formulate either one or three implementation intentions or, in the control condition, to list up to 10 favorite healthy snacks (cf., Adriaanse et al., 2009). After these instructions, participants received a "registering diary", in which they could indicate the amount and type of snacks they had consumed for another period of 3 days, starting on the day after participation in the laboratory. An appointment was made to return the diary in exchange for their reward. Lastly, participants were debriefed and thanked.

Instructions

Implementation Intention Conditions. Participants received detailed instructions on paper to formulate one or three implementation intentions. Personally relevant critical cues and alternatives were adopted. Participants were asked to specify the most important cue (or three cues in the three implementation intentions condition) for their unhealthy snacking behavior, in an "if. . ." format. Then, participants wrote down an alternative behavior (or three different alternatives, one for each critical cue) in a "then. . ." format. Lastly, participants were requested to write down their plan(s) in the following format: "If [your critical cue], then [your solution]."

Control Condition. An active control condition was adopted to eliminate the possibility that observed effects are a result of merely thinking about one's goal intention and healthy alternatives (Adriaanse et al., 2009). This is important, as the effectiveness of implementation intentions on eating behavior may otherwise be easily overstated (Adriaanse et al., 2011b). To this end, participants were instructed to carefully think about healthy alternatives that could be consumed instead of the habitual unhealthy snack and were requested to list up to 10 favorite healthy alternatives (cf., Adriaanse et al. 2009; Study 3).

Measures

Monitoring Diary. Participants were provided with a paper diary and were requested to monitor their unhealthy snacking behavior at baseline. The diary, based on a diary that has been used in previous studies and developed in collaboration with a registered dietician (e.g., Adriaanse et al., 2009), consisted of 14 options for unhealthy snacks (e.g., cookie or crisps). An option "other" was also provided. A snack was defined as any unhealthy food consumed in between the regular meals (breakfast, lunch, and dinner). Participants were additionally asked to specify how much of that snack they consumed, in appropriate units (e.g., a "handful" for crisps). Participants were instructed to fill out the diary within 30 minutes after each snacking occasion and could report up to six occasions per day. In the monitoring diary, participants were additionally asked to specify with who and where they were, what kind of activity they were doing, and their most important reason to take the unhealthy snack.

Registering Diary. The registering diary was similar to the monitoring diary, except that in this diary, only the type and amount of snacks per snacking occasion were reported. On the basis of this diary, the number of snacking occasions and caloric intake from unhealthy snacks were calculated as the dependent variables.

Intention. Intention to eat less unhealthy snacks was measured with three items ("I intend/plan/want to eat less unhealthy snacks"). Participants rated their answers on 7-point scales from 1 (*totally disagree*) to 7 (*totally agree*). Cronbach's α was .94, and a mean score was computed.

Habit Strength. Participants were asked to fill out an adapted version of the Self-Report Habit Index (Verplanken & Orbell, 2003), measuring the habit to eat unhealthy snacks with 12 items (e.g., "Eating unhealthy snacks is something I do automatically."). Answers were rated on 7-point scales from 1 (*totally disagree*) to 7 (*totally agree*). Cronbach's α was .88, and a mean score was computed.

Data Analyses. The dependent variables were the number of snacking occasions and mean daily caloric intake from unhealthy snacks. Daily caloric intake from unhealthy snacks was calculated by multiplying each reported snack with the average amount of kilocalories it contains. Averages were derived from the Dutch Nutrition Centre (2010).

Results

Descriptive Statistics and Randomization Check

At baseline, participants had on average 2.13 snacking occasions daily ($SD = 1.12$) and consumed on average 398 kilocalories per day from unhealthy snacks ($SD = 276$). Participants had a high intention to eat fewer unhealthy snacks ($M = 5.35$, $SD = 1.14$) and a medium-to-strong unhealthy snacking habit ($M = 4.10$, $SD = 1.00$). The three conditions did not differ in terms of mean BMI, age, intention, habit strength, number of snacking occasions, or caloric intake at baseline (all $p > .23$), indicating successful randomization.

In the implementation intention conditions, 80% of the identified critical cues in the implementation intentions were encountered during the monitoring phase, demonstrating that participants indeed specified critical cues in the implementation intentions that they actually encountered in their daily lives.

Main Analyses

Number of Snacking Occasions. An analysis of variance (ANOVA) was conducted with time (baseline versus follow-up) as a within-subject variable, condition (one implementation intention versus three implementation intentions versus control) as a between-subject variable, and number of snacking occasions as a dependent variable. No main effect of condition was found $F(2, 60) = 0.32$, $p = .72$. A significant main effect of time was observed, $F(1, 60) = 22.70$, $p < .001$, $\eta_p^2 = 0.27$, indicating that all participants reported fewer snacking occasions after the experimental manipulation compared with before the manipulation. However, this main effect was qualified by a significant time-by-condition interaction effect, $F(2, 60) = 4.56$, $p = .01$, $\eta_p^2 = 0.13$, indicating that reduction in the number of snacking occasions varied between the three conditions (Figure 1). In order to examine how the three conditions differed, simple main effects of time were calculated within each condition separately.

Simple Main Effects. A repeated-measures ANOVA with time as a within-subject variable and number of snacking occasions as a dependent variable was conducted for each condition. A main effect of time was found within both the control condition, $F(1, 21) = 8.56$, $p = .01$, $\eta_p^2 = 0.29$, and the one implementation intention condition, $F(1, 19) = 17.76$, $p < .001$, $\eta_p^2 = 0.48$. In the control condition, participants significantly reduced their number of snacking occasions from

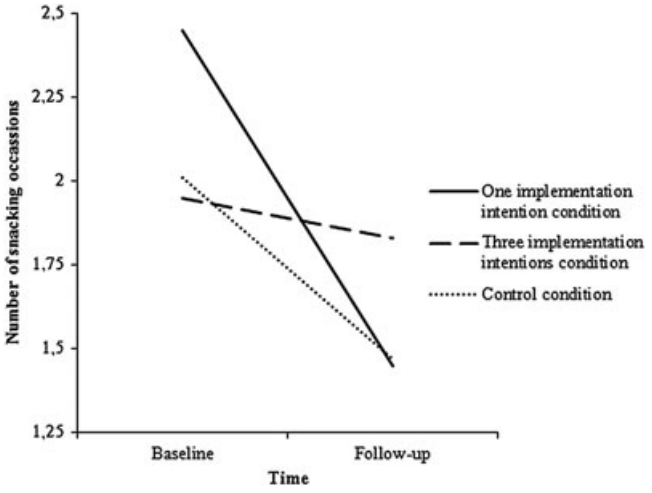

Figure 1. Study 1—effect of formulating one, three, or zero implementation intentions on the number of snacking occasions

on average 2.01 snacking occasions at baseline ($SD = 1.12$) to 1.47 at follow-up ($SD = 0.89$). Participants who formulated a single plan reduced their number of snacking occasions from an average of 2.45 snacking occasions at baseline ($SD = 1.34$) to 1.45 snacking occasions at follow-up ($SD = 0.82$). In the three implementation intentions condition, however, no effect of time was observed, $F(1, 20) = 0.47$, $p = .50$ (baseline: $M = 1.95$, $SD = 0.84$; follow-up: $M = 1.83$, $SD = 0.74$).

Caloric Intake. A similar repeated-measures ANOVA was conducted with time (baseline versus follow-up) as a within-subject variable, condition (one implementation intention versus three implementation intentions versus control) as a between-subject variable, and mean daily caloric intake as a dependent variable. No main effect of condition was found $F(2, 60) = 0.12$, $p = .89$. The analysis showed a significant main effect of time, $F(1, 60) = 8.77$, $p = .004$, $\eta_p^2 = 0.13$, indicating that mean daily caloric intake from unhealthy snacks was decreased after manipulation compared with baseline consumption. Moreover, the time-by-condition interaction approached significance, $F(2, 60) = 2.85$ $p = .066$, $\eta_p^2 = 0.09$, suggesting that reduction in mean daily caloric intake from unhealthy snacks differed between the conditions (Figure 2).

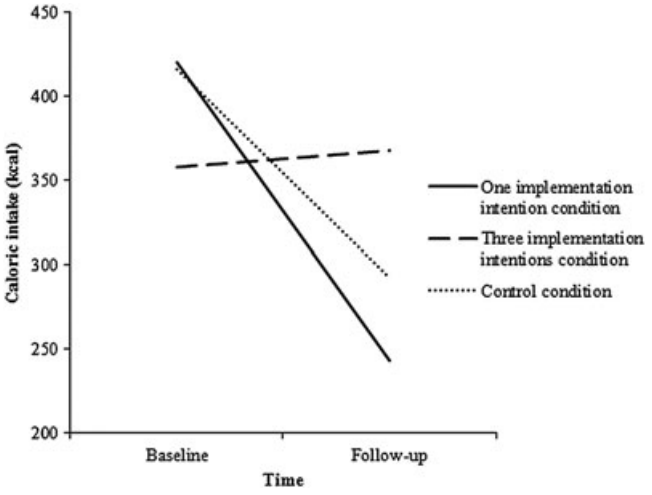

Figure 2. Study 1—effect of formulating one, three, or zero implementation intentions on caloric intake from unhealthy snacks

Again, in order to examine how the three conditions differed in caloric intake reductions, simple main effects of time were calculated within each condition separately.

Simple Main Effects. A repeated-measures ANOVA with time as a within-subject variable and daily caloric intake as a dependent variable was conducted for each condition. A main effect of time was found within both the control condition, $F(1, 21) = 5.52$, $p = .03$, $\eta_p^2 = 0.21$, and the one implementation intention condition, $F(1, 19) = 6.96$, $p = .02$, $\eta_p^2 = 0.27$. In the control condition, participants significantly reduced their caloric intake from unhealthy snacks from on average 416 per day at baseline ($SD = 325$) to 292 at follow-up ($SD = 259$). Participants who formulated one implementation intention reduced their daily caloric intake from unhealthy snacks from 420 on average at baseline ($SD = 320$) to 243 kilocalories at follow-up ($SD = 180$). In the three implementation intentions condition, however, again, no effect of time was observed, $F(1, 20) = 0.04$, $p = .85$ (baseline: $M = 358$, $SD = 161$; follow-up: $M = 368$, $SD = 197$).

Discussion

Study 1 showed that whereas making one implementation intention successfully diminished unhealthy snacking habits, formulating three implementation intentions was not effective. Making multiple plans resulted in neither a reduced number of unhealthy snacking occasions nor a decrease in caloric intake from unhealthy snacks.

Interestingly, also the participants who merely formulated their goal intentions significantly reduced their unhealthy snacking behavior. It should be noted, however, that all participants in this study monitored their unhealthy snacking behavior preceding the planning phase, which might have affected their snack consumption. The question that remains, however, is why multiple plans are counter-effective when fighting unwanted habits.

STUDY 2

The first study showed that making multiple implementations was not beneficial for changing unwanted behaviors. In the next study, we aimed to replicate this finding by using a cognitive measure and examine what lies beneath these adverse effects. Study 2 was therefore designed to investigate how the accessibility of habitual snacks and healthy alternatives would be affected when formulating one, three, or zero plans or when making one related implementation intention and two additional plans for an unrelated domain (e.g., academic achievement).

Method

Participants

One hundred and twenty one students who, upon recruitment, responded affirmatively to the question "Would you like to eat less unhealthy snacks?" were recruited in exchange for €5 or a course credit. Owing to technical problems, 11 participants

could not be included in the analyses. Participants ($n = 17$) who were underweight ($BMI < 18.5$; WHO, 2003) or did not report their BMI were excluded from the analyses. The final sample consisted of 93 participants (50% were women, 47% were men, and 3% not reported) with a mean age of 21.05 years ($SD = 3.46$) and a mean BMI of 23.41 ($SD = 4.80$, range: 18.59–54.35).

Design

The experiment had a 2 (type of means: habitual unhealthy snack versus healthy alternative; within-subjects) × 4 (condition: one implementation intention versus three implementation intentions versus unrelated implementation intentions versus control; between-subjects) mixed design.

Procedure

The accessibility of habitual unhealthy snacks and healthy alternatives after being primed with the critical situation was tested when formulating one, three, or zero implementation intentions or one related and two unrelated plans, using a lexical decision task. To this end, personalized information was adopted, using information (e.g., critical cues, habitual snacks, and healthy alternatives) that was generated by participants themselves. The study consisted of three tasks; a means-generation task, an implementation intention formulation task, and a lexical decision task. In addition, participants filled out several questionnaires.

Upon arrival at the laboratory, participants were seated behind a computer and started filling out a questionnaire measuring intention to eat less unhealthy snacks and unhealthy snacking habits. Then, in the means-generation task, all participants were asked to generate three different snacking occasions, three different habitual snacks, and three different alternatives. By asking participants in all conditions to specify all means for three snacking situations, the effects of making one or three plans could be examined for the first habit (for which all implementation intention conditions made a plan) and for the second and third habits (for which only the three implementation intentions condition formulated plans). Possibly, compared with the effect of making a single plan, that of making three implementation intentions is less effective for the first habit, yet more effective for the second and third habits, as only the multiple implementation intentions condition made plans for these habits. After this, all participants were asked to identify two critical situations and possible solutions to deal with these situations in an unrelated domain, namely, academic achievement.

Then, participants were randomly assigned to one of the four conditions. In the implementation intentions task, all participants were given instructions to first rehearse their general goal intention to reduce their unhealthy snack intake. Participants in the implementation intention conditions were then asked to formulate either one or three (related) plans. Plan commitment and plan motivation for each of the plans were measured immediately after the formulation of each plan. Next, the lexical decision task was administered. After this, participants were asked fill out a second questionnaire assessing intention, habits, hunger, perceived healthiness of the habitual snacks, and alternative means and demographic variables. Lastly, participants were debriefed and thanked.

Means-Generation Task

In order to generate personally relevant critical cues, habitual snacks, and healthy alternatives that could be specified in the implementation intentions and the lexical decision task, a means-generation task was employed (see Adriaanse et al., 2011a, for details). Participants were requested to think about three different snacking situations and to specify one word for each situation that best reflected their critical cue for taking unhealthy snacks. Participants were explicitly asked to generate three different critical cues. Then, they were requested to specify for each of the three critical cues what kind of unhealthy snack they often consume in that situation and to report a healthier alternative for this situation, like taking a healthy snack or engaging in an alternative activity. Participants were requested to specify a different habitual snack and alternative behavior for each situation. To illustrate, when participants indicated that they consume unhealthy snacks when feeling bored, when watching television, and when being with friends, they were asked "what kind of unhealthy snack do you usually consume in the situation 'bored'/'television'/'friends'?" and were additionally asked to describe "what kind of alternative could you consume or do in the situation 'bored'/'television'/'friend'?" After this, participants were asked to identify two situations in which they find it difficult to adhere to their goal of academic performance. In addition, they were requested to specify a solution for each of the situations.

Implementation Intentions Task

In the implementation intention task (cf., Adriaanse et al., 2011a), all participants were given instructions to first rehearse their general goal intention to reduce their unhealthy snack intake. Participants in the implementation intention conditions were given detailed instructions to formulate either one or three implementation intentions. Participants in the one implementation intention condition and the unrelated implementation intentions condition formulated their plan for the first snacking situation and the corresponding alternative they had specified. In addition, participants in the unrelated implementation intentions condition were given detailed instructions after formulating one snacking plan, to formulate two implementation intentions with regard to their academic achievement, also using idiosyncratic information. For participants in the three implementation intentions condition, the instructions were adjusted to formulate three implementation intentions regarding snacking behavior, e.g., "You have indicated that you usually consume 'chocolate', 'popcorn', and 'crisps' in the situation 'bored', 'television' and 'friends'. Now, please write down your first plan with your first critical cue ('bored') and your first solution ('apple') as follows: 'If [your critical cue], then [your solution].' " This procedure was repeated for the second and third habits.

Lexical Decision Task

The lexical decision task, adopted from Adriaanse et al. (2011a), was presented as a separate study and adjusted to

allow for testing the effectiveness of multiple implementation intentions. Participants were told that in each trial of this task, a word would be presented shortly, followed by a string of x's, and then a string of letters would appear on the computer screen. They were instructed to indicate as quickly as possible whether this string of letters was a word or nonword by pressing a left or right key. The task consisted of two blocks of 24 trials. Each trial started with a fixation cross (1000 ms). Then, a word was shortly presented (50 ms). Following this prime, a string of x's was used as a backward mask (700 ms). Then, the target word or nonword that participants were supposed to respond to appeared on the screen until a left or right key was pressed.

The targets included the 6 means participants had generated with regard to snacking behavior (the three habitual and three alternative means), 6 neutral words, and 12 nonwords. Means regarding academic achievement were not included. Primes included the three critical cues generated by participants and three neutral words. In the critical trials, a critical cue prime was presented together with one of the two corresponding means (habitual or alternative) as the target. Per block, each critical cue prime was presented four times: before presenting the corresponding habitual and alternative means and before presenting two nonwords. Each neutral word prime was also presented four times: before two neutral words and before two nonwords. Reaction times on the critical trials (i.e., the habitual or alternative means after being primed with the critical cue) were used as a dependent variable in the analyses.

Questionnaires

Intention. Intention to eat less unhealthy snacks was measured at the beginning and end of the experiment similar to Study 1 (Cronbach's $\alpha = .91$ and Cronbach's $\alpha = .95$, respectively).

Habit Strength. Habit strength was measured similar to Study 1 (Cronbach's $\alpha = .93$).

Perceived Healthiness. Perceived healthiness of all three habitual snacks and alternatives were measured by asking "How healthy is [mean]?", rated on 7-point scales, from 1 (*not at all*) to 7 (*very much*).

Hunger. Participants were asked to what extent they were feeling hungry at that moment, rated on 7-point scales from 1 (*not at all*) to 7 (*very much*).

Plan Commitment. After implementation intention was formulated (in the multiple implementation intention conditions after each plan separately), commitment to the plan was measured with two items (e.g., "I expect to act out this plan in the next week.") on 7-point scales from 1 (*totally disagree*) to 7 (*totally agree*), all $r > .82$, all $p < .001$.

Plan Motivation. Plan motivation was also measured after formulating each plan, using a 4-item self-determination motivation questionnaire (Sheldon & Kasser, 1998), which was adopted for the present study to assess whether the motivation to act out the plan was extrinsically motivated (e.g., "because somebody else wants you to or because you'll get something from somebody if you do"), or intrinsically motivated (e.g., "because of the fun and enjoyment which acting out the plan will provide you—the primary reason is simply your interest in the experience itself"), on 7-point scales from 1 (*not at all for this reason*) to 7 (*completely because of this reason*). A plan motivation index was calculated by subtracting the sum of the extrinsic ratings from the sum of intrinsic ratings (cf., Sheldon & Kasser, 1998).

Data Analyses

Incorrect and extreme fast or slow reaction times (>3 *SD*s from the mean) on trial level were reported as missing. Reaction times on critical trials, that is, target words (the habitual or alternative means) preceded by the critical situation, were included in the analyses. Average response times were calculated by combining the response times in the two blocks.

To verify that the healthy alternatives identified by the participants were indeed regarded as healthier than the habitual snack, the perceived healthiness of the means was assessed. Moreover, additional analyses were conducted to examine whether possible findings may be due to differences in plan commitment and plan motivation when making multiple plans. Differences between conditions in plan commitment and plan motivation were examined for the first plan. Within the multiple plans condition, differences in commitment and motivation were examined between the three plans.

Regarding the main analyses, reaction times were log transformed before entering in the analyses. For ease of interpretation, however, reported means and standard deviations are original values in milliseconds. The analyses were first conducted for the habit that participants in all implementation intention conditions had targeted (Habit 1) and then for the habits that were only targeted by participants in the three implementation intentions condition (Habits 2 and 3 combined).

Results

Descriptive Statistics and Randomization Check

Participants had a fairly high intention to eat less unhealthy snacks ($M = 5.14$, $SD = 1.32$) and a medium-to-strong unhealthy snacking habit ($M = 4.07$, $SD = 1.27$). Significant differences between the conditions on any of the demographic or study variables or between the reaction times for irrelevant words were absent (all $p > .11$), indicating successful randomization.

Perceived Healthiness Check

It was tested whether participants specified alternatives that were indeed perceived as healthier than the habitual snack. Alternatives specified by the participants were mostly healthy snacks (e.g., apple) or engagement in an activity (e.g., working out). A repeated-measures ANOVA was adopted, with type of means (habitual snack versus alternative) as the within-subject variable, condition (one implementation intention versus three implementation intentions versus unrelated implementation intentions versus control) as the between-subject variable, and perceived healthiness as the dependent variable. The results indicated a main effect of type of means for all analyses, showing that the alternative means were perceived

as healthier than the corresponding habitual snack, all $F(1, 91) > 73.98$, all $p < .001$. No effects of condition, all $F(1, 91) < 1.42$, all $p > .23$, or interaction effects between type of means and condition were found, all $F(1, 91) < 2.14$, all $p > .14$, indicating that this did not differ between the conditions.

Main Analyses

Habit 1. A 2 (type of means: habitual snack versus alternative; within-subjects) × 2 (condition: one implementation intention versus three implementation intentions versus unrelated implementation intentions versus control; between-subjects) repeated-measures ANOVA with reaction time to target words as a dependent variable revealed no main effect of type of means, $F(1, 86) = 0.77$, $p = .38$, or condition, $F(3, 86) = 0.50$, $p = .68$. However, a marginally significant type of means by condition interaction effect was observed, $F(3, 86) = 2.46$, $p = .068$, $\eta_p^2 = 0.08$, showing that the effect of type of means differed between the conditions (Figure 3). In order to examine how the conditions differed, simple main effects of type of means were calculated within each condition separately.

Simple Main Effects. A repeated-measures ANOVA with type of means as a within-subject variable and reaction time as a dependent variable was conducted for all four conditions separately. No effect of type of means was revealed for the three implementation intentions condition, $F(1, 24) = 0.51$, $p = .48$, and the control condition, $F(1, 21) = 0.98$, $p = .33$. However, in the unrelated implementation intentions condition, a marginally significant effect for type of means was found, $F(1, 19) = 3.41$, $p = 0.08$, $\eta_p^2 = 0.15$, suggesting that participants in this condition responded faster to the alternative means compared with the habitual means after seeing their critical cue. Moreover, in the one implementation intention condition, a main effect of type of means was found, $F(1, 22) = 4.13$, $p = .05$, $\eta_p^2 = 0.16$, indicating that participants who formulated one plan were significantly faster to respond to the alternative, compared with the habitual means.

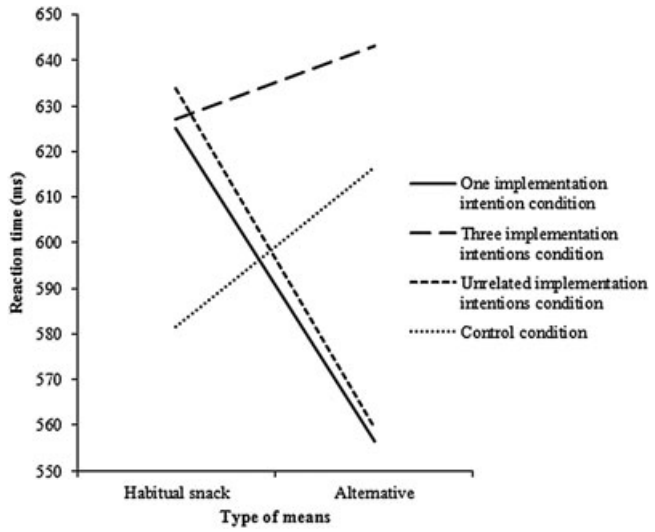

Figure 3. Study 2—effect of formulating zero, one, three, or one related and two unrelated implementation intentions on reaction times to the habitual snack or alternative when primed with corresponding critical snacking situation for plan 1 (variables in the figure not log transformed)

Habits 2 and 3. A similar repeated-measures ANOVA was employed to examine whether the conditions differed in their response latencies to the habitual snack compared with the alternative for the habits for which only the three implementation intentions condition formulated implementation intentions. No main effect of type of means, $F(1, 87) = 0.35$, $p = .56$, or condition, $F(1, 87) = 0.18$, $p = .91$, was found. In addition, no type of means by condition interaction effect was observed, $F(1, 87) = 0.58$, $p = .63$, indicating that for these habits, none of the conditions had a cognitive advantage for one of the means over the other, regardless of the number of implementation intentions formulated.

Plan Commitment and Plan Motivation

An ANOVA revealed no differences between the conditions in plan commitment, $F(3, 92) = 1.26$, $p = .29$, or plan motivation, $F(3, 92)$, $p = .22$, for the first plan. In addition, within the three implementation intentions condition, a repeated-measures ANOVA with habit (Habits 1, 2, and 3) as a within-subject variable showed no differences of plan commitment, $F(2, 23) = 0.81$, $p = .46$. Therefore, no support was found for these alternative explanations. A similar analysis for plan motivation did show a difference between the three plans, $F(2, 23) = 5.07$, $p = .02$, $\eta_p^2 = 0.31$, indicating that participants were somewhat more intrinsically motivated to act out the first ($M = 6.32$, $SD = 0.63$) or third ($M = 5.96$, $SD = 0.63$) plan compared with the second plan ($M = 5.04$, $SD = 0.62$).

DISCUSSION

In the second study, we examined the cognitive effects of making multiple implementation intentions targeting counter-intentional habits. The present results add to our theoretical framework in two ways. First, we replicated the findings of our first study using a cognitive measure, by showing that making one implementation intention is more effective in changing unhealthy snacking habits than making multiple plans. When formulating a single plan, the alternative means became more accessible upon priming with the critical cue compared with the habitual means. Yet, participants who formulated three implementation intentions did not replace their unhealthy habit. Second, the present findings suggest that the reduced effects of making multiple plans occur as a result of interference of information when enacting the plans, rather than formulating multiple plans itself. Participants who formulated multiple implementation intentions regarding an unrelated domain also seemed to replace their unwanted habit with a new one, as they displayed marginally significantly faster responses to the healthy alternative compared with the habitual means after the critical cue prime. Importantly, participants who formulated three implementation intentions also did not outperform the other participants on the second and third habits. Thus, no advantage was established in the three

implementation intentions condition for the first plan, as well as for the extra two plans.

The results cannot be accounted for by differences in the extent to which people are committed to their plans or motivated to act out one's plan for the first plan. Whereas the extent to which people were intrinsically motivated was slightly lower for the second plan, this was not the case for the third plan. Therefore, motivation does not seem to be affected consistently by making multiple plans.

GENERAL DISCUSSION

In the present article, the effect of making multiple implementation intentions was investigated, examining behavioral and cognitive implications. In the first study, it was found that whereas formulating a single plan successfully reduced both the number of snacking occasions and caloric intake from unhealthy snacks, formulating three implementation intentions was not at all effective. In the second study, it was shown that when a single (snacking) plan was formulated, the healthy alternative became more accessible than the habitual snack, indicating that the unwanted habit (critical cue—habitual means association) was successfully replaced with a new, desirable one (critical cue—alternative means association). Making three implementation intentions regarding snacking behavior, however, did not result in a cognitive advantage of the alternative means over the habitual means for the first plan, nor for the other two plans, indicating that no additional benefits from the other two implementation intentions were attained. Thus, although multiple plans for the target behavior should intuitively provide people with more opportunities to successfully act upon one's intention, the present findings show, both with behavioral and cognitive measures, that formulating multiple implementation intentions is ineffective when fighting unhealthy snacking habits. Moreover, on the basis of the results from the second study, we can conclude that not formulating multiple plans itself underlies these adverse effects, but the interference of information when enacting the plans.

In line with a—until now untested—suggestion made by Webb (2006), it appears that the effects of implementation intentions are diluted when making multiple plans, resulting in less successful goal striving compared with plans that are formulated in isolation. Importantly, in line with Gollwitzer's (2006) suggestion that multiple implementation intentions targeting the same critical cue might endanger its effectiveness, we explicitly focused on implementation intentions specifying different critical cues and alternatives to decrease the possibility that multiple plans were less effective because they were directly competing. Our instructions thus served to optimize the likelihood for multiple implementation intentions to be successful.

The results are in line with a previous study indicating that a single implementation intention, rather than multiple plans, is more effective in goal attainment in everyday behavior (Dalton & Spiller, 2012). However, the present study also extends these findings by showing that formulating multiple plans in service of the same goal (i.e., consuming less unhealthy snacks) is also not beneficial. Dalton and Spiller (2012) provided an explanation for the adverse effect of multiple implementation intentions by suggesting that multiple plans are less effective because people lack commitment to each plan, owing to facing difficulties that come with pursuing multiple goals. In the present study, however, we did not find support for this explanation. Yet, in line with the suggestion made by Webb (2006), the present study shows that the ineffectiveness of multiple plans could be attributed to weaker cognitive associations between the cue and the alternative response that are established when multiple plans are adopted, as a result of interference when enacting the plans.

It should be noted that other studies (e.g., Armitage, 2004; Achtziger, Gollwitzer & Sheeran, 2008) have shown positive behavioral effects when making multiple implementation intentions. There are, however, some important distinctions between the current study and previous studies. Importantly, none of these studies explicitly compared one implementation intention with multiple plans. Therefore, examining whether making more implementation intentions was also less beneficial compared with making a single plan was not possible in these studies. Still, it could be expected that making multiple plans would show positive effects compared with the control condition. In our behavioral study, participants monitored their unhealthy snacking behavior at baseline. We included this monitoring phase to ensure that participants were able to identify three critical cues for their unhealthy snacking. However, this might very well have affected snack consumption at baseline already in such a way that no additional effects of multiple plans were observable. In addition, the present studies adopted active control conditions to the extent that participants in the control group first monitored their snacking behavior and then listed 10 healthy alternatives (Study 1) or identified cues and generated possible alternatives (Study 2). These procedures might have induced spontaneous plan formulation (as they were able to identify a critical "if" and a suitable "then" during the control task). For these reasons, it is possible that no additional benefits of the multiple plans condition compared with the control condition were observed.

Although the large body of evidence showing the effectiveness of implementation intentions in numerous domains is convincing (e.g., Adriaanse et al., 2011b; Gollwitzer & Sheeran, 2006; Verplanken & Faes, 1999), the present results show that there are also limits to the use of implementation intentions. For many behaviors targeted in previous studies, especially studies conducted in controlled settings, fuelling a single cue–response link with one implementation intention is sufficient to achieve behavior change. However, when trying to change complex behaviors—as most of the targeted behaviors are—the behaviors are induced by multiple critical cues and in multiple situations, and the usual implementation intentions approach may therefore not be sufficient.

The current findings thus have important implications for research and interventions regarding the effectiveness of implementation intentions. In many behavior change intervention studies, participants are stimulated to formulate multiple implementation intentions (e.g., De Vet et al., 2009; Jackson et al., 2005; Koestner et al., 2002). However, in light of the current findings, this strategy may seriously jeopardize the effectiveness of the plans. Indeed, several of these studies

(De Vet et al., 2009; Jackson et al., 2005) did not find beneficial effects of implementation intentions, and the present adverse effects of multiple plans may explain these findings. In addition, although in behavior change interventions it is common to ask individuals to make multiple implementation intentions, the present study shows that this might be an ineffective approach.

Therefore, other ways of using implementation intentions when targeting complex counter-intentional habits might be more effective. For example, rather than making multiple implementation intentions at once, a phased approach could be more successful. In this way, one unwanted habit would be targeted with an implementation intention first, and only when the new desired behavior has been established as an automatic habitual response, an additional habit might be addressed. Such an approach could be adopted in future research to examine the effectiveness of sequential implementation intentions rather than concurrent multiple implementation intentions. Another direction for future research is to examine whether it is possible to make additional effective plans targeting different domains. For example, next to making plans to limit unhealthy food intake, one could make an implementation intention to increase physical activity. However, so far, the only study examining the effectiveness of implementation intentions targeting different behaviors (Dalton & Spiller, 2012) did not show positive behavioral effects. The implication of such a multiple plans paradigm thus remains to be examined.

As the present study focused on *changing* unwanted habits, the lower effectiveness of multiple plans may not be generalized to implementation intentions promoting *new* behaviors as well. Adopting new habits is generally easier to achieve than changing old ones (Holland, Aarts, & Langendam, 2006), and the dilution may therefore be weaker. Indeed, recent findings suggest that making multiple plans may in fact be quite promising when targeting the initiation of new habits such as fruit and vegetable intake (Wiedemann et al., 2011a) and physical activity (Wiedemann et al., 2011b). Nonetheless, the study by De Vet et al. (2011) showed that multiple plans targeting physical activity is only effective when the specificity of plans is protected. Moreover, as these studies merely provide correlational evidence, future research is warranted to examine whether the findings of the present study apply to multiple implementation intentions promoting new behaviors as well.

Although the present studies yield promising results, some limitations should be noted. In the first study, unhealthy snacking behavior was tested using a self-report measure. Although self-report measures may be vulnerable to underreporting of snack consumption or incomplete data, it is considered a high-quality outcome measure to administer unhealthy snack consumption (Adriaanse et al., 2011b). In addition, a snack diary is regarded to be one of the most sophisticated measures of eating behavior (De Castro, 2000). Furthermore, in the second study, the cognitive effects found in the present study provide a credible and theoretically important explanation for the current findings. However, a superior test would be to examine the mental associations between the critical cues and the habitual and alternative means before measuring unhealthy snack intake. In this way, it would be possible to actually predict unhealthy snack consumption using the cue–response associations. However, it is important to note that a direct relation between the cognitive measure and behavioral change is hard to identify, especially when the behavior is assessed with an extended period rather than one measurement (e.g., measuring food intake over several days). The difficulty with the link between the critical cue and the alternative is that this is not static (Adriaanse et al., 2011a): after the behavioral response has been repeatedly induced by the critical cue, the link between the two means will be strengthened, which makes it difficult to relate the mental associations assessed in the laboratory to actual behavior change (Holland et al., 2006).

The present studies have several noteworthy strengths. For one, the behavioral and cognitive effects of formulating multiple implementation intentions were experimentally tested. In addition, both studies used idiosyncratic means, as participants identified their personally relevant critical cues, habitual snacks and healthier alternative. Especially when assessing a lexical decision task, using idiosyncratic means is not common, yet it adds to the validity of the experiments. Even compared with the study by Adriaanse et al. (2011a) in which participants were able to choose their own critical cues, the personal relevance was even further improved, as in this study, the alternative was also selected by participants themselves. Moreover, we adopted a strict test to examine the adverse effects of multiple implementation intentions, as we explicitly targeted implementation intentions serving the same goal, while specifying different cues and alternative responses in order to maximize the effectiveness of multiple plans.

To conclude, although making one implementation intention effectively changes complex counter-intentional habits such as unhealthy snacking habits, the present study is the first to show that formulating multiple implementation intentions is less beneficial for successful goal pursuit, even when nonconflicting implementation intentions are formulated. Moreover, the present studies show that rather than formulating multiple implementation intentions itself, the reduced effects of making multiple plans occur as a result of interference of related information when enacting these plans. When aiming to change complex behavior, fueling one's intentions with one good plan will thus be more effective than making multiple implementation intentions.

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