

Personality and Social Psychology Bulletin

<http://psp.sagepub.com/>

Planning What Not to Eat: Ironic Effects of Implementation Intentions Negating Unhealthy Habits

Marieke A. Adriaanse, Johanna M. F. van Oosten, Denise T. D. de Ridder, John B. F. de Wit and Catharine Evers

Pers Soc Psychol Bull 2011 37: 69

DOI: 10.1177/0146167210390523

The online version of this article can be found at:

<http://psp.sagepub.com/content/37/1/69>

Published by:



<http://www.sagepublications.com>

On behalf of:



Society for Personality and Social Psychology

Additional services and information for *Personality and Social Psychology Bulletin* can be found at:

Email Alerts: <http://psp.sagepub.com/cgi/alerts>

Subscriptions: <http://psp.sagepub.com/subscriptions>

Reprints: <http://www.sagepub.com/journalsReprints.nav>

Permissions: <http://www.sagepub.com/journalsPermissions.nav>

Citations: <http://psp.sagepub.com/content/37/1/69.refs.html>

Planning What Not to Eat: Ironic Effects of Implementation Intentions Negating Unhealthy Habits

Personality and Social
Psychology Bulletin
37(1) 69–81
© 2011 by the Society for Personality
and Social Psychology, Inc
Reprints and permission:
sagepub.com/journalsPermissions.nav
DOI: 10.1177/0146167210390523
http://pspb.sagepub.com


Marieke A. Adriaanse¹, Johanna M. F. van Oosten¹,
Denise T. D. de Ridder¹, John B. F. de Wit^{1,2},
and Catharine Evers¹

Abstract

The present studies tested the effectiveness of implementation intentions with an “if [situation], then not [habitual response]” structure. Based on ironic process theory and the literature on the processing of negations, it was expected that these “negation implementation intentions” would, ironically, strengthen the habit (situation–response association) one aims to break. In line with the hypotheses, forming negation implementation intentions resulted in cognitive ironic rebound effects as well as behavioral ironic rebound effects compared to an intention only condition or a replacement implementation intention. Additionally, it was found that negation implementation intentions are most likely to result in ironic rebound effects when the habit to be negated is strong. Although implementation intentions are generally highly effective in facilitating behavior change even when this involves breaking unwanted habits, the present research suggests that they are ineffective when they have a negating structure.

Keywords

implementation intentions, ironic rebound effects, negation, habits, snacking

Received November 27, 2009; revision accepted August 22, 2010

For a wide range of behaviors, individuals regularly fail to translate their intentions into actual goal-directed behavior (Webb & Sheeran, 2006). However, in recent years it has been shown that furnishing one’s intentions with implementation intentions can increase the likelihood that intentions are acted upon (e.g., Gollwitzer, 1999; Gollwitzer & Sheeran, 2006). Whereas intentions merely specify a desired end-state (“I intend to achieve Z”), implementation intentions specify where, when, and how the end-state will be achieved and take the form of “If I am in situation X, then I will perform goal-directed behavior Y” (Gollwitzer, 1999). To illustrate, when formulating an implementation intention to support the intention to increase one’s fruit intake, a specific situation that is a good opportunity to act is identified (“having lunch at noon”) and linked to a specific goal-directed action (“eating an apple”), resulting in the following implementation intention: “If I have my lunch at noon, then I will eat an apple.”

By specifying a critical situation for acting on one’s intentions in advance, one becomes perceptually ready to recognize this situation and hence is less likely to miss it as a good opportunity to act. Moreover, since the situation is linked to a specific behavior, the control of the behavior is delegated

from the self to the critical cue specified in the implementation intention, resulting in an automatic response upon encountering this situation that does not require conscious effort or intent (Gollwitzer, 1999; Parks-Stamm, Gollwitzer, & Oettingen, 2007).

Breaking Habits by Means of Implementation Intentions

In addition to the bulk of convincing evidence demonstrating the effectiveness of implementation intentions in promoting the initiation of new behaviors, such as attending cancer screening or increasing fruit intake (e.g., Armitage, 2007; Sheeran & Orbell, 2000), more recently it has been proposed that implementation intentions can also be effective in *changing*

¹Utrecht University, Utrecht, The Netherlands

²University of New South Wales, Sydney, Australia

Corresponding Author:

Marieke A. Adriaanse, Department of Clinical and Health Psychology,
Utrecht University, P.O. Box 80140, 3508 TC Utrecht, The Netherlands
Email: M.A.Adriaanse@uu.nl

existing unwanted habits (e.g., quit eating fatty snacks; Gollwitzer, 1999; Gollwitzer & Sheeran, 2006; Holland, Aarts, & Langendam, 2006). Specifically, three types of counterhabitual implementation intentions have been proposed that may be effective in breaking habits (Gollwitzer, Bayer, & McCulloch, 2005; Sheeran, Milne, Webb, & Gollwitzer, 2005).

The first type of implementation intention that has been proposed for breaking habits is a “replacement implementation intention.” This type of implementation intention aims to reduce the “situation–habitual response” association by linking the critical cue for the habitual response to a *new, desired* response (e.g., Adriaanse, De Ridder, & De Wit, 2009; Holland et al., 2006). For example, if one always eats chocolate when feeling sad, a replacement implementation intention could be: “If I am sad, then I will cheer myself up by watching a comedy.” The effectiveness of replacement implementation intentions in breaking habits has been demonstrated in many studies (e.g., Adriaanse et al., 2009; Cohen, Bayer, Jaudas, & Gollwitzer, 2008; Holland et al., 2006; Schweiger Gallo & Gollwitzer, 2007; Schweiger Gallo, Keil, McCulloch, Rockstroh, & Gollwitzer, 2009; Stewart & Payne, 2008) targeting a variety of habits (e.g., unhealthy snacking habits, stereotyping).

A second type of implementation intention that has been proposed for breaking habits is an implementation intention specifying to *ignore* the critical cue. These “If X, then ignore X” plans have been shown to reduce fear reactions to spiders (Schweiger Gallo et al., 2009), to shield the goal of attending psychotherapy from unwanted negative affect (Sheeran, Aubrey, & Kellett, 2007), to reduce craving-induced unhealthy food intake, and to shield a goal of performing well from negative inner states of irritation and performance anxiety (Achtziger, Gollwitzer, & Sheeran, 2008).

The third type of implementation intention that has been proposed for breaking habits is an implementation intention that directly specifies *not* to perform the unwanted habitual behavior upon encountering the critical situation for that behavior (e.g., “If I am sad, then I will *not* eat chocolate”). Few studies have investigated the effectiveness of these “negation implementation intentions,” and the studies that have been conducted report mixed findings. In Gollwitzer and Schaal (1998, Study 3) an experiment is reported that shows that when a goal to judge old men in a nonstereotypical manner is augmented with the implementation intention “If I see an old man, then I will tell myself: Don’t stereotype!” the activation of the stereotype is inhibited. Similarly, Sullivan and Rothman (2008) showed that plans specifying where and when not to eat a certain unhealthy snack food facilitated the attainment of a goal to avoid unhealthy foods. However, Adriaanse, De Ridder, De Wit, and Evers (2010) showed that such avoidance plans actually resulted in an increased intake of unhealthy foods, and Otis and Pelletier (2008) reported increased levels of dysfunctional eating behavior as a result of planning to avoid unhealthy foods. In sum, as research on the effectiveness

of negation plans is limited and inconclusive, a more thorough investigation is needed.

Ironic Effects of Negation

As the essence of breaking habits is to *not* engage in the unwanted habitual behavior, negation implementation intentions seem to be the most straightforward type of implementation intention to break habits. Moreover, negation implementation intentions appear to have an advantage over replacement implementation intentions and ignore implementation intentions in terms of their practical applicability. The latter two types of plans are not always applicable because suitable alternatives may not always be available, and in many situations it may be difficult or impossible to ignore a situation eliciting the habitual response. For instance, when having the goal to stop eating unhealthy food but being at a party with only unhealthy snacks available, it is impossible to replace the unhealthy snacks by healthy substitutes, and it may be difficult to ignore the host offering the unhealthy snacks. Although negation implementation intentions would be applicable in such situations, there are two lines of research suggesting that, despite their practical applicability and straightforwardness, negation implementation intentions may not yield beneficial results.

First, according to Wegner’s (1994) ironic process theory, suppression of a thought may ironically result in this thought actually becoming more prevalent. According to Wegner, this effect may occur because suppression involves the activation of two concurrent systems: an intentional operating system and an automatic monitoring system. While the operating system is involved with searching for useful distractors, the monitoring system is involved with detecting failures in suppression, which, ironically, requires attention to be directed to the thought or behavior that is being suppressed. In case of stress or if other tasks require cognitive resources, the intentional operating system is disrupted, which has the ironic effect that the thought or behavior one is trying to suppress reaches awareness and is highly salient (Wegner, 1994).

Such ironic effects have been found in several domains. For example, trying not to stereotype has been found to result in greater stereotyping (Bodenhausen & Macrae, 1998). Similarly, Gawronski, Deutsch, Mbirkou, Seibt, and Strack (2008) showed that negating a stereotype without also activating the counterstereotype actually strengthened stereotypical activation. Moreover, suppression of anxiety-related thoughts has been found to result in increased anxiety (Koster, Rassin, Crombez, & Näring, 2003), and trying to suppress exciting sexual thoughts in fact causes increased sexual excitement (Wegner, Shortt, Blake, & Page, 1990).

Second, research on the processing of negating sentences indicates that implementation intentions specifying the negation of an unwanted response may be difficult to process. To understand a negated situation (e.g., “The door is *not* open”), a

mental representation of what is being negated (an open door) is made first, followed by a rejection of this situation, which will then lead to a representation of the true situation (a closed door; Kaup, Lüdtke, & Zwaan, 2006). This means that the situation that is being negated is initially made cognitively accessible. To illustrate, Hasson and Glucksberg (2006) showed that participants did not comprehend the true situation of a negation (e.g., “The train to Boston was no rocket”) until 500 to 1,000 ms after the sentence had been read. Before that point only the affirmative-related representation was accessible, as was shown by a facilitation of responses to affirmative-related prime words (e.g., *fast*). Similarly, Mayo, Schul, and Burnstein (2004) showed that negations spontaneously activated associations that were incongruent with the intended meaning of the negation, except when the negation had a readily accessible opposite schema (e.g., “It is not warm” and “It is cold”).

Ironic Effects of Negation Implementation Intentions

The literature outlined above suggests that forming negation implementation intentions may in fact result in an *increased*, instead of the intended *inhibited*, accessibility of the habitual response upon encountering the critical situation. To illustrate, when forming a negation implementation intention such as “If I am sad, then I will *not* eat chocolate,” the representation of eating chocolate when feeling sad would be made accessible first, *reinforcing* the association between the situation (sad) and the response (eating chocolate). As the studies mentioned earlier have indicated, subsequently trying to reject such a link is difficult (e.g., Hasson & Glucksberg, 2006; Mayo et al., 2004). Moreover, although negating sentences are always difficult, in the case of trying to suppress habits, the situation–habitual response association is already represented in memory as a strong cognitive link, which most likely makes it even more difficult to subsequently reject this association. Formulating a negation implementation intention may therefore leave the situation–habitual response association highly accessible, which would then actually increase the likelihood that the habitual response is executed upon encountering the situation.

Four studies were conducted to systematically test our hypothesis that negation implementation intentions will ironically result in a habit that is strengthened rather than inhibited. The behavior under study concerned unhealthy snacking. To provide an elaborate test of our hypotheses, the strength of the unhealthy snacking habit upon formulating negation implementation intentions was assessed on a cognitive level using lexical decision tasks (Studies 1 and 2), as well as on a behavioral level by means of snack diaries (Studies 3 and 4).

Study 1

It was hypothesized that forming the implementation intention “If [personal critical situation], then I will not eat chocolate!”

would result in a heightened accessibility of the critical situation–chocolate association, compared to forming a general goal intention.

Method

Participants. Female students who were motivated to eat fewer unhealthy snacks and who were not underweight (body mass index [BMI] < 18.5) or obese (BMI > 30) were invited to participate in a study on eating behavior (for similar inclusion criteria, see Adriaanse et al., 2009, Studies 1 and 2). Fifty-two females were recruited. Three participants with extreme reaction times (> 2.5 *SD* from the mean) on the critical trials of the lexical decision task were excluded from the analyses, as was 1 participant who responded incorrectly to the critical trials. This resulted in a total sample of 48 participants, with a mean BMI of 21.62 (*SD* = 1.96) and a mean age of 19.69 years (*SD* = 1.95).

Procedure and design. The experiment had a factorial design with condition (negation implementation intention vs. intention only) as a between-subjects factor. Participants were seated in individual cubicles behind a computer on which all tasks were administered. First, participants were told that in this experiment we wanted to help them eat fewer unhealthy snacks, and in particular less chocolate, because this is an unhealthy snack female students generally consume too much. Participants were asked to describe in one word their *critical cue* for eating chocolate (this could be any cue they considered relevant such as a time of day, a feeling, or an activity), which would later be used as the *critical cue prime* in the lexical decision task. The habit of eating chocolate was given because chocolate is a typical and popular snack and because this would allow for matching the other (neutral and non-) words in the lexical decision task to the word *chocolate* in word length and frequency.

After assessing participants’ liking of chocolate, all participants were reminded of their goal of eating fewer unhealthy snacks, and in particular consuming less chocolate, and were then randomly assigned to one of the two conditions: Half of the participants augmented their goal intention with a negation implementation intention, and the other half merely repeated their goal intention. Finally, a lexical decision task was administered to measure the strength of the association between the critical situation and the word *chocolate*. After finishing, participants were asked to indicate their age, height, and weight. Then, they were debriefed, reimbursed (€3 or course credit), and thanked for their participation.

Materials

Liking of chocolate. Participants were asked how much they liked chocolate on a 7-point scale ranging from 1 (*totally disagree*) to 7 (*totally agree*) to control for liking of chocolate.

Implementation intention. To minimize the difference in instructions between the two conditions, participants in both conditions were told that scientific research had shown that if one wants to stick to a goal it helps to make a certain type of plan. For participants in the intention only condition, this “plan” merely involved repeating their goal intention “I will not eat chocolate!” Participants in the negation implementation intention condition were given the following instructions to augment their goal intention to eat less chocolate with a more specific type of plan:

The plan will look as follows: “If (situation) and I want to have a snack, then I will not eat chocolate!” For instance, if you had indicated earlier that you usually eat chocolate when you are “bored,” then you will make the following plan: “If I am feeling bored and I want to have a snack, then I will not eat chocolate!” Please copy the following plan literally, while inserting your own situation “[generated critical situation]” by writing it down below: “If (situation) and I want to have a snack, then I will not eat chocolate!”

Participants in both conditions were then instructed to commit themselves to following their plan and were asked to visualize themselves executing the plan until the last screen closed after 60 s.

Lexical decision task. Participants had to indicate by using a left or right key on their keyboards (counterbalanced across participants) whether each given letter string was an existing word. The task consisted of two blocks of 16 trials, with each block including 1 critical trial, 7 neutral-word trials, and 8 non-word trials. On the critical trials, the word *chocolate* was shown, after being preceded by the critical situation prime word that participants in both conditions had generated themselves. The neutral and non-words were preceded by neutral prime words, non-prime words, and once per block with the situation prime word. The dependent variable was participants’ mean reaction time to the word *chocolate* after being primed with their critical situation (in milliseconds), with shorter reaction times indicating a higher cognitive activation of the situation–chocolate association.

Each trial started with a fixation cross at the center of the screen for 1 s, which was then replaced by a prime word, presented for 50 ms. The prime word was masked for 500 ms by a string of Xs, which was replaced by a target word that remained on the screen until participants had pressed the left or right key. Between two trials a blank screen was presented for 2 s as an intertrial interval. All trials were presented in random order and response times were measured from the onset of the target word until the moment participants pressed a response key. Only trials that participants responded to correctly were used to calculate average reaction times.

As mean reaction times on the trials of the lexical decision task were not normally distributed, reaction times were

natural log transformed. However, to facilitate interpretation, means and standard deviations are presented for the non-natural-log-transformed variable.

Results and Discussion

Descriptives and randomization check. Participants reported liking chocolate a lot ($M = 6.50$, $SD = 1.03$). To check whether randomization was successful, separate ANOVAs were performed with condition (negation implementation intention vs. intention only) as the independent variable and liking of chocolate, age, BMI, and reaction time to neutral words as the dependent variables. None of the ANOVAs yielded significant effects, $ps > .36$.

Situation–chocolate association. A one-way ANOVA was performed with condition as the independent variable and mean reaction time on the critical trials as the dependent variable.¹ The ANOVA showed a significant effect of condition, $F(1, 46) = 4.66$, $p < .05$, $\eta_p^2 = .09$; participants in the negation condition had shorter mean reaction times to the word *chocolate* after presentation of the situation prime ($M = 591.65$, $SD = 111.37$) than did participants in the intention only condition ($M = 704.74$, $SD = 224.17$). Results from Study 1 thus confirm the hypothesis that forming a negation implementation intention leads to a heightened activation of the cognitive situation–chocolate association compared to an intention only control condition.

Study 2

Because in Study 1 the word *chocolate* was only presented in combination with the situation prime, results of this study do not rule out the possibility that the effect was due to a heightened activation of the word *chocolate* instead of a heightened association between the critical situation and the word *chocolate*. Therefore, in Study 2 critical target words were preceded by a situation prime for half of the participants and by a neutral prime for the other half of the participants to rule out this alternative explanation.

Additionally, in Study 2 the effect of formulating a negation implementation intention was compared with an intention only condition as well as to a replacement implementation intention condition. The replacement implementation intention was formulated in such a manner that it was identical to the negation implementation intention, except that the negation (“then I will not”) was substituted with a replacement (“then instead of . . . I will . . .”). This additional control condition allowed for assessing whether ironic effects were truly caused by the negating structure of the negation implementation intention and not merely by the joint presentation of the situation and response in the implementation intention.

It is important to note that because of the “instead of” structure, the replacement implementation intention is different from replacement implementation intentions that have

been found effective in reducing unwanted habits in previous studies. These implementation intentions generally only specify the alternative behavior (e.g., “If critical situations X arises, then I will perform alternative behavior Y!”; e.g., Adriaanse et al., 2009) rather than the alternative behavior as well as the habitual behavior to be suppressed. We expect that although a negating structure is key to the ironic rebound effects that have been observed, rehearsing the old habitual cue–response association is never conducive to breaking habits. So, the replacement implementation intention employed in the present research is primarily used as a very strict control condition to demonstrate that the negating structure is essential for ironic rebound effects to occur, but it is not expected to yield any beneficial effects compared to the intention only condition.

Method

Participants. Female students who were motivated to eat fewer unhealthy snacks and who were not underweight (BMI < 18.5) or obese (BMI > 30) were invited to participate in a study on eating behavior. Ninety-eight females were recruited. After excluding 1 participant who responded extremely slowly (> 2.5 *SD*) to all critical trials, the final sample consisted of 97 participants with a mean BMI of 22.05 (*SD* = 2.18) and a mean age of 22.28 years (*SD* = 3.96).

Procedure and design. The experiment had a 3 (condition: negation implementation intention vs. intention only vs. replacement implementation intention) × 2 (prime: situation prime vs. neutral prime) between-subjects design. The general procedure was similar to Study 1 except that liking of chocolate was now assessed in a questionnaire after, rather than before, the manipulation. Even though liking of chocolate, chips, and cookies is probably relatively stable, it could be affected by the experimental manipulation. As we aim to correct for any effects of liking on the accessibility of the snack words in the lexical decision task, assessing liking after the experimental manipulation is thus most appropriate. Additionally, to ascertain that participants were intending to eat less unhealthy snacks and to rule out the possibility that any potential effects were due to differences in intention across conditions, a measure of the overarching goal intention to eat less unhealthy snacks was included in the questionnaire.

A final difference in the general procedure was that when generating their critical cue, this time participants were asked to describe in one word their critical cue for eating “unhealthy snacks, such as chocolate, chips or cookies.” Implementation intentions were targeted to the habit of eating unhealthy snacks in general (rather than the habit of eating chocolate specifically, as was done in Study 1), as this would allow for including a greater number of critical trials (i.e., *chocolate*, *chips*, and *cookies* instead of just the word *chocolate*) and thus increase the reliability of our findings.

Materials

Implementation intention. Instructions were similar to Study 1. However, this time, after rehearsing the general goal intention “I will eat less unhealthy snacks!” participants were randomly assigned to either the intention only control condition, the negation implementation intention condition, or the replacement implementation intention condition. Similar to Study 1, participants in the intention only control condition then simply rehearsed their general goal intention again, whereas participants in the negation implementation intention made the following plan: “If [self-generated critical situation] and I want to have a snack, then I will not eat an unhealthy snack!” Participants in the replacement implementation intention were instructed to form the implementation intention “If [self-generated critical situation] and I want to have a snack, then instead of an unhealthy snack I will eat a piece of fruit!”²

Questionnaire. Liking of chocolate, chips, and cookies was measured (“How much do you like chocolate/chips/cookies?”) on 7-point scales ranging from 1 (*not at all*) to 7 (*very much*). The strength of the overarching goal intention to eat less unhealthy snacks was assessed by four items (“I intend to/plan to/expect to/want to eat less unhealthy snacks in the near future”; $\alpha = .89$), rated on 5-point scales ranging from 1 (*totally disagree*) to 5 (*totally agree*).

Lexical decision task. The lexical decision task was similar to Study 1 except that this time it consisted of one block of 24 trials, including 3 critical trials, 9 neutral-word trials, and 12 non-word trials. In the critical trials, the word *chocolate*, *chips*, or *cookies* was shown after being preceded by the critical situation prime word that participants had generated themselves (prime condition) or a neutral word (no-prime condition). The dependent variable was the mean response time to the three critical trials. Only trials to which participants responded correctly were used to calculate average reaction times. Similar to Study 1, the dependent variable was not normally distributed and was therefore natural log transformed. However, means and standard deviations are presented for the non-natural-log-transformed variable.

Results and Discussion

Descriptives and randomization check. On average, participants had a moderate to high intention to eat less unhealthily ($M = 3.68$, $SD = .82$) and liked chocolate ($M = 5.69$, $SD = 1.47$), chips ($M = 5.01$, $SD = 1.50$), and cookies ($M = 5.23$, $SD = 1.29$) a lot. To check whether randomization was successful, separate ANOVAs were performed with condition (negation implementation intention vs. intention only vs. replacement implementation intention) and prime (prime vs. no-prime) as the independent variables and age, BMI, intention, and liking of chocolate, chips, and cookies as the dependent variables. Randomization was successful except for liking of chocolate, as the condition effect for this variable

was significant, $p < .01$. Specifically, participants in the negation implementation intention condition reported to like chocolate significantly less ($M = 4.91$, $SD = 1.72$) than participants in the intention only ($M = 6.14$, $SD = .91$), $p < .05$, or the replacement implementation intention ($M = 6.03$, $SD = 1.38$), $p < .05$, condition. Liking of chocolate was therefore entered as a covariate in subsequent analyses.

Situation–unhealthy snack association. An ANCOVA with condition and prime as the independent variables, liking of chocolate as a covariate, and the mean reaction time on the critical trials as the dependent variable revealed no main effects. However, as expected, the Condition \times Prime interaction was significant, $F(2, 90) = 3.00$, $p = .05$, $\eta_p^2 = .06$. Simple main effects within the neutral prime showed no effect of condition, $p = .28$. Simple main effects within the situation prime condition showed that the effect of the covariate liking of chocolate was significant, $F(1, 44) = 5.54$, $p < .05$, $\eta_p^2 = .11$, and revealed a significant effect of condition, $F(2, 44) = 4.40$, $p < .05$, $\eta_p^2 = .17$. Participants in the negation implementation intention condition had shorter mean reaction times to the critical target words ($M = 595.02$, $SD = 111.92$) than did participants in the intention only condition ($M = 651.13$, $SD = 144.13$), $p < .05$, and participants in the replacement implementation intention condition ($M = 676.17$, $SD = 96.76$), $p < .01$. The intention only condition did not differ significantly from the replacement implementation intention condition, $p = .46$.

Thus, Study 2 replicated the findings from Study 1, confirming the hypothesis that the activation of the situation–unhealthy snack association is heightened after formulating a negation implementation intention. Furthermore, the finding that ironic effects only occurred in the situation prime condition indicates that forming a negation implementation intention only heightens the accessibility of the *situation–unhealthy snack association* (i.e., the representation of the habit) and not just the accessibility of *unhealthy snack words* in general. Finally, ironic effects only occurred in the negation implementation intention condition and not in the replacement implementation intention condition despite the fact that both implementation intention manipulations (negation and replacement) included the situation word, the words *unhealthy snacks*, and the joint presentation of these two words equally often. Accordingly, these results indicate that the negating structure is critical for the ironic rebound effects to occur.

Study 3

To assess whether the cognitive ironic rebound effect also generalizes to actual snacking behavior, Study 3 was conducted in which reports of actual snacking behavior were included. It was hypothesized that forming a negation implementation intention results in an increased intake of unhealthy foods compared to both control conditions (intention only and replacement implementation intention condition).

Method

Participants. Female students who were motivated to eat fewer unhealthy snacks and who were not underweight (BMI < 18.5) or obese (BMI > 30) were invited to participate in a study on eating behavior. One hundred and thirty females were recruited to participate. Two participants who formulated incorrect implementation intentions were excluded from the analyses, as were 4 participants who failed to hand in their food diary. This resulted in a final sample of 124 participants with a mean BMI of 21.46 ($SD = 2.01$) and a mean age of 20.38 years ($SD = 1.97$).

Procedure and design. The experiment had a factorial design with condition (negation implementation intention vs. intention only vs. replacement implementation intention) as independent variable. The general procedure was similar to Study 2 except that after going through the experimental manipulation, filling out the questionnaire, and indicating their age, height, and weight, participants received a snack diary as the dependent measure. Participants were instructed on how to fill out the snack diary, and an individual appointment was made for returning the diary approximately 1 week later. Upon returning the diary, participants filled out a final questionnaire and were thanked, debriefed, and reimbursed.

Materials

Implementation intention. Instructions for the three conditions were similar to Study 2 except that instructions referred to the habit of eating chocolate specifically (see also Study 1). The negation implementation intention held: “If [self-generated critical situation] and I want to have a snack, then I will not eat chocolate!” and the replacement implementation intention held “If [self-generated critical situation] and I want to have a snack, then instead of chocolate I will eat an apple!”

Questionnaire. Intention to eat less unhealthily ($\alpha = .90$) was assessed similar to Study 2. Liking of chocolate was assessed by three items (“Eating chocolate is pleasant/enjoyable/tasty”), which could be answered on 5-point scales ($\alpha = .88$).

Snack diary. The snack diary was based on the snack diaries used by Adriaanse et al. (2009) and consisted of templates with one column displaying precoded options for healthy snacks and one column displaying precoded options for unhealthy snacks. For both columns, the option “other” was also provided. The diary was thoroughly explained to participants. Participants were asked to fill out one template for each snacking episode over 7 consecutive days following the experiment. The amount of snacks consumed could be indicated in appropriate units (e.g., “pieces” for cookies or fruits, and “handful” for chips).

The dependent variables were the frequency of unhealthy snacking as well as total caloric intake on unhealthy snacks over the week. Frequency of unhealthy snacking was calculated as the sum of templates in which unhealthy snacks

were reported. Caloric intake of unhealthy snacks was calculated by multiplying each reported snack by the average amount of kilocalories it contains.

Final questionnaire. Upon returning the diary, a final questionnaire was administered. Specifically, participants were asked about how motivated they had been to follow their plan during the week of filling in their snack diary, how seriously and honestly they had filled in their snack diary, and to what extent they thought the experimenter had wanted them to succeed in following their plan on 7-point scales ranging from 1 (*not at all*) to 7 (*very much*). These variables enabled controlling for unintended differences between the two conditions.

In addition to these control variables, participants were also asked to indicate how successful they had been in diminishing their chocolate consumption since doing the planning exercise on the computer, with responses given on a 7-point scale ranging from 1 (*not at all*) to 7 (*very much*). This item will be referred to as self-perceived success.

Results and Discussion

Descriptives and randomization check. On average, participants had a high intention to eat less unhealthily ($M = 3.94$, $SD = .75$) and liked chocolate a lot ($M = 4.05$, $SD = .66$). Furthermore, participants reported to have been moderately to highly motivated to follow their plan ($M = 4.94$, $SD = 1.34$), reported to have been very serious and honest ($M = 6.48$, $SD = .73$) in filling in their snack diaries, and felt that the experimenter wanted them to succeed in following their plan ($M = 4.93$, $SD = 1.24$). Separate ANOVAs were conducted with condition (negation implementation intention vs. intention only vs. replacement implementation intention) as the independent variable and age, BMI, intention to eat less unhealthily, liking of chocolate, motivation, seriousness and honesty of filling in the diary, and experimenter demand as the dependent variables. None of the ANOVAs showed a significant effect, $ps > .22$.

Snacking frequency. An ANOVA was performed with condition as the independent variable and frequency of unhealthy snacking as the dependent variable. The ANOVA showed a significant effect of condition, $F(2, 121) = 6.07$, $p < .01$, $\eta_p^2 = .09$. One-tailed planned contrasts indicated that more episodes of unhealthy snacking were reported in the negation implementation intention condition ($M = 12.61$, $SD = 5.93$) than in the replacement implementation intention condition ($M = 9.05$, $SD = 4.21$), $p < .01$, or than in the intention only condition ($M = 9.81$, $SD = 4.31$), $p < .01$. The replacement implementation intention condition did not differ significantly from the intention only condition, $p = .24$.

Caloric intake. To investigate whether the difference between conditions in frequency of unhealthy snacking episodes also implies a difference in caloric intake on unhealthy snacks, an ANOVA was performed with condition as independent variable and the amount of caloric intake due to consumption

of unhealthy snacks as the dependent variable. The ANOVA showed a significant effect of condition, $F(2, 119) = 3.15$, $p < .05$, $\eta_p^2 = .05$. One-tailed planned contrasts showed that participants in the negation implementation intention condition had a higher caloric intake on unhealthy snacks ($M = 2,903$, $SD = 1,674$) than participants in the replacement implementation intention condition ($M = 2,096$, $SD = 1,322$), $p < .01$, and a marginally significant higher caloric intake than participants in the intention only condition ($M = 2,400$, $SD = 1,341$), $p = .06$. The replacement implementation intention condition did not differ significantly from the intention only condition, $p = .17$.

Self-perceived success. To assess whether participants in the negation implementation intention condition differed in the extent to which they perceived having succeeded in diminishing their chocolate consumption, an ANOVA was conducted with self-perceived success as the dependent variable. This ANOVA revealed a marginally significant effect of condition, $F(2, 120) = 2.38$, $p < .10$, $\eta_p^2 = .04$. One-tailed planned contrasts showed that participants in the negation implementation intention condition perceived to have been less successful ($M = 3.28$, $SD = 1.45$) than participants in the intention only condition ($M = 3.98$, $SD = 1.54$), $p < .05$. The replacement implementation intention condition ($M = 3.71$, $SD = 1.40$) differed only marginally from the negation implementation intention, $p = .09$, and did not differ significantly from the intention only condition, $p = .20$.

Taken together, Study 3 showed that participants in the negation implementation intention condition consumed unhealthy snacks more frequently, consumed (marginally) more calories from unhealthy snacks, and reported lower self-perceived success in diminishing chocolate consumption compared to the intention only condition. These findings show that the cognitive effects of negation implementation intentions as demonstrated in Studies 1 and 2 are relevant as they also generalize to actual behavior.

Study 4

A pitfall of assessing overall snack consumption in a diary in Study 3 was that it was difficult to validly distill the amount of chocolate consumed from such a broad measure (i.e., if someone reports to have eaten a piece of cake or a cookie, it was often unclear whether this may have been chocolate cake or a chocolate cookie and whether this should be added to the amount of chocolate consumed). Therefore, a limitation of Study 3 is that the amount of chocolate consumed could not be used as a dependent measure. To ensure a closer match between the content of the implementation intentions and the dependent measure assessing *overall* unhealthy snack intake, a fourth study was conducted where the negation implementation intention focused on the more general habit of “snacking unhealthily” (see also Study 2) rather than the habit of eating chocolate.

Another objective of this fourth study was to assess habit strength as a potential moderator. Considering that the few studies that have previously investigated the effectiveness of negation implementation intentions yielded mixed findings ranging from positive effects to ironic rebound effects, moderating factors may be responsible for the inconsistent effectiveness of negation implementation intentions. A likely candidate moderator variable is the *strength* of the habit one is trying to break: It makes sense to assume that the stronger the situation–habitual response association is represented in memory before forming the negation implementation intention, the higher the likelihood that one fails to reject this association. It was thus hypothesized that negation implementation intentions would result in ironic rebound effects, particularly for strong rather than weak habits.

To investigate this, the effect of negation implementation intentions on unhealthy snacking behavior was compared with a replacement implementation intention condition as well as with an active control condition. That is, instead of employing an intention only control condition, Study 4 employed a control condition in which participants had to list options for healthy snacks in addition to forming a strong goal intention. This additional task was included to ensure that participants would all spend an equal amount of time working on a task related to healthy eating (Adriaanse et al., 2009).

Method

Participants. Female students who were motivated to eat fewer unhealthy snacks and who were not underweight (BMI < 18.5) or obese (BMI > 30) were invited to participate in a study on eating behavior. Sixty-five students were recruited, and 61 students handed in their food diary. These students had a mean BMI of 21.98 ($SD = 2.09$) and a mean age of 21.00 years ($SD = 1.88$).

Procedure and design. The experiment had a 3 (condition: negation implementation intention vs. intention + healthy options vs. replacement implementation intention) \times 2 (habit strength: weak vs. strong) between-subjects design. Participants were first asked to fill out a questionnaire, which included the measure of unhealthy snacking habit strength. Participants were then randomly assigned to one of the three experimental conditions and received the corresponding instructions. Unlike the previous three studies, the questionnaire and experimental manipulation were administered on paper rather than on the computer. Instructions and procedures for filling out and returning the diary as well as debriefing and reimbursement were similar to Study 3.

Materials

Questionnaire. Participants' intention to eat less unhealthily ($\alpha = .94$) was assessed similar to Study 3, but this time 7-point scales, ranging from 1 (*totally disagree*) to 7 (*totally*

agree), were used. Habit strength of eating unhealthy snacks was measured using the Self-Report Habit Index (SRHI; Verplanken & Orbell, 2003). The SRHI consists of 12 items ($\alpha = .94$) measuring habit strength and was, for the purpose of this study, adapted in such a way that it referred to the habit of eating unhealthy snacks (e.g., "Eating unhealthy snacks is something I do without thinking about it") Participants indicated their response on 7-point scales ranging from 1 (*totally disagree*) to 7 (*totally agree*).

Implementation intentions. Participants were randomly assigned to one of three conditions. Participants in the implementation intention conditions were reminded of their goal of eating less unhealthy snacks. Then they were asked to describe in one word their personal critical situation in which they usually eat unhealthy snacks. Participants were explained that unhealthy snacks referred to all types of unhealthy food that are eaten in between meals, and some examples of unhealthy snacks were provided. The critical situation was subsequently used in the implementation intention, which held "If [self-generated critical situation] and I want to have a snack, then I will not take an unhealthy snack!" in the negation implementation intention condition and "If [self-generated critical situation] and I want to have a snack, then instead of an unhealthy snack I will eat a piece of fruit!" in the replacement implementation intention condition.

Participants in the intention + healthy options condition were reminded of their goal of eating less unhealthy snacks and were then asked to make a list of at least 5 and a maximum of 10 of their favorite healthy snacks (see also Adriaanse et al., 2009).

Snack diary. The snack diary was similar to Study 3, but to make the study less demanding for participants, they were allowed to aggregate their unhealthy snack consumption in one entry for each day. The dependent variable was the amount of kilocalories consumed on unhealthy snacks.

Final questionnaire. Similar to Study 3, when handing in their snack diaries, participants were asked several control questions. This time participants were asked how motivated they had been to eat less unhealthy snacks during the week of filling in their snack diary, how seriously and honestly they had filled in their snack diary, how serious they had been in doing the exercise (i.e., formulating the implementation intention or listing options for healthy snacks), and to what extent they had trusted, before keeping the diary, that the exercise would be helpful in achieving the goal of eating less unhealthy snacks, on 7-point scales ranging from 1 (*totally disagree*) to 7 (*totally agree*).

Results and Discussion

Descriptives and randomization check. Participants had strong intentions to eat less unhealthy snacks in the coming days ($M = 5.73$, $SD = 1.29$) and had moderately strong unhealthy snacking habits ($M = 4.03$, $SD = 1.17$). Moreover, participants

reported to have been moderately to highly motivated to eat less unhealthy snacks ($M = 5.26$, $SD = 1.22$), very serious and honest ($M = 6.66$, $SD = .68$) in filling in their snack diaries, serious in doing the exercise ($M = 5.42$, $SD = 1.16$), and rather confident that the exercise would be helpful to achieve the goal of eating less unhealthy snacks ($M = 5.17$, $SD = 1.32$).

To check whether randomization was successful, separate ANOVAs with condition (negation implementation intention vs. intention + healthy options vs. replacement implementation intention) as the independent variable and age, BMI, habit strength, intention to eat less unhealthy snacks, retrospective motivation, seriousness and honesty of filling in the diary, seriousness of doing the exercise, and trust in the exercise as the dependent variables were performed. None of the effects reached significance, $ps > .20$.

Unhealthy snacking behavior. To assess the assumed moderating effect of habit strength, a multiple linear regression analysis was conducted with caloric intake of unhealthy snacks as the dependent variable. A dummy variable for the negation implementation intention condition and a dummy variable for the replacement implementation intention condition (the intention + healthy options condition was used as the reference condition), habit strength, and the interaction terms of habit strength, which each of the two dummies were entered simultaneously into the model (see Table 1 for zero-order correlations). Habit strength was mean centered before being entered into the model (Aiken & West, 1991). The analysis revealed that the model was significant and included a marginally significant effect of the negation implementation intention condition and, more importantly, a significant Habit Strength \times Negation Implementation Intention interaction (see Table 2).

To examine this interaction, simple slopes were computed for participants with weak versus strong unhealthy snacking habits (+1 SD vs. -1 SD of the mean habit strength score; Aiken & West, 1991). Simple slopes analyses indicated that when participants had relatively strong unhealthy snacking habits, making negation plans significantly increased unhealthy snack consumption compared to the intention + healthy options condition ($B = 1,456.10$, $p < .01$), whereas for participants with relatively weak unhealthy snacking habits, condition was not related to unhealthy snack consumption ($B = -371.86$, $p = .41$). Estimated mean scores for caloric intake of unhealthy snacks for weak and strong habits across the three conditions are depicted in Table 3.

Study 4 confirmed the hypothesis that forming a negation implementation intention results in a higher consumption of unhealthy snacks particularly when negation implementation intentions are targeted at strong habits.

General Discussion

Ever since the introduction of implementation intentions as a means of translating intentions into goal-directed behavior (Gollwitzer, 1993), a body of evidence has accumulated that

Table 1. Study 4: Means, Standard Deviations, and Correlations of Variables Used in the Regression Analysis

	1	2	3	4
1. Replacement II	—			
2. Negation II	-.49**	—		
3. Unhealthy snack habit strength	.09	-.03	—	
4. Caloric intake on unhealthy snacks	-.16	.24†	.23†	—
<i>M</i>			4.03	1,655.38
<i>SD</i>			1.17	1,096.41

Replacement II = dummy variable created for the replacement implementation intention condition; Negation II = dummy variable created for the negation implementation intention condition.

† $p < .10$. ** $p < .01$.

Table 2. Study 4: Results of Regression Analysis for Caloric Intake on Unhealthy Snacks

	<i>B</i>	<i>t</i>	ΔF	ΔR^2
Model			3.49	.24**
Replacement II	-139.78	-0.46		
Negation II	542.12†	1.68		
Unhealthy snack habit strength (USHS)	-65.07	-0.31		
Replacement II \times USHS	127.67	0.47		
Negation II \times USHS	781.0**	2.71		

Replacement II = dummy variable created for the replacement implementation intention condition; Negation II = dummy variable created for the negation implementation intention condition.

† $p < .10$. ** $p < .01$.

Table 3. Study 4: Estimated Means for Caloric Intake on Unhealthy Snacks per Condition for Weak Versus Low Habits (Median Split)

	Condition		
	Negation II	Replacement II	Control
Weak habit	1,418.04	1,428.33	1,494.54
Strong habit	2,692.78	1,415.58	1,628.35

attests to its efficacy in numerous domains and in different samples. Although most of this evidence initially concerned goal striving in terms of initiating new and wanted behaviors, it has been suggested that implementation intentions can also be beneficial when goal striving concerns breaking existing habits. One type of counterhabitual implementation intention that has been suggested to be effective in breaking

existing habits is an implementation intention that specifies the *negation* of the habitual response (Gollwitzer et al., 2005; Sheeran et al., 2005).

As the research that has been conducted to investigate the efficacy of this type of implementation intention is scarce and has produced mixed findings (Adriaanse et al., 2010; Gollwitzer & Schaal, 1998; Otis & Pelletier, 2008; Sullivan & Rothman, 2008), the present studies were designed to test the effectiveness of negation implementation intentions in breaking unhealthy snacking habits. Based on studies demonstrating the difficulty of processing negations (Kaup et al., 2006; Mayo et al., 2004), and on findings demonstrating ironic rebound effects of thought suppression (Wegner, 1994), it was hypothesized that negation implementation intentions would strengthen the association between a critical situation and a habitual response and could therefore actually reinforce the habit one tries to break.

Study 1 showed that forming a negation implementation intention resulted in a heightened cognitive situation–snack association compared to an intention only condition. Study 2 replicated this finding and, importantly, showed that this effect only occurred for the *specific* snacking habit and not for the activation of the snack word in general. Additionally, by including a replacement implementation intention condition the alternative explanation that it was not the negation of the habit but the mere joint presentation of the critical cue and unwanted response that causes the ironic rebound effects was ruled out. Study 3 showed the ironic rebound effects on a behavioral level: Forming negation implementation intentions resulted in more unhealthy snack consumption (in terms of snacking frequency and caloric intake) compared to merely forming a goal intention or forming replacement implementation intentions.

Based on the mixed findings that have been reported previously for the effectiveness of negation implementation intentions, it was hypothesized that the extent to which negation plans lead to ironic rebound effects depends on the strength of the habit that is being suppressed. Study 4 investigated the moderating impact of habit strength and revealed that ironic rebound effects significantly increased when the habit to be suppressed was strong rather than weak. Although habit strength has been found to moderate implementation intention effectiveness in previous work on implementation intentions (Gollwitzer & Sheeran, 2006; Webb, Sheeran, & Luszczynska, 2009), this is the first time that its moderating role has been assessed in relation to negation implementation intentions.

Our findings that negation implementation intentions lead to ironic rebound effects are in line with previous studies showing that negations can result in the activation of incongruent concepts or associations in the absence of a readily accessible opposite schema (Mayo et al., 2004) or alternative concepts (Gawronski et al., 2008; Wegner, Schneider, Carter, & White, 1987). As there is no readily accessible opposite cognitive schema for *not* eating chocolate (except eating

chocolate) when a negation plan to not eat chocolate in a critical situation is formed, such negation plans resulted in a heightened activation of the situation–chocolate association. Results from Studies 2, 3, and 4 are particularly interesting in this respect, as these revealed that when an alternative schema or response is provided, as was done in the replacement implementation intention condition (i.e., eating an apple or a piece of fruit), no cognitive or behavioral ironic rebound effects occur.

The present findings are also in line with ironic process theory (Wegner, 1994), which states that trying to suppress a certain thought most likely results in the subsequent intrusion of these thoughts, in particular when one is under high cognitive load. The present findings add to this that thought suppression is also likely to result in ironic rebound effects when it concerns the suppression of associations that are already strongly represented in memory. This idea is further corroborated by findings from Study 4 that revealed that ironic rebound effects of negation implementation intentions are most likely to occur in case of suppressing strong rather than weak habits.

This moderating effect of habit strength might explain why Sullivan and Rothman (2008) found positive effects for negation implementation intentions. In this study, participants could choose an approach goal (i.e., to snack on more healthy foods) or an avoidance goal (i.e., to snack on fewer unhealthy foods) and were then randomly assigned to make a corresponding implementation intention or not. It could be argued that avoidance goals may have only been chosen by people who judged this goal to be easy, for instance, by people who do not have a strong habit of eating unhealthy foods. This would explain why in this study no ironic rebound effects were found for negation implementation intentions. A study by Van Oosten (2009, Study 4) supports this assumption. Results from this study indicated that when allowed to choose between a plan to not eat chocolate in a critical situation or a plan to substitute chocolate with a piece of fruit in a critical situation, participants with a strong habit of eating chocolate in that critical situation were indeed less likely to choose the negation plan.

Similar to Sullivan and Rothman (2008), Gollwitzer and Schaal (1998) reported positive effects for negation implementation intentions. Specifically, these authors showed that an implementation intention with the format “If I see an old man, then I will tell myself: Don’t stereotype!” can be effective in inhibiting the activation of stereotypical beliefs regarding elderly men. However, an important difference between this negation implementation intention and the negation implementation intentions used in the present research is that the plan formulated in the study on reducing stereotypical beliefs essentially has an approach format. Rather than directly negating the habitual cue–response association, this implementation intention specifies to perform the action of *telling oneself* not to behave in a certain way. It could thus be argued that the implementation intention used in this study on reducing

stereotypical beliefs is not actually a negation implementation intention.

The present findings have important implications for strategies and interventions aimed at changing unwanted habits. Whereas previous research has mostly reported beneficial effects of implementation intentions, potentially leading to the assumption that all implementation intentions are (equally) effective, the present research underlines the importance of differentiating between different formulations of implementation intentions when goal striving concerns changing existing habits. Specifically, the present findings are among the first to indicate that even a highly effective self-regulatory strategy such as the formulation of implementation intentions has its boundary conditions: When targeting existing (strong) habits, it seems prudent to be cautious in the formation of implementation intentions and to make sure that they do not have a negating structure.

Considering the positive effects that have previously been reported, one is probably better off choosing replacement implementation intentions (e.g., Adriaanse et al., 2009; Cohen et al., 2008; Holland et al., 2006; Schweiger Gallo et al., 2009; Schweiger Gallo & Gollwitzer, 2007; Stewart & Payne, 2008) to successfully break habits. However, we hasten to say that these replacement implementation intentions should, similar to the studies outlined above, specify only the alternative behavior (e.g., “If critical situations X arises, then I will perform alternative behavior Y!”; e.g., Adriaanse et al., 2009) rather than the alternative behavior as well as the behavior to be suppressed. The latter was done in the present studies only to create a very strict control condition but does not benefit the efficacy of the implementation intention.

Another alternative type of implementation intention that could be considered when aiming to suppress existing habits is ignore implementation intentions. Instead of negating or replacing existing responses, these plans specify to ignore the critical stimulus (Sheeran et al., 2005). The ignore plan has been found to be effective in breaking habits (e.g., Achtziger et al., 2008) but was not investigated in the present research because the replacement plan allowed for a more identical comparison with the negation plan. That is, the latter two types of implementation intentions both require changing the representation of the critical situation–habitual response association, whereas forming an ignore plan only bears on the representation of the critical situation. However, the very fact that ignore implementation intentions do not involve an alteration of an existing association may make this type of counterhabitual implementation intention highly effective in breaking habits.

Limitations

Several limitations of the present studies have to be noted. First, because idiosyncratic critical cues were used in Studies 1 and 2, word length and frequency of the neutral and critical primes could not be controlled for. One could argue that this

lack of control over the linguistic qualities of the primes limits the interpretability of our effects. However, it is important to note that critical cues were entered by participants *before* they were randomly divided over the experimental conditions, which greatly limits the likelihood that the primes’ linguistic qualities differed across conditions.

Second, findings for actual food intake in Studies 3 and 4 were based on self-report. However, we controlled for several variables such as honesty and seriousness in filling in the snack diaries. Moreover, besides investigating behavioral effects, similar effects were found on cognitive measures, which strengthens our confidence that results for food intake are reliable. The fact that cognitive as well as behavioral measures were employed is also a major improvement to previous studies that restricted their findings to either cognitive measures (e.g., Webb & Sheeran, 2007) or overt behavioral measures (e.g., Achtziger et al., 2008; Adriaanse et al., 2009).

Third, it could be argued that merely setting the goal intention to eat fewer unhealthy snacks may by itself already lead to ironic rebound effects. Although this may be true, investigating the effect of intentions was not the topic of the present research. Similar to other implementation intention studies, we aimed to investigate whether, given a certain goal intention, implementation intentions can enhance the likelihood that this goal intention is acted on. Moreover, other studies in which the overarching goal intention also involved *not* to perform a certain behavior, such as not getting frightened (Schweiger Gallo et al., 2009; Schweiger Gallo & Gollwitzer, 2007), not getting disgusted (Schweiger Gallo et al., 2009), and not consuming unhealthy snacks (Adriaanse et al., 2009) found positive effects for another type of implementation intention (replacement implementation intention). This makes it unlikely that the ironic rebound effects found in the present study were merely due to the overarching goal intention being not to eat unhealthy snacks.

A final limitation is that participants were not allowed to choose their own response in the “then” part of their implementation intention. However, to the best of our knowledge, Studies 1 and 2 are already unique in using at least some idiosyncratic material (personal critical cue) in the formulation of implementation intentions and the corresponding targets in the lexical decision tasks.

Conclusion

The present studies provide an important and novel contribution to the literature on implementation intentions in showing that although implementation intentions facilitate the initiation of new and wanted behavior, there are certain boundary criteria when it comes to avoiding a habitual response. Even though negation implementation intentions seem straightforward and easily applicable, these plans are likely to result in cognitive as well as behavioral ironic rebound effects when used for breaking habits. Therefore, in

the case of avoiding an unwanted habitual response, the most important criterion for constructing effective implementation intentions seems to be the absence of a negating structure.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the authorship and/or publication of this article.

Funding

The authors received no financial support for the research and/or authorship of this article.

Notes

1. A 2 (block: first block vs. second block; within subjects) \times 2 (condition: negation implementation intention vs. intention only; between subjects) repeated measures ANOVA with reaction time to the word *chocolate* as dependent variable indicated there was a main effect of condition, $F(1, 45) = 4.17, p < .05$. Results further indicated that although reaction times were significantly slower in the second block $F(1, 45) = 4.91, p < .05$, the effect of condition was not moderated by block, $p = .86$. Therefore, it was concluded that reaction times to the critical target *chocolate* in the first and second blocks could be averaged and analyzed in a one-way ANOVA to facilitate interpretation.
2. The alternative response of eating a piece of fruit was given in the replacement implementation intention condition because letting participants choose their own alternative would have made the replacement implementation intention more personal than the negation implementation intention. Since personal plans are more likely to have a beneficial effect on goal progress (Koestner et al., 2006) this could have confounded results.

References

- Achtziger, A., Gollwitzer, P. M., & Sheeran, P. (2008). Implementation intentions and shielding goal striving from unwanted thoughts and feelings. *Personality and Social Psychology Bulletin, 34*, 381-393.
- Adriaanse, M. A., De Ridder, D. T. D., & De Wit, J. B. F. (2009). Finding the critical cue: Implementation intentions to change one's diet work best when tailored to personally relevant reasons for unhealthy eating. *Personality and Social Psychology Bulletin, 35*, 60-71.
- Adriaanse, M. A., De Ridder, D. T. D., De Wit, J. B. F., & Evers, C. (2010). *Avoiding unhealthy snacks: The role of avoidance plans and self-determination*. Manuscript submitted for publication.
- Aiken, L. S., & West, R. R. (1991). *Multiple regression: Testing and interpreting interactions*. Newbury Park, CA: Sage.
- Armitage, C. J. (2007). Effects of an implementation intention-based intervention on fruit consumption. *Psychology and Health, 22*, 917-928.
- Bodenhausen, G. V., & Macrae, C. N. (1998). Stereotype activation and inhibition. In R. S. Wyer Jr. (Ed.), *Stereotype activation and inhibition: Advances in social cognition* (Vol. 11, pp. 1-52). Mahwah, NJ: Erlbaum.
- Cohen, A. L., Bayer, U. C., Jaudas, A., & Gollwitzer, P. M. (2008). Self-regulatory strategy and executive control: Implementation intentions modulate task switching and Simon task performance. *Psychological Research, 72*, 12-26.
- Gawronski, B., Deutsch, R., Mbirikou, S., Seibt, B., & Strack, F. (2008). When "just say no" is not enough: Affirmation versus negation training and the reduction of automatic stereotype activation. *Journal of Experimental Social Psychology, 44*, 370-377.
- Gollwitzer, P. M. (1993). Goal achievement: The role of intentions. *European Review of Social Psychology, 4*, 141-185.
- Gollwitzer, P. M. (1999). Implementation intentions: Strong effects of simple plans. *American Psychologist, 54*, 493-503.
- Gollwitzer, P. M., Bayer, U. C., & McCulloch, K. C. (2005). The control of the unwanted. In R. R. Hassin, J. S. Uleman, & J. A. Bargh (Eds.), *The new unconscious* (pp. 485-516). Oxford, UK: Oxford University Press.
- Gollwitzer, P. M., & Schaal, B. (1998). Metacognition in action: The importance of implementation intentions. *Personality and Social Psychology Review, 2*, 124-136.
- Gollwitzer, P. M., & Sheeran, P. (2006). Implementation intentions and goal achievement: A meta-analysis of effects and processes. *Advances in Experimental Social Psychology, 38*, 69-119.
- Hasson, U., & Glucksberg, S. (2006). Does understanding negation entail affirmation? An examination of negated metaphors. *Journal of Pragmatics, 38*, 1015-1032.
- Holland, R. W., Aarts, H., & Langendam, D. (2006). Breaking and creating habits on the working floor: A field experiment on the power of implementation intentions. *Journal of Experimental Social Psychology, 42*, 776-783.
- Kaup, B., Lüdtke, J., & Zwaan, R. A. (2006). Processing negated sentences with contradictory predicates: Is a door that is not open mentally closed? *Journal of Pragmatics, 38*, 1033-1050.
- Koestner, R., Horberg, E. J., Gaudreau, P., Powers, T., Di Dio, P., Bryan, C., . . . & Salter, N. (2006). Bolstering implementation plans for the long haul: The benefits of simultaneously boosting self-concordance or self-efficacy. *Personality and Social Psychological Bulletin, 32*, 1547-1558.
- Koster, E. H. W., Rassin, E., Crombez, G., & Näring, G. W. B. (2003). The paradoxical effects of suppressing anxious thoughts during imminent threat. *Behaviour Research and Therapy, 41*, 1113-1120.
- Mayo, R., Schul, Y., & Burnstein, E. (2004). "I am not guilty" vs. "I am innocent": Successful negation may depend on the schema used for its encoding. *Journal of Experimental Social Psychology, 40*, 433-449.
- Otis, N., & Pelletier, L. G. (2008). Women's regulation styles for eating behaviors and outcomes: The mediating role of approach and avoidance food planning. *Motivation and Emotion, 32*, 55-67.
- Parks-Stamm, E. J., Gollwitzer, P. M., & Oettingen, G. (2007). Action control by implementation intentions: Effective cue

- detection and efficient response initiation. *Social Cognition*, 25, 248-266.
- Schweiger Gallo, I., & Gollwitzer, P. M. (2007). Implementation intentions: Control of fear despite cognitive load. *Psicothema*, 19, 280-285.
- Schweiger Gallo, I., Keil, A., McCulloch, K. C., Rockstroh, B., & Gollwitzer, P. M. (2009). Strategic automation of emotion regulation. *Journal of Personality and Social Psychology*, 96, 11-31.
- Sheeran, P., Aubrey, R., & Kellett, S. (2007). Increasing attendance for psychotherapy: Implementation intentions and the self-regulation of attendance-related negative affect. *Journal of Consulting and Clinical Psychology*, 75, 853-863.
- Sheeran, P., Milne, S. E., Webb, T. L., & Gollwitzer, P. M. (2005). Implementation intentions. In M. Conner & P. Norman (Eds.), *Predicting health behavior* (2nd ed., pp. 276-323). Buckingham, UK: Open University Press.
- Sheeran, P., & Orbell, S. (2000). Using implementation intentions to increase attendance for cervical cancer screening. *Health Psychology*, 19, 283-289.
- Stewart, B. D., & Payne, B. K. (2008). Bringing automatic stereotyping under control: Implementation intentions as efficient means of thought control. *Personality and Social Psychology Bulletin*, 34, 1332-1345.
- Sullivan, H. W., & Rothman, A. J. (2008). When planning is needed: Implementation intentions and attainment of approach versus avoidance health goals. *Health Psychology*, 27, 438-444.
- Van Oosten, J. M. F. (2009). "Then I will not negate." *On the effectiveness of implementation intentions suppressing a habitual snacking response* (Unpublished master's thesis). Graduate School of Social Sciences, Utrecht University, Utrecht, the Netherlands.
- Verplanken, B., & Orbell, S. (2003). Reflections on past behavior: A self-report index of habit strength. *Journal of Applied Social Psychology*, 33, 1313-1330.
- Webb, T. L., & Sheeran, P. (2006). Does changing behavioral intentions engender behavioral change? A meta-analysis of the experimental evidence. *Psychological Bulletin*, 132, 249-268.
- Webb, T. L., & Sheeran, P. (2007). How do implementation intentions promote goal attainment? A test of component processes. *Journal of Experimental Social Psychology*, 43, 295-302.
- Webb, T. L., Sheeran, P., & Luszczynska, A. (2009). Planning to break unwanted habits: Habit strength moderates implementation intention effects on behaviour change. *British Journal of Social Psychology*, 48, 507-523.
- Wegner, D. M. (1994). Ironic processes of mental control. *Psychological Review*, 101, 34-52.
- Wegner, D. M., Schneider, D., Carter, S. R., & White, T. L. (1987). Paradoxical effects of thought suppression. *Journal of Personality and Social Psychology*, 53, 5-13.
- Wegner, D. M., Shortt, J. W., Blake, A. W., & Page, M. S. (1990). The suppression of exciting thoughts. *Journal of Personality and Social Psychology*, 58, 409-418.