

Planning to Break Habits

Efficacy, Mechanisms, and Boundary Conditions of Implementation
Intentions Targeting Unhealthy Snacking Habits

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Planning to Break Habits

Efficacy, Mechanisms, and Boundary Conditions of Implementation Intentions Targeting
Unhealthy Snacking Habits

Plannen om Gewoontes te Doorbreken

De Effectiviteit, Mechanismen, en Randvoorwaarden van Implementatie Intenties in het
Doorbreken van Ongezonde Snack Gewoontes

(met een samenvatting in het Nederlands)

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Chapter 1

General Introduction

In this dissertation it is investigated whether planning can be used as a strategy to break unwanted habits. Most people probably have ‘planned’ to break a bad habit at some point in their lives. In fact, many of us ‘plan’ to break our bad habits quite frequently; we make strong commitments to ourselves, or to a significant other, to really finally quit smoking tomorrow (or maybe next year). Or we may, in a moment of strong determination, order Sonja Bakker’s latest diet book because this time we are definitely going to start dieting - really - the very minute the book is delivered. Yet, this is not the type of planning that is referred to in this dissertation, as most people who have made such ‘plans’ to quit smoking, or start dieting, will most likely acknowledge that their success rate is not all too impressive. Indeed, these type of outcome plans - labeled ‘goal-intentions’ in the Social and Health Psychology literature - are only weak predictors of behavior, especially when that behavior involves trying to break habits (Webb & Sheeran, 2006).

The plans that are the topic of this dissertation are labeled ‘implementation intentions’ (Gollwitzer, 1999). These are plans that are actually formulated *in addition* to general goal-intentions. Implementation intentions have been found to promote acting in line with one’s intentions, especially when these intentions involve the performance of new and wanted behaviors (e.g., to start taking vitamin C tablets; Sheeran & Orbell, 1999). Their efficacy has not been tested much, however, for goal-intentions that pertain to breaking unwanted habits, such as quitting smoking or diminishing one’s unhealthy snack intake. This is what I will be investigating in the present dissertation. However, before going into the specifics of this dissertation, a more thorough overview of the literature on intentions, implementation intentions, and habits will be provided to outline more elaborately the theoretical basis for the research described in this dissertation. Thereafter, I will introduce the specific research questions of this dissertation and provide an outline of the five empirical chapters in which these research questions are tested.

The Road to Hell is Paved with Good Intentions

Many theories in Social and Health Psychology identify the presence of strong goal-intentions (e.g., “I intend to quit smoking!”) as the key to successful goal-directed behavior (e.g., Ajzen, 1991; Carver & Scheier, 1982; Locke & Latham, 1990). However, despite numerous studies and meta-analyses demonstrating that a strong association between goal intentions and goal-directed action indeed exists (Ajzen, 1991; Armitage & Connor, 2001), in recent years the central role of intentions as the solution to successful behavior change has been challenged. This challenge resulted from the observation, in particular in the health domain, that for a wide range of (difficult) behaviors, such as quitting smoking (D’Onofrio, Moskowitz, & Braverman, 2002), or maintaining a low fat diet (Armitage, 2004), individuals regularly failed to act in accord with their good intentions, despite being highly motivated. This lack of correspondence between intentions and behavior (the ‘intention-behavior gap’; Orbell, Hodgkins, & Sheeran, 1997; Sheeran & Orbell, 1999) turned out to be a common observation in Social and Health Psychology and led researchers to acknowledge that although having strong goal intentions is a *necessary* prerequisite, it is generally not *sufficient* for behavior change, in particular when goal-striving is difficult (Gollwitzer & Oettingen, 1998).

The reason why being strongly motivated to perform a certain behavior is not sufficient to ensure behavioral enactment is that successful goal-striving is dependent on resources - such as memory, attention, and self-control - which are limited. Due to the fact that these resources are limited, several self-regulatory problems may hinder the process of successful goal striving (Gollwitzer & Sheeran, 2006). For example, when we are fatigued or preoccupied with other activities, we may fail to remember to act on our intentions, or our attention may wander so that we miss good opportunities to act (Gollwitzer & Sheeran, 2006). Or, after having had to resist the temptation of surfing on the internet while writing a boring report, little self-control is left for resisting that delicious brownie offered to you by a colleague (Muraven, Tice, & Baumeister, 1997). In fact, for many of our health goals, we need to have resources available pretty much all day in order to be successful in goal-striving. For example, in our ‘toxic food environment’ (Wadden, Brownell, & Foster, 2002) tempting unhealthy foods are available everywhere. For a person intending to eat less unhealthily even short lapses in attention or self-control may thus already be detrimental to successful goal-striving. So, as the saying “The road to hell is paved with good intentions”, illustrates, for difficult behaviors that rely heavily on conscious attention and the ability to exert self-control (e.g., refraining from smoking, drinking alcohol, or eating unhealthy foods), merely having strong intentions might not get us any closer to attaining our goal at all. That is, if we do not use the proper self-regulatory strategies, such as forming implementation intentions.

He Who Fails to Plan, Plans to Fail

Even when resources are (temporarily) low, this does not necessarily have to mean that acting in accord with one’s intentions is impossible. Over the past decade, evidence has accumulated to show that when goal-intentions are furnished with *implementation intentions* self-regulatory problems such as described above should not hinder behavioral enactment, even when resources are low (for a meta-analysis of implementation intention effects, see Gollwitzer & Sheeran, 2006). Unlike intentions that merely specify a desired end-state (“I intend to achieve Z!”), implementation intentions specify the where, when, and how of goal-striving (“If I am in situation X, then I will perform goal-directed behavior Y!”; Gollwitzer, 1999). For example, an implementation intention to support the intention to eat more fruits specifies a situation that represents a good opportunity for eating more fruits (e.g., ‘having my four o’clock break at work’) and then links this situation to a specific goal-directed action (e.g., ‘taking an apple from the cafeteria’) resulting in the following implementation intention; “If I am having my four o’clock break at work, then I will take an apple from the cafeteria”.

By specifying a critical situation in advance, this situation becomes strongly accessible in memory, which increases the chance that this situation, when encountered, is recognized as a good opportunity to act upon one’s intentions (Gollwitzer, 1999; Parks-Stamm, Gollwitzer, & Oettingen, 2007; Webb & Sheeran, 2007). Further, and even more importantly, by employing an if-then format to link a situation to a specific goal-directed behavior, the control of the behavior is delegated from the self to the specified situation resulting in the goal-directed behavior to be activated *automatically* upon encountering the situation (Gollwitzer, 1999; Parks-Stamm, Gollwitzer, & Oettingen, 2007; Webb & Sheeran, 2004; 2007; 2008). This means that resources such as memory, attention and self-

control are no longer required to act upon one's intentions which makes it less likely that problems such as failing to remember to act, or failing to seize the opportunity to act, hinder goal-striving (Gollwitzer & Sheeran, 2006). Indeed, numerous studies have demonstrated that as a result of forming an implementation intention, the performance of goal-directed behavior exhibits features of automaticity, as the behavior is initiated immediately (Cohen, Bayer, Jaudas, & Gollwitzer, 2008; Gollwitzer & Brandstätter, 1997), efficiently (Brandstätter, Lengfelder, & Gollwitzer, 2001; Gawrilow & Gollwitzer, 2008), and without conscious intent (Bayer, Achtziger, Gollwitzer, & Moskowitz, 2009).

Ever since implementation intentions were introduced as a promising strategy to promote goal-directed action (Gollwitzer 1993; 1999), their use has been tested in various health domains, leading to ample support for their efficacy in promoting numerous types of health behaviors, such as vitamin C intake (Sheeran & Orbell, 1999), exercising (Milne, Orbell, & Sheeran, 2002; Prestwich, Lawton, & Conner, 2003; Rise, Thompson, & Verplanken, 2003), resuming functional activity after joint-replacement surgery (Orbell & Sheeran, 2000), attending cervical cancer screening (Sheeran & Orbell, 2000), performing breast self-examination (Orbell, Hodgkins, & Sheeran, 1997), and eating a healthy diet (Armitage, 2004; De Nooijer, De Vet, Brug, & De Vries, 2006; Kellar & Abraham, 2005; Verplanken & Faes, 1999). Despite the overwhelmingly positive findings, however, one major 'gap' in the evidence pertains to the fact that these studies are generally concerned with health *promoting* behaviors (Gollwitzer & Sheeran, 2006).

Health promoting behaviors require the initiation or continuation of desired responses (e.g., eating (more) fruits), whereas health risk behaviors require a change of existing unwanted *habits* (e.g., diminishing the consumption of unhealthy snacks; Gollwitzer & Sheeran, 2006). Changing existing habits is generally more difficult than initiating new behavior or supporting ongoing responses (Holland, Aarts, & Langendam, 2006; Webb & Sheeran, 2006). However, sometimes breaking unwanted habits is necessary. For example, in our present day society where obesity and chronic diseases such as cardiovascular disease and cancer have taken central stage, many of our health goals concern an alteration of existing habits (e.g., quitting smoking, eating fewer fatty foods, limiting alcohol intake), warranting an investigation of the efficacy of implementation intentions in endorsing this type of behavior change.

Old Habits Die Hard

Habits develop as people repeatedly perform a specific behavior (e.g., opening up a bag of chips) in similar situations (e.g., when watching television) to pursue their goals (e.g., relaxing; Aarts & Dijksterhuis, 2000; Wood & Neal, 2007). Such situations may entail external circumstances, like watching TV, but they may also entail internal cues or self-states, such as 'being bored', or 'feeling upset'. This repeated co-occurrence of a situation and a behavior eventually creates a direct mental association between the situation and the behavior. This association is strengthened each time the situation and behavior co-vary, until, finally, a habit has been formed and the situation *automatically* triggers the behavior (Aarts & Dijksterhuis, 2000; Bargh, 1990; Bargh & Gollwitzer, 1994); that is, without awareness, unintentionally, efficiently, and with limited controllability (Bargh, 1994).

Although in daily life habit formation is a necessary adaptive process, as it allows individuals to perform their daily routines without requiring continuous conscious decision making (Wood, Quinn, & Kashy, 2002), it also has some obvious negative consequences. The fact that a behavior has become automatic, and thus unrelated to conscious intentions, makes it difficult to change this behavior (Aarts & Dijksterhuis, 2000; Wood & Neal, 2007). This persistent nature of habits becomes problematic when the behavior is no longer wanted. For example, after several months of eating chips when watching television, I may find that I no longer fit into my favorite (and very expensive) pair of jeans, which motivates me to lose some weight by changing my diet to include fewer chips. Unfortunately, the activation of ‘eating chips’ upon watching television now occurs automatically, without the involvement of conscious intentions, so whether or not my intentions have changed does not affect my behavior in this situation (Aarts & Dijksterhuis, 2000; Wood & Neal, 2007).

As intentions have little influence on the performance of habitual behaviors when encountering critical situations, one way to change habits once they are formed is to avoid or remove this critical stimulus (Verplanken & Wood, 2006; Wood, Tam, & Witt, 2005). While there is persuasive evidence that this approach is indeed effective in disrupting habits (Wood et al., 2005), one may wonder how applicable this approach is to most unhealthy habits. Most critical cues for unhealthy habitual behaviors are difficult to remove or cannot be easily avoided. For example, most people are unable to avoid ‘being bored’, and may not like to quit ‘watching television’. Alternative approaches to breaking habits, which rely on self-regulation of behavior in the presence of the critical stimulus instead of on removing the stimulus altogether, are thus called for. The formulation of counter-habitual implementation intentions may be such a strategy.

Habit Cures Habit

Although little empirical evidence was available when starting the research (September 2006) described in this dissertation, some authors had theorized about the efficacy of implementation intentions in breaking habits (Gollwitzer, 1999; Gollwitzer, Bayer, & McCulloch, 2005; Gollwitzer & Sheeran, 2006; Sheeran, Milne, Webb, & Gollwitzer, 2005). Implementation intentions strongly resemble habits (they have even been referred to as ‘instant habits’; Gollwitzer, 1999), as they instigate similar automatic responses that only differ in origin; that is whether they are the result of repeated action (i.e., habits) or reflect conscious planning (i.e., implementation intentions; Aarts & Dijksterhuis, 2000). Based on this resemblance it was argued that if a person is familiar with his/her ‘situation-behavior profile’ (Gollwitzer & Sheeran, 2006), or, in other words, knows which cue(s) elicit(s) the habitual behavior, the formation of implementation intentions could be tailored to this existing cue-habitual response link in order to alter it and break the habit (Gollwitzer, 1999; Gollwitzer & Sheeran, 2006). In fact, it was theorized that this alteration of existing cue-behavior links could be achieved by several different types of implementation intentions (Gollwitzer et al., 2005; Sheeran, Milne, et al., 2005), two of which will be discussed below.

A first type of implementation intention that was proposed for breaking a habit, or a ‘situation-habitual response’ association, is an implementation intention that specifies to *not* perform the unwanted habitual response upon encountering the critical situation (e.g., “If I am watching

TV, then I will not eat chips”; Sheeran, Milne, et al., 2005). At the time of starting the research presented in this dissertation, no studies had been published that demonstrated the efficacy of this ‘negation implementation intention’, although some unpublished work is cited in the book chapters in which this strategy is proposed to be effective in breaking habits (Gollwitzer et al., 2005; Sheeran, Milne, et al., 2005).

Another type of implementation intention that was thought to be useful in breaking habits, is an implementation intention that specifies to perform an *alternative* behavior upon encountering the critical cue for the habitual behavior (e.g., “If I am watching TV, then I will take a handful of healthy apple chips”; Sheeran, Milne, et al., 2005). So, in order to reduce the ‘situation-habitual response’ association, this ‘replacement implementation intention’ links the critical cue for the habitual response to an antagonistic wanted response (Sheeran, Milne, et al., 2005). At the time of starting the present research, the only empirical evidence that convincingly supported the efficacy of this type of implementation intention in breaking habits came from Holland et al. (2006) who demonstrated that this type of planning could be effective in changing recycling habits.

Although Verplanken and Faes (1999) arguably used a similar type of implementation intention in a study on unhealthy eating habits, and participants who had made implementation intentions ate more healthily than participants who did not make any plans, this study did not provide clear evidence that participants actually broke any habits, or that they actually replaced unhealthy foods by healthy foods. Similarly, a study by Armitage (2004) showed that implementation intentions were effective in decreasing fat consumption compared to a control condition. However, the design of this study was limited, as participants in the control condition were not asked to change their fat or food intake, and the dependent measure relied on participants’ ability to remember their intake of 63 foods over a period of a month. Moreover, similar to the study by Verplanken and Faes (1999), it was not clear whether participants actually replaced fatty foods by low fat foods. It therefore remains to be determined whether replacement implementation intentions are effective in breaking unhealthy habits.

Food For Thought (and Research)

To summarize, most studies that have tested the use of implementation intentions in the health domain involved promoting health-protective behaviors, such as cancer screening (Sheeran & Orbell, 2000), or increasing vitamin C intake (Sheeran & Orbell, 1999). Despite some theorizing about potential ways to effectively apply implementation intentions to diminish health-risk behaviors (Gollwitzer et al., 2005; Sheeran, Milne, et al., 2005), at the time of conducting the present research, hardly any studies existed that empirically tested the efficacy of implementation intentions for this more difficult type of behavior change (Gollwitzer & Sheeran, 2006). Such research is warranted from a theoretical perspective, as to date few effective ways for changing existing habits have been identified, as well as from a public health perspective, as presently many of the general public’s (health) goals pertain to the reduction of unwanted habits, such as smoking, excess alcohol consumption, or eating unhealthy foods. Based on this rationale, the main aim of

this dissertation is to test whether implementation intentions can be effective in breaking unwanted habits.

There are several implications of using implementation intentions to change existing habits rather than to promote wanted behaviors. First, implementation intentions aimed at promoting wanted behaviors tend to have the same format; they specify the behavior to be performed in the 'then-part' of the plan. However, the formation of implementation intentions directed at decreasing unwanted habits is less straightforward, as these plans can have various formats. These counter-habitual implementation intentions can either specify to avoid the unwanted behavior, or to approach an alternative behavior, when the critical situation for the unwanted behavior presents itself (or even to ignore the critical situation; this type of implementation intention is not tested in the present dissertation, but see the final chapter of this dissertation for a discussion of the potential efficacy of this type of plan).

For both types of implementation intentions empirical evidence demonstrating their efficacy in breaking habits is lacking, but from a theoretical perspective these plans seem to have different advantages and disadvantages. As the essence of breaking habits is to *not* engage in the unwanted habitual behavior, planning to not perform the unwanted habitual behavior in the critical situation appears to be the most straightforward type of counter-habitual implementation intention. The efficacy of this type of plan does not depend on the availability of alternative behaviors, as do replacement implementation intentions, making this type of plan more frequently applicable than replacement implementation intentions, and, consequently more likely to yield beneficial results. However, while negation implementation intentions may indeed be more practically applicable than replacement implementation intentions, there may also be disadvantages to using this strategy. There is convincing evidence that trying not to think of something, or not performing a certain behavior, is rather difficult (Wegner, 1994), and that the processing of such negations frequently fails (Hasson & Glucksberg, 2006), which puts into question whether implementation intentions specifying not to perform a habitual behavior will be effective. In view of these considerations, the present dissertation will test both plans for their efficacy in breaking habits. In doing so, I will start by testing the efficacy of plans specifying not to perform the habitual response, as this type of implementation intention would be most practically applicable if it is indeed effective.

In addition to testing the efficacy of both types of implementation intentions, other central issues in the present dissertation evolve around the mechanisms and boundary conditions of these implementation intentions (in)efficacy in breaking habits. Knowing which underlying processes make these types of plans (in)effective and understanding under which conditions they are (in)effective, helps to direct future research and to create useful interventions for breaking habits. One such boundary condition that will be investigated is the extent to which truly critical cues are identified and specified in implementation intentions. Whereas implementation intentions directed at initiating or promoting wanted behaviors can specify *any* situation that represents a good opportunity to act, implementation intentions aimed at reducing existing unwanted behaviors need to specify the *critical* cue for the unwanted behavior in order to be effective. I will investigate whether the degree to which implementation intentions specify truly critical cues indeed determines

their efficacy. Additionally, as identification of critical cues may be difficult, it will be examined whether additional self-regulation strategies enhancing insight into these critical cues may increase implementation intentions' efficacy in breaking habits.

Eating Less Unhealthily is Not a Piece of Cake

The efficacy, mechanisms and boundary conditions of implementation intentions in breaking habits will be investigated in the domain of eating behavior, specifically for unhealthy snacking behavior. A focus on eating behavior was deemed relevant as diminishing unhealthy eating habits is typically seen as a difficult and complex type of behavior that is repeatedly found subject to self-regulatory failures, despite the presence of strong motivation (Kumanyika et al., 2000). This not only makes reducing unhealthy eating a behavior that is highly in need of supporting self-regulation strategies like implementation intentions, but it also demonstrates that it is a behavior that is prone to benefit from implementation intentions (Adriaanse, De Ridder, De Wit, & Vinkers, 2009a), as (a) the presence of a (difficult) self-regulatory problem, and (b) a strong motivation to change are prerequisites for implementation intentions to be effective (Gollwitzer & Sheeran, 2006).

It was decided to focus on the reduction of unhealthy snacking behavior as a specification of eating less unhealthily in general as previous research has indicated that specific goals (such as eating fewer unhealthy snacks) generally lead to better outcomes than abstract goals (e.g., eating less unhealthily; cf. Locke & Latham, 1990). Further, the students participating in the present research tended to have strong unhealthy snacking habits and their snacking behavior was also expected to have a higher chance of being affected by their motivation and implementation intentions than the content of their main meals, as many of the students were still living with their parents. Lastly, targeting unhealthy snacking habits was considered appropriate from a public health perspective as unhealthy snack consumption has been identified to be an important contributor to overweight (De Graaf, 2006; Jahns, Siega-Riz, & Popkin, 2001; Zizza, Siega-Riz, & Popkin, 2001).

The Present Dissertation

Based on the above presented rationale, the main research question which this dissertation sets out to answer is: Can implementation intentions be used to effectively break unwanted habits? In answering the main research question this dissertation further aims to:

- Investigate the efficacy of implementation intentions that specify the avoidance of unhealthy foods as well as of implementation intentions that specify the replacement of unhealthy foods with healthy foods, employing 7-day snack diaries.
- Investigate the underlying mechanisms that make these different types of implementation intentions (in)effective, employing implicit cognitive measures as well as behavioral measures (snack diaries).
- Investigate whether, by fostering the identification of critical cues, mental contrasting can augment the efficacy of implementation intentions in decreasing unhealthy snacking habits.

These issues will be dealt with in a series of five empirical chapters and one general discussion chapter which will be described in more detail below. Please note that the chapters of this dissertation - including this introductory chapter - were written in such a way that they can be read independently and in any order and that, therefore, the content of the chapters may overlap to some extent.

Overview of the Chapters

Chapter 2 - This chapter provides a first test of the efficacy of planning when these plans specify the avoidance of unwanted behaviors, such as consuming unhealthy snacks. In Study 2.1, the spontaneous use of such avoidance plans for unhealthy snacking was measured and related to subsequent unhealthy snack intake, using a 7-day snack diary. As there were reasons to expect that this self-reported use of plans to avoid unhealthy foods would actually be related to increased unhealthy food intake, it was also assessed which factors predict the use of this potentially maladaptive strategy (in particular the level of autonomous vs. controlled motivation; Study 2.1 and 2.2), and which reasons participants reported for making such plans (to initiate or to postpone goal-directed action; Study 2.2).

Chapter 3 - In this chapter an experimental - rather than correlational - design was used to more stringently test the efficacy of plans that specify to avoid an unwanted response. As we also aimed to increase insight into the underlying processes, in a series of four studies, more implicit, cognitive outcome measures (lexical decision tasks; Studies 3.1 & 3.2) were employed in addition to behavioral outcome measures (7-day snack diaries; Studies 3.3 & 3.4). Moreover, a variety of control conditions were utilized, ranging from intention-only control conditions, an intention plus a listing of healthy snacks control condition, to control conditions requiring the formation of alternative implementation intentions.

Chapter 4 - In this chapter a different type of counter-habitual implementation intention is tested for its efficacy in reducing unhealthy snack consumption. Specifically, it was tested whether linking a critical cue for unhealthy snacking behavior to an *alternative* healthy behavior in an implementation intention could be effective in reducing unhealthy snack consumption. An additional aim of the studies presented in this chapter was to test the efficacy of specifying different types of cues in the if-part of these 'replacement implementation intentions'. A pilot study using a comprehensive snack diary was conducted to identify cues for unhealthy snacking, differentiating between situational (where/when) and motivational (why) cues. Studies 4.1 and 4.2 then tested the efficacy of replacement implementation intentions specifying either these situational or motivational cues in altering snacking habits, employing 7-day snack diaries.

Chapter 5 - In chapter 5 the cognitive effects of replacement implementation intentions were investigated in order to gain insight into the underlying processes that make these plans effective. It was hypothesized that replacement implementation intentions increase the link between a critical cue and an alternative behavior, while the link between this cue and the old habitual behavior is simultaneously weakened, and that these combined effects result in the habitual means no longer having an advantage in the 'horse race' with the alternative means. To test this hypothesis, Studies 5.1, 5.2, and 5.3 investigated the cognitive effects of formulating replacement implementation intentions

on critical cue-habitual response and critical cue-alternative response associations, using lexical decision tasks with a priming procedure.

Chapter 6 - This last empirical chapter tests whether combining the formation of replacement implementation intentions with a strategy that may enhance insight into critical cues - mental contrasting (Oettingen, 2000) - may augment the efficacy of these implementation intentions. In Study 6.1 it was first tested whether participants using this combined strategy indeed consumed fewer unhealthy snacks than participants in a control condition, employing 7-day snack diaries. Study 6.2 then investigated whether this combined strategy was more effective than mental contrasting or formulating implementation intentions alone. This last study also assessed whether any beneficial effects of the combined strategy could be related to mental contrasting increasing perceived clarity of critical cues for unhealthy snacking.

The final chapter of this dissertation, *Chapter 7*, summarizes and discusses the main results described in the previous chapters and draws some overarching conclusions regarding the research questions. Moreover, I will address the implications, scientific relevance, and limitations of the present studies, and make some suggestions for future directions in research on implementation intentions and breaking habits.

Chapter 2

Planning for the Wrong Reasons: Individuals with Controlled Motivation Make Plans to Avoid Unhealthy Foods that are Ineffective

Submitted as:

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Abstract

Previous research has demonstrated that formulating action plans is helpful in promoting goal-directed behaviors and that autonomous motivation predicts the formation of action plans. However, action planning may not be effective and related to controlled motivation when plans are directed at *avoiding* unhealthy behaviors ('avoidance planning'). Study 1 investigated this by examining avoidance planning in the context of diminishing unhealthy snack intake. Results indicated that avoidance plans were related to an *increased* consumption of unhealthy snacks and that participants high in controlled motivation were more inclined to formulate avoidance plans. As it is difficult to explain why individuals high in controlled motivation make action plans at all, Study 2 assessed the reasons participants report for making plans. Results showed that individuals high in controlled motivation make plans with the objective of *postponing* rather than promoting goal-directed action, implying that for these individuals making plans is an end in itself.

Currently it is estimated that worldwide more than 1 billion people are overweight and that by the year 2015 another 0.5 billion people may be added to this number (WHO, 2005). Being overweight is a major risk factor for heart disease, stroke, type 2 diabetes, and other chronic diseases (Visscher & Seidell, 2001). One of the most obvious methods of preventing overweight is reducing caloric intake by avoiding foods that contain too much saturated fat and/or sugar. Although many people may be motivated to avoid unhealthy foods, it is a well-documented finding that motivation is often not enough to ensure actual goal-directed behavior (Webb & Sheeran, 2006). As action planning, in particular the formation of implementation intentions, has proven to be a very effective strategy to promote the translation of one's motivation into action, the present research aims to investigate the efficacy and determinants of action plans directed at the avoidance of unhealthy foods (i.e., avoidance planning).

Action Planning

For many types of health goals, such as regularly performing breast self-examination (Orbell, Hodgkins, & Sheeran, 1997), or taking vitamin C tablets (Sheeran & Orbell, 1999), having a strong goal intention is generally insufficient to ensure actual goal-directed behavior. However, this lack of correspondence between intentions and goal-directed behavior (the 'intention-behavior gap'; Orbell et al., 1997; Sheeran & Orbell, 2000) can be reduced when specific action plans specifying where, when and how to perform the goal-directed behavior are formulated to support one's goal intentions (Gollwitzer, 1999; Gollwitzer & Sheeran, 2006).

Numerous studies have investigated the role of action planning in goal striving for different health behaviors. Although the majority of studies on action planning in the health domain are aimed at *initiating* health *promoting* behaviors, like for example, eating more fruit and vegetables (e.g., Armitage, 2007), or increasing exercise behavior (e.g., Milne, Orbell, & Sheeran, 2002), more recently action planning has also been applied to goal striving that involves *diminishing* health *risk* behaviors, such as reducing the consumption of fatty foods (Luszczynska, Scholz, & Sutton, 2007), or quitting smoking (Webb, Sheeran, & Luszczynska, 2009). These studies on action planning for diminishing health risk behaviors mainly involve plans that specify the *replacement* of an unhealthy behavior with a healthier alternative. Although this approach may be promising, diminishing health risk behaviors, such as reducing the consumption of fatty snacks, essentially requires the *avoidance* of the unhealthy behavior. People who spontaneously make plans for these types of goals will therefore presumably often make plans that directly specify the mere avoidance - rather than the replacement - of the unhealthy behavior. As to date there are only a limited number of studies available that have investigated the efficacy of such spontaneously formulated avoidance plans (but see: Otis & Pelletier, 2008), the present study aims to investigate (a) the efficacy of spontaneous avoidance plans in reducing the consumption of unhealthy foods and (b) the role of motivation in promoting the formation of spontaneous avoidance plans for unhealthy foods.

Efficacy of Action Plans to Diminish Unhealthy Eating

An impressive number of studies have demonstrated beneficial effects of action planning on eating healthily. Positive effects have been found for plans directed at promoting consumption of fruit and/or vegetables, low-fat food items, and a proper variety of foods (e.g., Armitage, 2007; De Nooijer, De Vet, Brug, & De Vries, 2006; Luszczynska, Scholz, et al., 2007; Luszczynska, Tryburcy, & Schwarzer, 2007; Verplanken & Faes, 1999). Nevertheless, there are reasons to expect that action planning will not yield positive results when the plans that are made concern the *avoidance* of *unhealthy* food items. First of all, avoidance goals and plans have consistently been linked to negative outcomes such as less goal progress (Elliot & McGregor, 1999), lower subjective well-being (Elliot, Sheldon, & Church, 1997) and more mood disturbance (Dickson & MacLeod, 2004a; Dickson & MacLeod 2004b), when compared to approach goals and plans. Moreover, in the domain of eating behavior specifically, it has been found that spontaneous avoidance food planning is related to more eating concerns and bulimic symptoms (Otis & Pelletier, 2008) and that instructing participants to formulate an avoidance plan is ineffective in translating motivation for healthy eating into actual progress towards one's weight loss goal (Koestner, Otis, Powers, Pelletier, & Gagnon, 2008).

The association of avoidance planning with eating concerns and bulimic symptoms (Otis & Pelletier, 2008), and the lack of effects of avoidance plans on weight loss (Koestner et al., 2008), suggest that avoidance planning may not be very effective in actually diminishing unhealthy food consumption and may even lead to an increased consumption of unhealthy foods. Nevertheless, it has to be noted that the findings of Otis and Pelletier (2008) also indicated that avoidance food planning was related (although less strongly) to more healthy eating habits (e.g., eating fruit/vegetables/grain products, and foods low in (saturated) fat and cholesterol).

The limited findings regarding the efficacy of avoidance planning are thus mixed. This could be due to the different dependent measures that were employed in the two pertinent studies (i.e., correlations with eating concerns, bulimic symptoms, and general eating habits versus progress towards one's weight loss goal). Moreover, these measures can also be considered quite distal from the actual behavior specified in the avoidance plans. For example, the extent to which a person reaches his or her personal weight loss goal is dependent on several factors that are beyond the target of a plan specifying to avoid unhealthy foods, such as baseline weight, goal size, and exercising behavior.

These limited and mixed findings warrant research that directly addresses the effects of spontaneous avoidance planning on *actual unhealthy food consumption* rather than on more distal measures, such as eating concerns, bulimic symptoms, general eating habits or progress towards weight loss goals. Therefore, the present study investigates the efficacy of spontaneous avoidance planning on unhealthy food intake over a one week period. Based on the previous research and theorizing it is hypothesized that avoidance planning results in an increased rather than decreased consumption of unhealthy foods.

The Role of Motivation in Promoting the Formation of Avoidance Plans

If it is indeed the case that avoidance planning results in an increased consumption of unhealthy foods, it is important to identify which people spontaneously tend to use this strategy in

an attempt to eat less unhealthily. In the present study we investigate whether the extent to which intentions are derived from motivation that is *self-determined* predicts the formation of avoidance plans (e.g., Brickell & Chatzisarantis, 2007; De Ridder, De Wit, & Adriaanse, 2009; Koestner et al., 2008; Otis & Pelletier, 2008).

Self-Determination Theory (SDT; Deci & Ryan, 2000) postulates that there are three basic psychological needs - the need for autonomy, competence, and relatedness - and that the satisfaction of these needs is essential for goal striving to become internalized, which in turn promotes a good health and overall well-being. In SDT, goal striving that is highly internalized is referred to as autonomous motivation (which can be differentiated into identified and intrinsic motivation) and goal striving that is not internalized but pressured by outside forces is referred to as controlled motivation (which can be differentiated into external and introjected regulation).

There is abundant empirical support for the assertion that controlled (as opposed to autonomous) motivation results in less need satisfaction and is consequently associated with poorer health and well-being (e.g., Pelletier, Dion, Slovicc-D'Angelo, & Reid, 2004.; Williams et al., 2006; Williams, Grow, Freedman, Ryan, & Deci, 1996). For example, it has been found that autonomous motivation is positively associated with healthy eating behaviors, whereas controlled motivation predicts dysfunctional eating behaviors and is negatively associated with healthy eating behaviors (Pelletier et al., 2004).

The finding that the degree to which behavior is self-determined predicts whether goal-striving regarding health and well-being is successful, suggests that the extent to which motivation is self-determined is also related to the use of strategies or tools that have been found conducive to goal-striving, such as action planning. Indeed, several studies have demonstrated that people are more likely to formulate action plans when their motivation is autonomous rather than controlled (Brickell & Chatzisarantis, 2007; De Ridder, De Wit, et al., 2009; Koestner et al., 2008), even when controlling for levels of goal intentions (e.g., De Ridder, De Wit, et al., 2009). However, these studies are all concerned with approach planning and not with plans that specify the *avoidance* of an unwanted behavior. The only study that to date has looked at the role of self-determination for the formation of avoidance plans is a study by Otis and Pelletier (2008) on avoidance of unhealthy foods. These authors found that, in contrast with findings for plans aimed at approaching healthy foods, controlled motivation and not autonomous motivation was the best predictor of avoidance planning.

This positive association between controlled motivation and avoidance planning makes intuitive sense considering that previous research already demonstrated a positive association between controlled motivation and avoidance goals (Elliot & Church, 1997; Murcia, Coll, & Garzón, 2009). Further, as controlled motivation is generally associated with poor outcomes (e.g., Pelletier et al., 2004; Williams et al., 2006; Williams et al., 1996), it would make sense to find that controlled motivation is also related to strategies associated with poor outcomes, such as avoidance planning (Koestner et al., 2008; Otis & Pelletier, 2008). Moreover, there are also clear theoretical underpinnings for an association between controlled motivation and avoidance planning. For example, Deci and Ryan (2000) argue that “although autonomy and control cannot be reduced to approach and avoidance,

[..] controlled behaviors will often, and perhaps frequently, have an avoidance-motivation character in so far as contingent punishments and negative consequences are often the conditions under which controlled behaviors are acquired” (p. 259). This avoidance character of controlled behaviors is also evident when looking at measures of controlled motivation, which generally include more avoidance-oriented items than do measures of autonomous motivation (e.g., Williams et al., 1996; Williams, Freedman, & Deci, 1998).

Another explanation for the relation between controlled motivation and avoidance planning is derived from findings by Pelletier et al. (2004). These authors found that women high in autonomous motivation for regulating their eating behavior are more concerned by the quality of the food they consume, whereas women high in controlled motivation for regulating their eating behavior are more concerned with the quantity of food consumed. Based on these findings, it can be argued that concerns about the quantity of food reflect concerns of not eating too much, which promote the formation of avoidance rather than approach plans to regulate food intake (Otis & Pelletier, 2008).

There is thus a clear theoretical and empirical basis for the proposed (and observed: Otis & Pelletier, 2008) relation between controlled motivation and avoidance planning. However, this proposed relation is in contrast with previous research demonstrating that individuals with autonomous motivation exert more effort toward achieving their goal (e.g., Sheldon & Elliot, 1998) and show higher involvement (Ryan, Plant, & O’Malley, 1995), and the suggestion that controlled motivation fades during the pre-actional phase (in which plans are formulated, Pelletier et al., 2004; Sheldon & Elliot, 1998). In light of these findings it is difficult to explain that participants with strong controlled motivation put effort into making any type of plan at all.

However, it is important to note that the fact that individuals spontaneously make avoidance plans, does not tell us anything about the *objective* of these plans; it is more or less inferred that when people indicate to have made plans regarding when, where and how to avoid a certain behavior, these plans serve the purpose of getting started as soon as possible. While this is probably the case for people high in autonomous motivation, it could be that the plans formulated by people high in controlled motivation do not serve this purpose at all. Rather, considering that these individuals do not want to exert much effort in striving towards their goal, for them making plans might serve the purpose of postponing actual goal-directed action. This idea is also consistent with studies that have demonstrated that individuals with more controlled motivation are more likely to procrastinate (e.g., Senécal & Guay, 2000; Senécal, Julien, & Guay, 2003; Senécal, Koestner, & Vallerand, 1995).

In the present study we, therefore, hypothesize - in line with findings by Otis and Pelletier (2008) - that controlled motivation and not autonomous motivation to regulate one’s eating behavior is associated with making plans to avoid unhealthy foods. In addition, we assess the reasons reported for making plans to investigate our assumption that people high in controlled motivation make plans to postpone goal-directed behavior.

Research Overview

Two studies were conducted to investigate (a) the efficacy of spontaneously formulated avoidance plans and (b) the role of controlled motivation in promoting spontaneous avoidance

planning. Study 1 employed a seven day food-diary to investigate our hypothesis that avoidance planning resulted in an increased intake of unhealthy foods. Additionally, this study tested our hypothesis that participants with higher controlled motivation (but not autonomous motivation) were more likely to spontaneously make plans to avoid unhealthy snacks. Study 2 additionally addressed the reasons participants high in controlled and autonomous motivation report for making plans, to investigate the assumption that individuals high in controlled motivation make plans with the objective of postponing actual goal-directed action.

Study 1

Study 1 was designed to investigate the efficacy of spontaneously formulated avoidance plans in decreasing actual unhealthy snack intake and the relation between controlled motivation and avoidance planning. A focus on eating fewer unhealthy snacks as a specification of eating less unhealthily in general was deemed relevant as previous studies have shown that specific goals (such as eating fewer unhealthy snacks) lead to better performance compared to abstract goals (e.g., eating less unhealthily; cf. Locke & Latham, 1990). Additionally, snack consumption has been identified as an important contributor to overweight (e.g., De Graaf, 2006; Zizza, Siega-Riz, & Popkin, 2001) and is more likely to be affected by participants' motivation and action plans than any of their main meals as many of the participants in our sample were still living with their parents.

Method

Sample and Procedure

Female undergraduate students who responded affirmatively to the questions: "Do you consume at least four unhealthy snacks a week?", and "Do you have the intention to eat fewer unhealthy snacks in the near future?" ($N = 75$) were invited to participate in a study of eating behavior. Participants were asked to fill out a questionnaire and then keep a food diary for seven days. They received a 5 Euro reimbursement upon returning their diary after a week. Six participants who were underweight and one obese participant were excluded from the analyses. The final sample included 68 participants with a mean BMI of 21.92 ($SD = 2.70$) and a mean age of 20.82 years ($SD = 2.68$).

Questionnaire

The questionnaire included some general questions about age, weight, and height. Additionally, intention, type of motivation (autonomous and controlled), and avoidance planning were assessed. Intention was measured by three items that could be answered on 7-point Likert scales ranging from 1 (*totally disagree*) to 7 (*totally agree*) ("I intend/plan/expect to diminish my snack consumption in the coming week", Cronbach's alpha = .91).

To determine the degree to which participants' motivation for eating a healthy diet was self-determined, the autonomous and controlled motivation subscales from the Treatment Self-Regulation Questionnaire (TSRQ; Williams et al., 1996) were administered. The autonomous motivation subscale consists of 6 statements (e.g., "The reason I would eat a healthy diet is because

I feel that I want to take responsibility for my own health', Cronbach's alpha = .83), as does the controlled motivation subscale (e.g., 'The reason I would eat a healthy diet is because I want others to approve of me', Cronbach's alpha = .83). Participants were asked to indicate the extent to which each statement was true for them on 7-point Likert scales ranging from 1 (*not at all true*) to 7 (*very true*).

Avoidance planning was measured by three items (derived from Sniehotta, Schwarzer, Scholz, & Schüz, 2005): "I have made specific plans regarding when I will reduce my unhealthy snack intake", "I have made specific plans regarding where I will eat fewer unhealthy snacks", and "I have made specific plans regarding how I will reduce my unhealthy snack intake". Responses could be indicated on a 7-point Likert scale ranging from 1 (*totally disagree*) to 7 (*totally agree*). The avoidance planning scale showed good reliability, Cronbach's alpha = .89.

Snack Diary

After completing the questionnaire, participants received the snack diary (derived from Adriaanse, De Ridder, & De Wit, 2009b). The snack diary was thoroughly explained by the experimenter, and included instructions and an example of a diary entry on the first page. Participants were requested to record the amount of unhealthy and healthy snacks they consumed each day for seven consecutive days. Each of the seven entries (one for each day) consisted of one column with 12 categories of unhealthy snacks (e.g., candy bars) and one column with 13 categories of healthy snacks (e.g., fruit) which each had standardized portion sizes (e.g., 'handful' for chips). Categories and portion sizes were based on advice from a registered dietician. For both healthy and unhealthy snacks an 'other' option was also provided.

The dependent variables were the amount of unhealthy and healthy snacks consumed during the one week period. As the unhealthy snacks that participants consumed varied considerably in size and calories, unhealthy snack consumption was expressed in kilocalories (kcal). The amount of kcal derived from unhealthy snacks was calculated by multiplying each standard amount of unhealthy snacks consumed by the average amount of kcal it contained (based on guidelines from the Dutch Nutrition Centre and checked by a dietician). Healthy snacks varied little in size and calories so the consumption of healthy snacks was expressed in servings (e.g., one serving equals one banana or one granola bar).

Results

Table 1 shows the means, standard deviations, and correlations of the variables under study. Unhealthy snack intake (in kcal), healthy snack intake (servings) and avoidance planning were natural log-transformed before entering into the analysis as these variables were positively skewed. However, for ease of interpretation, mean scores in Table 1 are presented for the non-transformed variables.

Table 1
Means, Standard Deviations and Correlations for the Variables in Study 1

	1	2	3	4	5	6	7	8
Age (1)	-							
BMI (2)	.05	-						
Intention (3)	-.37**	.12	-					
Autonomous Motivation (4)	.04	-.12	.28*	-				
Controlled Motivation (5)	-.05	.12	.30*	.26*	-			
Avoidance Planning (6)	-.17	.02	.52**	.21	.43**	-		
Unhealthy Snacks in kcal (7)	-.09	-.10	-.06	-.10	-.15	.15	-	
Healthy Snacks (8)	-.03	.13	-.09	-.02	.02	-.03	.09	-
<i>M</i>	20.82	21.92	3.89	4.88	2.83	2.69	3102	20.13
<i>SD</i>	2.68	2.70	1.66	.96	1.05	1.63	2560	14.90

* $p < .05$; ** $p < .01$

Snack Consumption

The majority of participants handed in their food diary (92.6%). Participants on average reported to have consumed 3102 ($SD = 2560$) kcal in unhealthy snacks during the week and consumed 20.13 servings of healthy snacks ($SD = 14.90$; 47.6% were fruits and vegetables).

A multiple hierarchical linear regression analysis with age, intention, autonomous and controlled motivation in the first step, and avoidance planning entered in an additional second step, was performed on unhealthy snack consumption. Results showed that only the second step, which included avoidance planning, was significant. Participants with higher scores for avoidance planning consumed *more* calories from unhealthy snacks. The model explained 12.3% of the variance in unhealthy snack consumption (see Table 2).

To investigate whether the adverse effect of avoidance planning was dependent on level of autonomous or controlled motivation, two additional regression analyses were conducted. The first regression analysis included the autonomous motivation x avoidance planning interaction term in the third step and the second regression analysis included the controlled motivation x avoidance planning interaction term in the third step. In both regression analyses the interaction term was not significant¹, $F_s < 1$.

To investigate whether avoidance planning also affected healthy snack intake, a similar regression analysis was performed for healthy snack intake. This analysis revealed no significant effects, either when assessing total healthy snack consumption, or when only assessing fruit and vegetable consumption.

1. Autonomous motivation, controlled motivation and avoidance planning were mean centered before calculating the interaction terms.

Table 2

Multiple Linear Regression Analysis for Avoidance Planning and Unhealthy Snack Consumption

	Avoidance Planning			Unhealthy Snack Consumption (kcal)		
	β	ΔF	ΔR^2	β	ΔF	ΔR^2
<i>Step 1</i>		8.54	.352**		.57	.038
Age	.01			-.13		
Intention	.43**			-.21		
Autonomous Motivation	.01			-.06		
Controlled Motivation	.30**			-.24		
<i>Step 2</i>					5.55	.085*
Avoidance Planning				.37*		

* $p < .05$; ** $p < .01$

Note. Final β s are presented.

Avoidance Planning

A multiple linear regression analysis with age, intention, autonomous and controlled motivation was conducted to investigate which factors predicted the formation of avoidance plans. Results showed that the model was significant, with intention and controlled motivation as significant predictors. Participants with stronger intentions and higher controlled motivation were more inclined to make plans to eat fewer unhealthy snacks. The final model explained 35.2% of the variance in avoidance planning (see Table 2).

Discussion

Study 1 showed that, as expected, in particular individuals with high controlled motivation made action plans directed at the avoidance of unhealthy snacks. Additionally, Study 1 showed that, in line with our expectations, making plans to eat fewer unhealthy snacks is not an effective strategy for promoting a healthy diet, as higher levels of avoidance plans were related to an *increased* consumption of unhealthy snacks. This finding corresponds with the study of Otis and Pelletier (2008) that showed that avoidance planning predicted dysfunctional eating behavior.

The finding that both the interaction of controlled motivation with avoidance planning and the interaction of autonomous motivation with avoidance planning on unhealthy snack intake were not significant further indicates that the (negative) effect of avoidance planning on goal progress occurs irrespective of the level of controlled motivation and irrespective of the level of autonomous motivation. However, it is important to note that an alternative explanation for this lack of interaction effects could be that the present sample included very few participants who scored high on controlled motivation and low on avoidance planning, and very few participants who scored high on autonomous motivation and high on avoidance planning. As making avoidance plans thus seems to be something that is mainly done by participants high in controlled motivation, there may be too little variance to find significant interaction effects of autonomous/controlled motivation x avoidance planning. Future

research employing experimental manipulations of avoidance planning is therefore required to more stringently assess whether avoidance plans are always ineffective, or whether they are ineffective in the present study *because* they are formulated by participants with controlled motivation.

Study 2

The finding from Study 1 that participants high in controlled motivation were more likely to make specific plans to avoid unhealthy snacks is in line with earlier findings (Otis & Pelletier, 2008). However, this finding is puzzling in view of the fact that individuals with high controlled motivation are generally not very likely to exert much effort to achieve their goal (e.g., Sheldon & Elliot, 1998) and are more likely to procrastinate (e.g., Senécal & Guay, 2000; Senécal et al., 2003; Senécal et al., 1995). Therefore, a second study was conducted in which the reasons for making plans to eat healthily are investigated. It was expected that participants with high controlled motivation do not formulate plans in order to swiftly engage in goal-directed action, but rather to postpone goal-directed action and to experience a sense of relief.

Method

Sample and Procedure

Female undergraduate students who responded affirmatively to the questions: “Do you consume at least four unhealthy snacks a week?”, and “Do you have the intention to eat fewer unhealthy snacks in the near future?” ($N = 49$) were invited to fill out a questionnaire of eating behavior. Three participants who were underweight ($BMI < 18$) and three participants who failed to indicate their weight were excluded from the analyses. There were no obese participants in the sample. The final sample included 43 participants with a mean BMI of 22.10 ($SD = 2.72$) and a mean age of 20.00 years ($SD = 1.66$).

Questionnaire

The questionnaire was similar to Study 2 for measures of intention (Cronbach's $\alpha = .97$), autonomous (Cronbach's $\alpha = .88$) and controlled motivation (Cronbach's $\alpha = .79$), and avoidance planning (Cronbach's $\alpha = .73$). In addition, eight items measuring reasons for planning were included. These items can be found in Table 5 and were constructed to reflect two types of reasons for planning; planning to postpone action (e.g., “I make plans to eat healthily in order to soothe myself”, and “Making plans to eat healthily are a way to postpone actual action”) and planning to promote action (e.g., “Making plans to eat healthily motivates me to get started right away”, and “Making plans to eat healthily gives me a sense of control”).

Results

Descriptives

Table 3 shows the means, standard deviations, and correlations of the variables under study. Avoidance planning was natural log-transformed before entering into the analysis as scores were

positively skewed. However, for ease of interpretation, mean scores in Table 3 are presented for the non-transformed variables.

Avoidance Planning

A multiple regression analysis with age, intention, autonomous and controlled motivation was conducted to investigate which factors predicted the formation of avoidance plans. Results showed that the model was significant, with intention and controlled motivation as significant predictors. Participants with stronger intentions and stronger controlled motivation were more inclined to make plans to eat fewer unhealthy snacks. The final model explained 59.3% of the variance in avoidance planning (see Table 4).

Table 3

Means, Standard Deviations and Correlations for the Variables in Study 2

	1	2	3	4	5	6	7	8
Age (1)	-							
BMI (2)	.03	-						
Intention (3)	-.06	.20	-					
Autonomous Motivation (4)	.36*	.08	.19	-				
Controlled Motivation (5)	.02	-.07	.30*	.19	-			
Avoidance Planning (6)	.12	.13	.69**	.15	.49**	-		
Planning to Postpone Action (7)	.22	.07	.56**	-.07	.33*	.53**	-	
Planning to Promote Action (8)	.35*	.02	.48**	.36*	.25	.38*	.66**	-
<i>M</i>	20.00	22.10	3.93	4.65	2.57	2.64	3.06	3.75
<i>SD</i>	1.66	2.72	2.22	1.08	1.05	1.54	1.49	1.69

* $p < .05$; ** $p < .01$

Table 4

Multiple Linear Regression Analysis for Avoidance Planning

	β	ΔF	R^2
<i>Model</i>		13.87	.593**
Age	.19		
Intention	.62**		
Autonomous Motivation	-.09		
Controlled Motivation	.31**		

* $p < .05$; ** $p < .01$

Reasons for Planning

Principle Component Analysis with varimax rotation was employed to confirm that our scale of reasons for planning consisted of the hypothesized two factors. The plotted eigenvalues indeed suggested a 2-factor structure which accounted for 70.04% of the common variance. The eigenvalues for the two factors were 4.47 (planning to promote action) and 1.13 (planning to postpone action). All items loaded strongly on the expected factor (> .62). The rotated factor solution can be found in Table 5. Internal consistency estimates were acceptable for both subscales (Cronbach’s alpha = .79 for planning to postpone action and .87 for planning to promote action).

Table 5

Rotated Component Matrix of Reasons for Planning Items Based on PCA with Varimax Rotation

	Component	
I usually act upon my plans to eat more healthily	.88	-.03
Making a plan to eat more healthily motivates me to get started right away	.85	.31
I am 100% behind my plans to eat more healthily	.72	.30
Making plans to eat more healthily gives me a feeling of control	.70	.57
I put a lot of time into making plans and thinking about strategies to eat more healthily, but I don’t always enact them	.05	.85
Making a plan to eat more healthily instills a sense of relief	.50	.71
Making plans to eat more healthily are a way to postpone actual action	.13	.68
I make plans to eat more healthily in order to soothe myself	.50	.63

Note: Loadings > .60 are in bold font.

Reasons for Planning and Type of Motivation

Correlations of the two types of reasons for planning with autonomous and controlled motivation were examined to investigate our hypothesis that participants high in controlled motivation made plans in order to postpone action whereas participants high in autonomous motivation made plans in order to promote action. Results showed that controlled motivation was correlated with our scale for planning to postpone action and not with our scale for planning to promote action. In contrast, autonomous motivation was correlated with planning to promote action and not with planning to postpone action (see Table 3).

Discussion

Results from Study 1 were replicated; participants with higher controlled motivation were more likely to formulate plans to eat fewer unhealthy snacks. Additionally, and in line with previous research demonstrating positive associations between controlled motivation and procrastination (e.g., Senécal & Guay, 2000; Senécal et al., 2003; Senécal et al., 1995), it was found that participants high in controlled motivation reported to make plans to postpone action and to experience a sense of relief. Participants high in autonomous motivation, on the other hand, made plans to promote action initiation and to experience a sense of control.

General Discussion

Previous studies have consistently shown that instructing people to make specific action plans is helpful to initiate health promoting behaviors, such as increasing fruit and vegetable intake (e.g., Armitage, 2007; De Nooijer et al., 2006; Luszczynska, Tryburcy, et al., 2007). More recently, action plans have also been found to be effective in replacing unhealthy behaviors with alternative behaviors, such as performing an alternative behavior instead of smoking a cigarette when being stressed (Webb et al., 2009). However, less is known about the effects of action planning when these plans specify to *avoid* unhealthy behaviors, rather than replacing them. The present study hence aimed to extend previous findings on action planning by focusing on *avoidance planning*. Specifically, we aimed to (a) examine the efficacy of spontaneously formulated plans to avoid unhealthy foods in actually decreasing unhealthy snack consumption and (b) assess the role of motivation in promoting the formation of such avoidance plans.

Results for our first research question – whether spontaneous plans to avoid unhealthy snacking are effective in diminishing unhealthy snack consumption – showed that these plans resulted in an increased rather than decreased unhealthy snack consumption. Although this finding may seem at odds with the results from numerous studies that have demonstrated beneficial effects of action planning on goal striving (e.g., Armitage, 2007; De Nooijer et al., 2006; Luszczynska, Tryburcy, et al., 2007), our findings are in line with studies indicating that *avoidance* goals and plans tend to be related to negative outcomes (e.g., Dickson & MacLeod, 2004a; Dickson & MacLeod 2004b; Elliot & McGregor, 1999; Elliot, Sheldon, & Church, 1997). Also, when considering research on eating behavior in particular, our findings are in accord with results indicating that avoidance planning has adverse effects on eating behaviors, as reflected in increased eating concerns and bulimic symptoms (Otis & Pelletier, 2008).

With respect to our second research question – regarding the role of autonomous and controlled motivation in promoting the formation of avoidance plans – it was hypothesized that participants with higher controlled motivation were more likely to make avoidance plans. In line with our expectations, Studies 1 and 2 showed that even when controlling for intention, controlled, but not autonomous motivation, was significantly associated with the formation of action plans to avoid unhealthy snacking. This finding is in line with the proposition by Deci and Ryan (2000) that controlled behaviors often reflect behaviors performed out of fear and out of avoidance of punishment and other negative consequences and are therefore mainly avoidance-oriented. It makes sense to find that motivation that is grounded in the avoidance of adverse consequences leads to the formation of plans that are directly concerned with the avoidance of behaviors that could lead to such adverse consequences.

The observed relation between controlled motivation and avoidance planning is also in accordance with findings of Otis and Pelletier (2008), who also found a strong relation between controlled motivation, but not autonomous motivation, and avoidance planning. Otis and Pelletier (2008) explained their results by referring to work by Pelletier et al. (2004), which indicated that women high in controlled motivation are particularly concerned with the quantity of the food they consume, whereas women high in autonomous motivation are mostly concerned about the quality

of the food they consume. According to Otis and Pelletier (2008), concerns about quality are more in line with approach planning and concerns about quantity are more in line with avoidance planning, which may explain why participants high in controlled motivation were more inclined to make plans to avoid unhealthy foods.

The explanation proposed by Otis and Pelletier (2008) makes intuitive sense and also explains why previous studies on action planning aimed at initiating new behaviors found a strong association between autonomous rather than controlled motivation and planning (e.g., Brickell & Chatzisarantis, 2007; De Ridder, De Wit, et al., 2009; Koestner et al., 2008). Nevertheless, the relation between controlled motivation and avoidance planning departs from research indicating that individuals high in controlled motivation tend to exert less effort to achieve their goal, are more likely to procrastinate (e.g., Senécal & Guay, 2000; Senécal et al., 2003; Senécal et al., 1995), and the suggestion that controlled motivation fades during the pre-actional phase of goal striving (Sheldon & Elliot, 1998).

In light of these findings it is difficult to explain why participants with strong controlled motivation would invest effort in making any type of plan at all. Therefore, Study 2 explored the reasons these participants had for making plans. It was expected that the plans formulated by people high in controlled motivation were directed at postponing actual goal-directed action, and mostly served to provide a sense of relief. Results from Study 2 confirmed our expectations: rather than making plans to promote a swift initiation of goal-directed action as was the case for participants high in autonomous motivation, participants high in controlled motivation reported to not always enact their plans to eat healthily, and to make plans to postpone action and to assure and soothe themselves. These findings imply that for individuals high in controlled motivation making plans is an end in itself rather than a means to promote goal-directed action in that they make plans to give themselves a feeling of 'working on their goal' without actually acting on their plans.

It would be interesting to investigate whether the reasons for planning of participants high in controlled motivation are reflected in the content of their plans. Based on the present findings it could, for example, be expected that spontaneous action plans made by participants with high controlled motivation would focus on eating fewer unhealthy snacks 'next week' rather than 'today', in order to avoid having to act right away, but nevertheless instilling a feeling of actively working towards the goal. However, as our study does not allow for an explicit test of this idea, future research is needed to test this suggestion.

Several limitations of our studies need to be addressed. Firstly, the samples in both studies consisted of normal or overweight young females ($18 < \text{BMI} < 30$). It could be argued that these participants were not very interested in changing their dietary practices, or that maintaining a healthy diet was not particularly relevant for these relatively young and healthy women. However, as the mean intention to reduce unhealthy snack consumption was around the midpoint of the scale in both studies, eating less unhealthily seems to be a goal that at least a substantial part of the sample had adopted. Moreover, although no obese participants were included in our sample, 20.6% (Study 1), and 20.9 % (Study 2) of the participants had a BMI > 24 and could hence be classified as being overweight and at risk of becoming obese. Even so, future research is needed to investigate

the efficacy of avoidance planning and its relation to controlled motivation and trying to postpone action in a more highly motivated sample as results may be different for participants who all have a strong intention to eat less unhealthy snacks.

A second limitation refers to the fact that all of our findings are based on self-report data. This may in particular be a problem for the snack diary in Study 1, as participants have been found to underreport their caloric intake (e.g., Muhlheim, Allison, Heshka, & Heymsfield, 1998; Rennie, Coward, & Jebb, 2007). Nevertheless, food diaries can be considered one of the more sophisticated, naturalistic measures of eating behavior that are presently available (De Castro, 2000).

A last limitation concerns the correlational design of Study 1. Findings from Study 1 indicate that avoidance planning may be a specific type of action planning that is ineffective and can even have adverse effects. However, the negative effects obtained for avoidance planning in the present study may be due to the fact that we measured rather than manipulated the use of avoidance plans. In the present study, avoidance plans were mainly formulated by individuals high in controlled motivation and who had the objective to postpone action. It could therefore very well be the case that avoidance plans in themselves may be effective, as from our findings it becomes obvious that merely *asking* participants about their use of avoidance plans does not provide information about whether they have formed an “appropriate” plan. Based on the present findings we should therefore restrict our conclusion to stating that *spontaneously* formulated avoidance plans are ineffective.

Future research using experimental designs in which the use of avoidance planning is manipulated is hence needed in order to more stringently test the assumption that avoidance planning is by itself an ineffective strategy. Moreover, if avoidance planning does turn out to be effective (when making ‘correct plans, with the right objective’) it would be interesting to test whether people high in controlled motivation might then actually benefit most from a planning intervention as they do not appear to form ‘appropriate’ plans spontaneously².

Conclusion

Notwithstanding the above limitations, our studies contribute to the literature on action planning as they show that action planning may not always yield beneficial results. Spontaneously formulated plans directed at the avoidance of unhealthy snacks were found to be ineffective in decreasing unhealthy snack intake, and even resulted in an increased consumption of unhealthy snacks. Importantly, the present study also identified which individuals are most likely to use this ineffective strategy to decrease unhealthy snack intake as controlled motivation was positively related to the formation of plans to avoid unhealthy snacks. Our study also reveals why individuals with controlled motivation would engage in action planning as they do not seem to make plans for reasons that most people would consider obvious (i.e., initiating action), but rather to postpone action.

2. We would like to thank one of the anonymous reviewers for pointing out this suggestion for future research.

Chapter 3

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

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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 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 our hypotheses, forming negation implementation intentions resulted in (a) cognitive ironic rebound effects compared to an intention only condition, as well as (b) behavioral ironic rebound effects compared to an intention only condition or formulating 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. While implementation intentions are generally highly effective in facilitating behavior change even when this involves breaking unwanted habits, the present research thus suggests that they are ineffective when they have a negating structure.

For a wide range of behaviors, individuals regularly fail to translate their behavioral 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 is hence 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* existing unwanted habits (e.g., quit eating fatty snacks; Gollwitzer, 1999; Gollwitzer & Sheeran, 2006; Holland, Aarts, & Langendam, 2006). Specifically, three different types of counter-habitual implementation intentions have been proposed that may be effective in breaking habits (Sheeran, Milne, Webb, & Gollwitzer, 2005; Gollwitzer, Bayer, & McCulloch, 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, 2009b; Holland et al., 2006). For example, if someone 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'. Replacement implementation intentions have been found effective in reducing smoking behavior (but only for people with weak or moderate smoking habits; Webb, Sheeran & Luszczynska, 2009), changing recycling habits (Holland et al., 2006), reducing switch costs in a task-switching paradigm and overcoming the automatic effects of spatial location in a Simon task (Cohen, Bayer, Jaudas, & Gollwitzer, 2008), reducing automatic stereotypical thoughts (Stewart & Payne, 2008), reducing anxiety in the presence of spiders among spider phobics (Schweiger Gallo & Gollwitzer, 2007; Schweiger Gallo, Keil, McCulloch, Rockstroh, & Gollwitzer, 2009), reducing prompted disgust

reactions (Schweiger Gallo et al., 2009), and decreasing unhealthy snack consumption (Adriaanse, De Ridder, et al., 2009b).

The precise mechanisms by which these implementation intentions are effective in breaking habits are not clear yet. However, recent evidence indicates that as a result of formulating a replacement implementation intention, the cue-alternative response association is facilitated while the cue-habitual response association is inhibited and that these combined effects eliminate the cognitive advantage of the habitual means in the “horse race” with the alternative response (Adriaanse, Gollwitzer, De Ridder, De Wit, & Kroese, 2009).

A second type of implementation intention that has been proposed to be effective in reducing habits is an implementation intention aimed at ignoring the triggering stimulus or 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 a psychotherapy appointment from unwanted negative affect (Sheeran, Aubrey, & Kellar, 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 can be used to reduce a ‘situation-habitual response’ association is an implementation intention that directly specifies to suppress the unwanted habitual response upon encountering the critical situation for that response (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. An unpublished study by Gollwitzer, Achtziger, Schaal, & Hammelbeck (2002) showed that when a goal to judge the elderly in a non-stereotypical manner is augmented with the implementation intention “If I see an old person, 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 food. However, Adriaanse, De Ridder, and De Wit (2009c) showed that such avoidance plans actually resulted in increased intake of unhealthy foods, and Otis and Pelletier (2008) reported increased levels of dysfunctional eating behavior as a result of forming plans aimed at the avoidance of 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 intentions 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 that suggest that, despite their practical applicability and straightforwardness, negation implementation intentions may not yield beneficial results.

First, according to Wegner's *Ironic Process Theory* (1994), suppression of a thought may ironically result in this thought actually becoming more prevalent. According to Wegner (1994), 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 different 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 counter-stereotype 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. In order 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 made cognitively accessible first. 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 1000 milliseconds 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', '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, while negating a sentence is 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.

Research Overview

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, as well as on a behavioral level by means of self-report in snack diaries.

Study 1 provided a first test of our hypothesis by comparing the accessibility of the word representing the habitual response (chocolate) upon priming of the critical situation between a negation implementation intention and intention only condition. Study 2 aimed to replicate findings from Study 1, as well as to rule out the possibility that the two conditions differed in the activation of just the word ‘chocolate’, instead of the activation of the ‘situation-chocolate’ association (i.e., the habit). In Study 3, measures of actual snacking behavior (snack diary) were included to test the hypothesis that forming a negation implementation intention actually results in increased unhealthy snacking behavior. This study included an extra control condition (replacement implementation intention) to rule out the possibility that the effects were solely caused by differences in information activated by the implementation intention manipulation instructions. Lastly, Study 4 aimed to replicate this behavioral rebound effect, and additionally investigated whether the (in)effectiveness of negation implementation intentions on actual unhealthy snack consumption is moderated by habit strength.

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 ‘chocolate’ after being primed with the critical situation, compared to forming a general goal-intention.

Method

Participants

Fifty-two normal to overweight female students ($18.5 < \text{BMI} < 30$) who were motivated to eat fewer unhealthy snacks were recruited to participate in our study. Three participants with

extreme reaction times (> 2.5 SD's from the mean) on the critical trials of the lexical decision task were excluded from the analyses. This resulted in a total sample of 49 participants, with a mean BMI of 21.58 ($SD = 1.96$) and a mean age of 19.65 years ($SD = 1.94$).

Procedure and Materials

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 to eat fewer unhealthy snacks, and in particular less chocolate, because this is an unhealthy snack female students generally consume too much of. 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. Then, participants were reminded of their goal of eating fewer unhealthy snacks, and in particular consuming less chocolate. Half of the participants augmented this goal intention with a negation implementation intention, and the other half of participants merely repeated the goal intention. Finally, a lexical decision task was administered in order to measure the association between the critical situation and the word 'chocolate'. After finishing, participants filled in a questionnaire, were debriefed, paid (€ 3 or course credit), and thanked for their participation.

Questionnaire. Participants were asked to enter their age, height and weight. Additionally, they were asked how much they liked chocolate on a 7-point scale ranging from 1 (totally disagree) to 7 (totally agree).

Implementation intention. Participants were randomly assigned to one of two conditions: a negation implementation intention condition or an intention only condition. 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 asked to visualize themselves executing the plan until the last screen closed after 60 seconds.

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 or not. 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 centre of the screen for 1 second, which was then replaced by a prime word, presented for 50 ms. The prime word was masked for 500 ms by a string of X's, 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 seconds as an inter-trial 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 variables.

Results

Descriptives and Randomization Check

Participants reported to like chocolate a lot ($M = 6.51$, $SD = 1.02$). In order to check whether randomization was successful, separate Analyses of Variance (ANOVAs) were performed with condition (negation implementation intention vs. intention only) as the independent variable and liking of chocolate, age, and BMI as the dependent variables. None of the ANOVAs yielded significant effects, $ps > .31$.

'Situation-Chocolate' Association

A one-way ANOVA was performed with condition as the independent variable, and mean reaction time on the critical trial as the dependent variable. 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 participants in the intention only condition ($M = 704.74$, $SD = 224.17$). Participants did not differ in their reaction time to neutral words, $p = .23$.

Discussion

Study 1 confirmed 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. However, as the word 'chocolate' was only presented in combination with the situation prime, the results from Study 1 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’. A second study was conducted to rule out this alternative explanation.

Study 2

In Study 2, the lexical decision task was adapted in such a way that the word ‘chocolate’ was also preceded by a non-word prime in addition to the situation prime. This was done to demonstrate that forming a negation implementation intention results in a heightened activation of the *situation-chocolate association* (i.e., the representation of the habit) and not just in a heightened activation of ‘chocolate’ in general. A non-word prime was chosen rather than a neutral word prime, as the extent to which a ‘neutral’ prime is actually neutral and unrelated to the word ‘chocolate’ for an individual participant is difficult to establish.¹

Method

Participants

Twenty-eight normal weight to overweight female students who were motivated to eat fewer unhealthy snacks were recruited. Participants had a mean BMI of 21.48 ($SD = 1.28$) and a mean age of 19.89 years ($SD = 2.14$).

Procedure and Materials

The procedure regarding the implementation intention formation was equal to Study 1, but there were some changes to the questionnaires and the lexical decision task.

Questionnaires. Similar to Study 1, age, height, weight, and liking of chocolate were assessed. However, this time liking of chocolate was measured by three items (“Eating chocolate is pleasant/enjoyable/tasty”, $\alpha = .89$) on 5-point scales ranging from 1 (*totally disagree*) to 5 (*totally agree*). To check whether participants in both conditions were equally committed to the goal to eat less unhealthily, 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”, $\alpha = .90$), which could be answered on 5-point scales ranging from 1 (*totally disagree*) to 5 (*totally agree*).

Lexical decision task. The lexical decision task differed from Study 1, in that the word ‘chocolate’ was also preceded by a non-word. Moreover, to make the task less time consuming it was shortened to one block of trials. This block consisted of 24 trials, including 2 trials in which the target word was ‘chocolate’ (one with the situation prime and one with a non-word prime), 10 neutral-word trials and 12 non-word trials. Similar to Study 1, reaction times were not normally distributed and were therefore natural-log transformed. However, means and standard deviations are presented for the non-natural-log transformed variable.

1. However, a study using a neutral-word prime showed similar findings to Study 2: Participants in the negation implementation intention condition ($M = 813.69$, $SD = 379.45$) responded significantly faster to the target word ‘chocolate’ after the situation prime than participants in the intention only condition ($M = 969.86$, $SD = 375.33$), $p < .05$, but there was no significant effect of condition on the neutral word – chocolate association, $F < 1$. For sake of brevity this study is not included as a full study in the present paper.

Results

Descriptives and Randomization Check

On average, participants had a moderate to high intention to eat less unhealthily ($M = 3.42$, $SD = .82$) and liked eating chocolate a lot ($M = 4.23$, $SD = .64$). In order to check whether randomization was successful, separate ANOVA's were performed with condition (negation implementation intention vs. intention only) as the independent variable, and age, BMI, intention, and liking of chocolate as the dependent variables. There were no significant effects, $ps > .28$.

'Situation-Chocolate' Association

An ANOVA with condition as the independent variable and the reaction time on the critical situation-chocolate trial as the dependent variable showed a significant effect of condition, $F(1,26) = 4.03$, $p = .05$, $\eta_p^2 = .13$. Participants in the negation condition had shorter mean reaction times to the target word 'chocolate' after presentation of the situation prime ($M = 623.36$, $SD = 196.48$) than participants in the control condition ($M = 815.64$, $SD = 322.78$). Participants in the two conditions did not differ in their reaction time to the word 'chocolate' after being primed with a non-word, $F < 1$, or in reaction time to neutral words, $p = .20$.

Discussion

Study 2 replicated the findings from Study 1, confirming the hypothesis that the activation of the 'situation-chocolate' association is heightened after making the negation implementation intention. Further, the results from Study 2 showed that forming a negation implementation intention only heightens the accessibility of the 'situation-chocolate' association (and thus the snacking habit) and not just the accessibility of the word 'chocolate'. Moreover, participants in both conditions were equally committed to the goal to eat less unhealthy snacks.

Study 3

In order to assess whether the cognitive ironic rebound effect also generalizes to actual snacking behavior, a third study was conducted in which reports of actual snacking behavior were included. In this third study the effect of formulating a negation implementation intention was compared to 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 for the negation (*then I will not*) being substituted with a replacement (*then instead of... I will...*). This additional control condition allowed for ruling out the alternative explanation that any differences between the negation implementation intention condition and the intention only condition are merely caused by a joint presentation of the situation word and 'chocolate' in the instructions of the negation implementation intention condition.

Due to 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, De Ridder, et al., 2009b), 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 used as a control condition to demonstrate that the negating structure is essential for ironic rebound effects to occur, but is not expected to yield any beneficial effects compared to the intention only condition.

It was hypothesized that forming a negation implementation intention results in an increased intake of unhealthy foods compared to both control conditions. In order to investigate this hypothesis, participants had to keep a snack diary during the week after forming the implementation intentions. We chose a snack diary assessing overall unhealthy snack intake rather than a specific measure of chocolate intake. This was deemed necessary as previous diary studies conducted in our laboratory indicated that recording the consumption of *one* specific food type that is the subject of restriction results in floor effects. Such floor effects may result from increased self-representation biases or from the registration of such a specific food type being an intervention in its own right.

Method

Participants

One hundred and thirty normal to overweight female students who were motivated to eat fewer unhealthy snacks 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 Materials

After filling out some questionnaires, participants were randomly assigned to the negation implementation intention condition, the replacement implementation intention condition, or the intention only condition. Participants were then instructed on how to fill out the snack diary, and an individual appointment was made for returning the diary approximately one week later. Upon returning the diary, participants filled out a final questionnaire, were thanked, debriefed, and reimbursed.

Questionnaires. Measures of age, BMI, intention to eat less unhealthily ($\alpha = .90$) and liking of chocolate ($\alpha = .88$) were similar to Study 2.

Implementation intention. Instructions for the negation implementation condition and the intention-only condition were similar to Studies 1 and 2. It was explained to participants that formulating a certain plan would make it easier for them to adhere to their goal of eating less chocolate, and then either the goal intention was repeated (intention only condition) or an implementation intention was formulated. However, this time there were two implementation intention conditions. Next to the negation implementation intention, a replacement implementation

intention condition was added in which participants were instructed to form the implementation intention “If [*self-generated critical situation*] and I want to have a snack, then instead of chocolate I will eat an apple!”².

Snack diary. The snack diary was based on the snack diaries used by Adriaanse, De Ridder, et al. (2009b) and consisted of templates with one column displaying pre-coded options for healthy snacks and one column displaying pre-coded options for unhealthy snacks. For both columns, an 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 a period of seven 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 with the average amount of kilocalories it contains.

Final questionnaire. Upon returning the diary, a final questionnaire was administered that included some extra control questions. 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

Descriptives and Randomization Check

On average, participants had a moderate to high intention to eat less unhealthily ($M = 3.94$, $SD = .75$) and liked chocolate a lot ($M = 4.05$, $SD = .66$). Separate ANOVAs were conducted with condition (negation implementation intention vs. intention only vs. replacement implementation intention) as 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

2. The alternative response of eating an apple was given in the replacement implementation intention condition. This was deemed necessary as 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.

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

In order 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 ($M = 2903, SD = 1674$) than participants in the replacement implementation intention condition ($M = 2096, SD = 1322$), $p < .01$, and a marginally significant higher caloric intake than participants in the intention only condition ($M = 2400, SD = 1341$), $p = .06$. 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, $p = .20$.

Discussion

Study 3 showed that negation implementation intentions resulted in a higher frequency of unhealthy snacking, and a (marginally) higher caloric intake on unhealthy snacks in the week after forming this type of implementation intention. These findings demonstrate that the cognitive effects of negation implementation intentions as demonstrated in Studies 1 and 2 are relevant as they also generalize to actual behavior. Participants in both implementation intention conditions were presented with the situation word, the word 'chocolate', and the joint presentation of these two words equally often during the implementation intention manipulation. This rules out the possibility that effects were caused by differences in presentation of the critical situation word together with 'chocolate' in the manipulation.

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 is 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. Nevertheless, results for the amount and frequency of overall unhealthy snack consumption as well as for self-perceived success all point in the same direction: Participants in the negation implementation intention condition consumed unhealthy snacks more frequently, consumed more calories from unhealthy snacks, and reported lower self-perceived success in diminishing chocolate consumption compared to the intention only condition. This increases our confidence that negation implementation intentions lead to cognitive as well as behavioral ironic rebound effects.

Study 4

In order to ensure a closer match between the implementation intentions and the specific behavior they aim to tackle, a fourth study was conducted where the content of the negation implementation intention was altered to focus on the more general habit of ‘snacking unhealthily’ 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 in case of strong rather than weak habits. To investigate this, the effect of negation implementation intentions on unhealthy snacking behavior was compared to a replacement implementation intention condition as well as to 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 in order to ensure that participants would all spend an equal amount of time working on a task related to healthy eating (Adriaanse, De Ridder, et al., 2009b).

Method

Participants

Normal to overweight female students ($N = 65$) who were motivated to eat fewer unhealthy snacks were recruited to participate in a diary study on snacking behavior. Sixty one 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 Materials

The procedure was similar to Study 3 except that this time questionnaires and the implementation intention manipulation were filled out on paper instead of on the computer.

Questionnaires. Age, height and weight were assessed similarly to previous studies. Participants' intention to eat less unhealthily ($\alpha = .94$) was this time assessed on 7-point scales, ranging from 1 (*totally disagree*) to 7 (*totally agree*). 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. Instructions for the negation implementation intention condition and the replacement implementation intention condition were similar to the previous studies, except that this time they were provided on paper instead of on the computer. Another difference was that in this study the implementation intentions referred to the more general habit of eating unhealthy snacks in order to more closely match the implementation intentions to the dependent variable (a snack diary assessing overall unhealthy snack intake). Specifically, participants in the implementation intention condition 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 five and a maximum of ten of their favorite healthy snacks.

Snack diary. The snack diary was similar to Study 3, but in order 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, prior to 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

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 ($M = 4.03$, $SD = 1.17$). In order 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

In order 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. The analysis included a dummy variable for the negation implementation intention condition and for the replacement implementation intention (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. Habit strength was mean centered before being entered into the analysis (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 1 for details).

To examine this interaction, simple slopes were computed for participants with weak vs. strong unhealthy snacking habits (+1SD vs. -1SD 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 ($\beta = .61$, $p < .01$), whereas for participants with weak unhealthy snacking habits, condition was not related to unhealthy snack consumption ($\beta = -.16$, $p = .41$).

Table 1
Multiple Linear Regression Analysis for Unhealthy Snack Intake

	β	ΔF	ΔR^2
<i>Model</i>		3.49	.24**
Negation II	.23#		
Replacement II	-.06		
Unhealthy Snack Habit Strength	-.07		
Negation II x Unhealthy Snack Habit Strength	.46**		
Replacement II x Unhealthy Snack Habit Strength	.09		

$p < .1$; * $p < .05$; ** $p < .01$

Discussion

Study 4 confirmed the hypothesis that forming a negation implementation intention results in a higher consumption of unhealthy snacks, but only when negation implementation intentions are targeted at strong habits. These findings indicate that people are more likely to experience difficulties associated with the processing of negations when the relation to be negated is represented in memory as a strong existing cognitive link.

General Discussion

Ever since the introduction of implementation intentions as a means of translating intentions into goal-directed behavior (Gollwitzer, 1999), an impressive body of evidence has accumulated that 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 counter-habitual 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, Milne, 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, De Ridder, et al., 2009c; Gollwitzer et al., 2002; 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 is trying 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 snacking habit ('situation-snack' association) and not for the activation of the snack word in general. 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 as well as caloric intake) compared to merely forming an intention or forming replacement implementation intentions. Including a replacement implementation intention condition provided a stringent test of the assumption that it is the negation of the habit that causes the ironic rebound effects as replacement implementation intentions were similar to negation plans except that they did not have a negation structure.

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 et al., 2009), this is the first time it has been measured 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 (Wegner, Schneider, Carter, & White, 1987; Gawronski et al., 2008). 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 Study 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 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) did find 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 be 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 by 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 colleagues (2002) also reported positive effects for negation implementation intentions. Specifically, these authors showed that an implementation intention with the format "If I see an old person, then I will tell myself: Don't stereotype!" can be effective in inhibiting the activation of stereotypical beliefs regarding elderly. 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 had 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. In fact, it could 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.

Specifically, considering the positive effects that have previously been reported, one is probably better off choosing replacement implementation intentions (e.g., Adriaanse, De Ridder, et al., 2009b; Cohen et al., 2008; Holland et al., 2006; Stewart & Payne, 2008; Schweiger Gallo & Gollwitzer, 2007; Schweiger Gallo et al., 2009) in order to successfully break habits. However, we hasten to say that these replacement implementation intentions should, similar to the studies outlined above, only specify the alternative behavior (e.g., “If critical situations X arises, then I will perform alternative behavior Y!”; e.g., Adriaanse, De Ridder, et al., 2009b), 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.

Another alternative type of implementation intention that could be considered when aiming to suppress existing habits are ignore implementation intentions. Instead of negating or replacing existing responses these plans specify to ignore the critical stimulus (e.g., Sheeran, Milne, et al., 2005). The ignore plan has previously been found to be effective in breaking habits (e.g., Achtziger, Gollwitzer & Sheeran, 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 upon the representation of the critical situation. However, it is the very fact that ignore implementation intentions do not involve a negation of an existing association which may make this type of counter-habitual implementation intention more effective in breaking habits than negation implementation intentions.

Limitations

Several limitations of the present studies have to be noted. First, findings for actual food intake in Studies 3 and 4 were based on self-reports in food diaries. However, we controlled for several variables such as honesty and seriousness in filling in their 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 to overt behavioral measures (e.g., Achtziger et al., 2008; Adriaanse, De Ridder, et al., 2009b).

Secondly, 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. As in other implementation intention studies, we aimed to investigate if, given a certain goal intention, implementation intentions can enhance the likelihood that this goal intention is acted upon. Moreover, other studies in which the overarching goal intention also involved *not* to perform a certain behavior, such as not getting frightened (Schweiger Gallo & Gollwitzer, 2007; Schweiger Gallo et al., 2009), not getting disgusted (Schweiger Gallo et al., 2009), and not consuming unhealthy snacks (Adriaanse, De Ridder, et al., 2009b) found positive effects for another type of implementation intention (replacement implementation intention). This makes it highly 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, even though 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.

Chapter 4

Finding the Critical Cue: Implementation Intentions to Change one's Diet Work Best when Tailored to Personally Relevant Reasons for Unhealthy Eating

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Abstract

Implementation intentions promote acting on one's good intentions. But does specifying where and when to act also suffice when goal striving involves complex change that does not merely require initiating a behavior, but rather the substitution of a habit by a new response? In a pilot study and two experiments, we investigated the efficacy of implementation intentions in replacing unhealthy snacks with healthy snacks, by linking different types of cues for unhealthy snacking (if-part) to healthy snacking (then-part). The pilot study identified cues for unhealthy snacking, differentiating between situational (where/when) and motivational (why) cues. Studies 1 and 2 tested the efficacy of implementation intentions specifying either situational or motivational cues in altering snacking habits. Results showed that implementation intentions specifying motivational cues decreased unhealthy snack consumption whereas the classic specification of where and when did not. Extending previous research, for complex behavior change 'why' seems more important than 'where and when'.

People often fail to act on their good intentions (Webb & Sheeran, 2006). Research on implementation intentions shows that a specific planning of one's goals can be an effective tool in bridging this so-called intention-behavior gap (e.g., Orbell, Hodgkins, & Sheeran, 1997; Sheeran & Orbell, 1999). So far, most studies that applied implementation intentions in the health domain primarily focused on health-protective behaviors, such as cancer screening or increasing vitamin C intake (Gollwitzer & Sheeran, 2006). Implementing these types of behaviors may be relatively straightforward as they mainly require the initiation of a desired response (e.g., attending a cancer screening or taking a vitamin C tablet). Much less research is available on the role of implementation intentions in altering health-risk behaviors such as smoking, excess alcohol consumption, or eating unhealthily (Gollwitzer & Sheeran, 2006). These latter types of health behavior may be much more complicated to change as they require the suppression of an undesired response (e.g., quit smoking) and sometimes even the substitution of the unwanted response by a wanted response (e.g., eating an apple *instead* of a candy bar).

Following a suggestion made by Gollwitzer and Sheeran (2006), we argue that more research is needed that investigates the beneficial effects of implementation intentions in changing health-risk behaviors. Consequently, the present research addresses the effectiveness of implementation intentions in decreasing unhealthy snack consumption and replacing this by more healthy eating patterns. In doing so, we employ an approach in which person-specific if-then patterns, that is, personal triggers for unhealthy snacking, are used as a basis for the formation of implementation intentions.

Implementation Intentions

For a wide range of health behaviors, such as giving up smoking (D'Onofrio, Moskowitz, & Braverman, 2002), taking up regular physical exercise (Milne, Orbell, & Sheeran, 2002), or maintaining a low fat diet (Armitage, 2004), individuals regularly experience difficulties in translating their behavioral intentions into action. Having a goal intention in these domains is generally insufficient to ensure enacting a desired behavior (Armitage & Conner, 2001; Webb & Sheeran, 2006). According to Gollwitzer (1999), in addition to forming goal intentions, implementation intentions, or plans concerning where, when and how one will perform the intended behavior, are required to ensure behavioral enactment.

Whereas goal intentions merely specify the end state one wants to obtain (e.g., "I intend to eat healthily"), implementation intentions stipulate the time, place and manner in which this goal will be achieved (e.g., "If I come home from work hungry in the evening, then I will eat an apple"), thereby creating an association between a specific situation and a desired behavioral response. As implementation intentions specify a particular opportunity for action (i.e., time and place), individuals are more likely to recognize this situation as a good opportunity to act. Moreover, since the situation is believed to become automatically linked to a specific behavior as a result of forming implementation intentions, one no longer has to decide *in situ* about which goal-directed behavior to perform when the opportunity to behave in a desired way arises. Consequently, when the specified situation ('coming home from work hungry in the evening') is encountered, the behavior ('eating an apple') is thought to be elicited automatically (Gollwitzer, 1999).

Implementation intentions have been found to promote several health-related behaviors, such as attending cervical cancer screening (Sheeran & Orbell, 2000) or breast screening (Rutter, Steadman, & Quine, 2006), performing breast self-examination (Orbell et al., 1997), vitamin C intake (Sheeran & Orbell, 1999), resuming functional activity after joint-replacement surgery (Orbell & Sheeran, 2000), exercising (Milne et al., 2002; Prestwich, Lawton, & Conner, 2003; Rise, Thompson, & Verplanken, 2003), and eating healthily (Armitage, 2004; De Nooijer, De Vet, Brug, & De Vries, 2006; Kellar & Abraham, 2005; Verplanken & Faes, 1999).

The majority of these studies, however, were concerned with health promoting behaviors that require the *initiation* of a desired response (e.g., eating more fruits or vegetables) rather than with changing an existing behavioral pattern (e.g., eating an apple *instead* of a candy bar; Gollwitzer & Sheeran, 2006). Replacing behavioral responses is generally more difficult than initiating new behavior or supporting ongoing responses (Holland, Aarts, & Langendam, 2006), especially when the old behavior is habitual (Webb & Sheeran, 2006). However, sometimes substituting an undesirable behavioral response is required. For example, when dieting to lose weight, one is not so much concerned with increasing fruit intake, but with replacing unhealthy snacks, such as crisps or chocolate, with healthy snacks, such as fruits or vegetables.

So far, several studies on implementation intentions and eating behavior have been conducted, but, to the best of our knowledge, only two studies were concerned with changing existing eating patterns (Armitage, 2004; Verplanken & Faes, 1999). A study by Verplanken and Faes (1999) showed that participants who had made implementation intentions ate more healthily than participants in the control condition who had not made such specific plans. However, although this study yielded promising results, it did not provide clear evidence that participants actually replaced unhealthy foods by healthy foods, as the implementation intentions were targeted at eating behavior for one day only and the results specified a composite score for the health-related quality of consumed foods, which could reflect a decrease in fatty foods, an increase in fruit and/or vegetable intake, or both.

A study by Armitage (2004) specifically addressed the reduction of fat consumption and showed that total fat intake, saturated fat intake, and the percentage of energy derived from fat significantly decreased among participants who had made implementation intentions, but not among participants in the no-treatment control condition. However, the dependent measure in this study (food frequency list) relied on participants' ability to remember their food intake for a whole month, which may have resulted in considerable memory bias. It therefore remains to be determined whether these results hold under more stringent conditions. The present study aims to address the lack of pertinent data by testing a novel approach that is designed to direct the formation of implementation intentions to existing if-then profiles in order to change participants' eating behavior.

Using Existing If-Then Patterns in Implementation Intentions

Habits and implementation intentions are thought to instigate similar automatic responses that only differ in origin; that is whether they are the result of repeated action (i.e., habits) or reflect conscious planning (i.e., implementation intentions; cf. Aarts & Dijksterhuis, 2000). Several authors have suggested that when attempting to alter existing behavior patterns, implementation intentions

could be used to link a new, desired behavior to the critical cue that previously triggered the habitual, unwanted response (Gollwitzer, 1999; Gollwitzer & Sheeran, 2006; Holland et al., 2006). If a person is familiar with his/her 'situation-behavior profile' (Gollwitzer & Sheeran, 2006) and thus knows which cues elicit the undesired response, this information can be used to tailor the formation of implementation intentions to these critical cues.

Following this line of reasoning, implementation intentions may not only be used to initiate a new response, but also to *override* old habitual responses. To illustrate, if a person wants to eat more healthily and is aware that s/he always eats crisps when watching television, this knowledge could be used to link the critical cue ('watching television') to a new, desired response (e.g., 'eating an apple'), resulting in the following implementation intention: "If I am watching television and I want to eat something, then I will eat an apple". In this way, "(i)mplementation intentions that specify the critical stimulus and link it to a response in line with the new goal should block the automatic initiation of the habitual response" (Gollwitzer, 1999, p. 500). Subsequently, when the critical cue is encountered, both the old habitual response and the new preferred response will be activated and compete for action initiation. Given that the cue-action link that is formed by the implementation intention is more recent than the habitual if-then pattern, the action stipulated in the implementation intention is assumed to have a good chance of overruling the habitual response (Holland et al., 2006).

Holland and colleagues tested this assumption in a study on recycling habits. Participants in the implementation intention condition were asked to plan where, when, and how they were going to recycle their used plastic cups and wastepaper and to visualize and write down these plans. Results showed that implementation intentions were indeed effective in breaking the old habit of throwing plastic cups and wastepaper into the bin and in creating the new habit of recycling these items.

In the present study a similar strategy will be applied to promote change in eating behaviors, in particular the consumption of snacks. A snack is defined as any type of food that is consumed between meals (De Graaf, 2006). Our focus on snacking as the type of eating behavior to be targeted by implementation intentions was based on two reasons. First, implementation intentions should be targeted to a specific goal (such as snacking) instead of to a more general goal (such as eating) in order for the newly planned response to effectively compete with the old habitual response (Holland et al., 2006). Second, a focus on snacking was deemed relevant because previous studies have consistently demonstrated that snack consumption is an important contributor to overweight (De Graaf, 2006; Jahns, Siega-Riz, & Popkin, 2001; Zizza, Siega-Riz, & Popkin, 2001).

Cues for Unhealthy Snacking

Although the results reported by Holland and colleagues (2006) are promising, it remains to be determined whether the above presented approach can also be applied to more complex behaviors such as unhealthy snacking. Whereas disposing of cups seems to be directly triggered by the situational context (the presence of an empty cup), unhealthy snacking is a complex type of behavior as it does not seem to be directly linked to specific situational cues such as times or places (De Graaf, 2006) and occurs for a variety of reasons.

The literature on emotional eating, for example, suggests that for some individuals having negative emotions is a reason for the consumption of snacks (e.g., Conner, Fitter, & Fletcher, 1999; Dubé, LeBel, & Lu, 2005). Other studies suggest that people adjust their eating patterns to their perception of the social situation in which eating occurs (Herman & Polivy, 2005). In addition, a study by Jackson, Cooper, Mintz & Albino (2003) showed that individuals report four distinct types of motivations to eating, including coping with negative affect, being social, complying with others' expectations, and enhancing pleasure.

In contrast to implementation intentions targeted at initiating new behaviors which require the specification of *any* cue which reflects a good opportunity to act, for implementation intentions to be effective in breaking habits it is essential that the if-part of the implementation intention specifies the cue that actually *triggers* the behavior to be substituted. For the behavior of disposing plastic cups this critical trigger is simply the presence of the situational cue 'empty plastic cup', as for the habit of throwing cups in the bin, the situation in itself represents the reason for performing the behavior.

However, as unhealthy snacking in general does not seem to be directly related to specific situational cues, for this type of behavior it seems of vital importance to specify the reason why the behavior is performed in order to capture the *critical* cue-behavior link. To illustrate, although a person who often eats unhealthy snacks to be social (e.g., eating a homemade cake at party which is kindly offered to you, or having some of the snacks that friends ordered when you are out having a beer together) might in many cases be with friends when this occurs, 'friends' may not represent the *critical* cue for eating unhealthy snacks. This person might for example not eat unhealthy snacks when attending class together with friends, and a social gathering with colleagues from work will also trigger snacking, despite no friends being around.

Considering that for unhealthy snacking the reasons for performing the behavior may not consistently overlap with specific situational cues, we believe that in order to truly tackle the unwanted habit, the reasons for performing the behavior ('why') should be considered next to 'traditional' situational cues reflecting time and place. Throughout this paper, we will refer to these two different types of cues as 'situational cues' ('where/when') and 'motivational cues' ('why').

As these motivational cues for eating unhealthy snacks probably reflect internal states or subjective cues (e.g., being bored, or feeling sad) and are thus different from the objective situational cues that are traditionally used in implementation intention research, a first necessary step after identifying these motivational cues would be to investigate if they can be effectively used in implementation intentions. If motivational cues are consistently related to unhealthy snacking, and can in fact be used in the if-part of implementation intentions, we expect these implementation intentions specifying the motivational underpinnings for unhealthy snacking to be more effective in altering snacking behavior than implementation intentions specifying situational cues.

Research Overview

A pilot study and two experimental studies were conducted to investigate whether making implementation intentions can help individuals to alter their snacking behavior. More specifically, we tested which type of cue (situational or motivational) can be most successfully used in implementation intentions aimed at replacing the consumption of unhealthy snacks by healthy snacks.

The pilot study was concerned with determining situational cues coinciding with unhealthy snacking as well as motivational cues reported for unhealthy snacking. As the motivational cues often reflected more internal, subjective states, and very little is known about the effectiveness of implementation intentions specifying these types of internal cues, Study 1 tested the assumption that motivational cues for unhealthy snacking from our pilot study could be successfully used in implementation intentions. As such, Study 1 examined whether this distinct type of if-then plans affected healthy snacking to the same extent as implementation intentions using situational cues related unhealthy snacking. Study 2 then compared the effectiveness of implementation intentions reflecting *personally relevant* motivational cues and implementation intentions reflecting *personally relevant* situational cues on the increase of healthy snacking as well as the decrease of unhealthy snacking, thus providing a full test of our assumption that implementation intentions specifying the personal reasons for the unwanted behavior (motivational cues) in the if-part are able to actually replace old snacking habits.

Pilot Study: Situational and Motivational Cues for Unhealthy Snacking

Method

Participants

Participants were female students recruited at the Utrecht Business and Management School. Fifty females aged 17-25 years were initially recruited and 43 students completed the study. Four underweight participants (BMI [Body Mass Index = weight/height x height] < 18) were excluded from the analysis as underweight (and obese) people might differ from normal weight and overweight people in the way they regulate their eating behavior and can be considered to have a pathological relation to food (i.e., Mela, 2006; Nasser, 2001; Vaidya & Malik, 2008). There were no obese people in the sample. The final sample consisted of 39 women with a BMI ranging from 18.3 to 27.0 ($M = 21.3$, $SD = 2.2$).

Procedure

Upon recruitment, participants were informed that the objective of the study was to gain insight into female students' snacking behavior and that their responses would remain anonymous. The study consisted of keeping a one-week food diary which was administered to examine where, when, and why people regularly eat unhealthy snacks. All participants received detailed instructions on how to use the diary and made an individual appointment to return their diary. When the diary had been completed, participants were debriefed and reimbursed with 5 Euro.

Food diary. In the food diary, participants were requested to record the unhealthy snacks they ate during each of seven consecutive days. Six entries of snacking behavior were possible for each day. The instructions stated that participants were supposed to fill out one entry for each occasion (defined as a 30 minute period) they were eating something unhealthy between meals and not for each separate consumption of an unhealthy snack. Healthy snacks did not have to be reported. In this manner, the frequency of *episodes* of unhealthy snacking and the corresponding situational and motivational cues could be determined.

Entries for each unhealthy snacking episode encompassed five types of responses to describe the details of the snack consumption, using pre-coded alternatives as well as an 'other option'. The five types of responses referred to the *nature and amount* of the unhealthy snacks that were consumed (e.g., 1 candy bar and 2 pieces of cake), the objective situational cues associated with unhealthy snacking; the *places* (e.g., home), *activities* (e.g., studying), and *company* (e.g., friends) related to the specific instance of snacking, as well as the *motivational cues* (perceived reasons) for snacking (e.g., feeling bored).

Labels for motivational cues reported for unhealthy snacking reflected the four categories of motivations for eating (coping, social, compliance, and pleasure) described by Jackson et al. (2003). Examples of motivational cues are feeling bored, to be social, politeness, and enjoyment. These types of psychological motivations for eating are well documented in the eating literature (e.g., Arnow, Kenardy & Agras, 1995; Conger, Conger, Costanzo, Wright, & Matter, 1980; Herman & Polivy, 2005; Hill, Weaver & Blundell, 1991; Lowe & Butryn, 2007; Van Strien, Schippers, & Cox, 1995).

Results & Discussion

Descriptives

Participants consumed unhealthy snacks on average 14.9 times a week ($SD = 6.0$). As the unhealthy snacks that participants consumed varied considerably in size and calories, the mean amount of kilocalories (kcal) derived from unhealthy snacks was estimated by multiplying each reported snack by the average amount of kilocalories it contains (based on guidelines by the Dutch Nutrition Centre; <http://www.caloriechecker.nl>, and validated by a professional dietician). The mean amount of kcal per day derived from unhealthy snacks was 404 ($SD = 277$).

Diary

As can be seen in Table 1, participants were often at home when eating unhealthy snacks. However, when they were not at home, the most often mentioned locations were at school, on a visit, or at work. The activities that were most often associated with eating unhealthy snacks were chatting, watching TV, studying, and relaxing. Furthermore, participants were often alone when they consumed unhealthy snacks, but when they had company they most often were with friends, family or classmates. The motivational cues for eating that were most often reported were having an appetite, enjoyment, feeling bored, and to be social.

Table 1

Most Often Reported Situational and Motivational Cues for Unhealthy Snacking

Situational Cues			Motivational Cues
Place	Activity	Company	
Home ($M = 7.5, SD = 4.0$)	Chatting ($M = 3.5, SD = 2.8$)	Alone ($M = 5.0, SD = 3.5$)	Appetite ($M = 5.3, SD = 3.2$)
School ($M = 2.8, SD = 2.4$)	Watching TV ($M = 3.3, SD = 3.2$)	Friends ($M = 4.3, SD = 3.1$)	Enjoyment ($M = 2.0, SD = 1.9$)
On a visit ($M = 1.1, SD = 1.5$)	Studying ($M = 2.3, SD = 2.3$)	Family ($M = 3.1, SD = 2.7$)	Feeling bored ($M = 1.9, SD = 2.0$)
Work ($M = 1.1, SD = 1.5$)	Relaxing ($M = 1.9, SD = 1.9$)	Classmates ($M = 1.8, SD = 1.8$)	To be social ($M = 1.8, SD = 1.9$)

Note. Means and standard deviations reflect the average frequency with which an option was registered in a diary.

Study 1: Using Motivational Cues in Implementation Intentions

Study 1 was designed to test whether the reported motivational cues for unhealthy snacking that deemed important in the pilot study could be successfully applied in the formation of implementation intentions. So far, little is known about the efficacy of using cues that do not reflect objective, external situations, such as specific times or places, in implementation intentions (see: for an exemption, Achtziger, Gollwitzer, & Sheeran, 2008). As very few studies have used internal or less objective cues, Study 1 was necessary in order to see whether the motivational cues participants reported in the pilot study could be used as cues in the if-part of implementation intentions in a similar way as traditional situational cues.

Study 1 had three conditions: one control condition and two experimental conditions (implementation intentions specifying either situational or motivational cues). For each of the two experimental conditions, two possible cues were used, as we wanted to make sure that any results would not be due to a specific cue that would work better or worse, but rather to the nature of the cue (situational cues vs. motivational cues). In each of the experimental conditions, half of the participants were therefore assigned to the first cue, and the other half of the participants to the second cue of the condition they were in. Our main analysis will concern a one-way ANOVA for the 3 conditions, but we will also test the 5 separate conditions to check for possible differences between the two cues within the 'situational cue' and 'motivational cue' condition.

In the first experimental condition, situational cues reflecting time and place as are traditionally used in implementation intention research were specified. For half of the participants in this condition, this situation was 'being alone' and for the other half in this condition, it was 'being at home', since these were the two situational cues that were most often linked to unhealthy snacking in the diaries (pilot study). In the second experimental condition, motivational cues for unhealthy snacking were used as triggers in the if-part of the implementation intentions. For half of the participants in this condition, the cue that was used was 'to be social', and for the other half the cue was 'feeling bored'. These were the most often reported reasons for unhealthy snacking in our pilot

study after ‘having an appetite’, which was an integral part of all implementation intentions specified (see below) and very close after ‘enjoyment’. We chose ‘to be social’ and ‘feeling bored’, instead of ‘enjoyment’, as we wanted to have two motivational cues which were equally specific and ‘enjoyment’ seems more general than ‘to be social’ or ‘feeling bored’. To summarize, participants were randomly assigned to either ‘alone’, ‘at home’, ‘social’, or ‘bored’, or to the control condition. However, in our first analysis the two situational cues are taken together (alone and at home) as well as the two motivational cues (social and bored).

In the experimental conditions, the above described cues were linked to the consumption of a healthy snack by means of implementation intentions. Based on recent evidence indicating that not only ‘traditional’ external cues, but also internal states such as ‘feeling exhausted’ or ‘feeling self-abandoned’ can be effectively used in the if-part of implementation intentions (Achtziger et al, 2008), it was hypothesized that both the situational (‘being at home’ and ‘being alone’) and the motivational cues (‘to be social’ and ‘feeling bored’) would be effective cues to initiate healthy snack consumption.

Method

Participants

Participants were female students (aged 18-25 years) from Utrecht University who, upon recruitment, responded positively to the question “Do you want to eat more healthily?”. A total of 127 female students were recruited and 118 participants completed the study. After excluding four underweight participants (BMI < 18), five obese participants (BMI > 30), and one participant who failed to indicate her weight, for similar reasons as in the pilot study, the final sample consisted of 108 participants with a BMI ranging from 18.1 to 29.2 ($M = 21.3$, $SD = 2.1$).

Procedure

Upon recruitment participants were randomly assigned to one of the two experimental conditions in which they were asked to make implementation intentions to eat a healthy snack, or to the control condition in which participants made no implementation intentions. Depending on the experimental condition, implementation intentions either specified a situational cue (‘being alone’ or ‘being at home’), or a motivational cue (‘feeling bored’, or ‘to be social’). After answering several questions regarding age, weight, height, and motivation to eat healthily (“How motivated are you to eat more healthily?” on a 7 point scale), participants received a food diary. Procedures regarding instructions, returning the diaries, debriefing and reimbursement were similar to those in the pilot study.

Implementation intentions. Participants in the experimental conditions were told that scientific research had shown that nearly every woman has a tendency to eat unhealthy snacks when she is alone/at home/feeling bored/acting social - depending on the specific experimental condition. Subsequently, participants were informed that planning beforehand to eat a healthy snack at that specific occasion can help to eat more healthily. Participants were then asked to choose a healthy snack they liked and that was readily accessible to them, followed by completing the statement “If I [am alone/am at home/am feeling bored/am acting social] and I feel like having a snack, then I will take a(n)”. After sentence completion was verified by the experimenter, participants were told that

this type of planning would work best when they would picture the specific situation in their minds (Taylor, Pham, Rivkin, & Armor, 1998). Participants were then encouraged to visualize acting out their plan for a couple of minutes.

Food diary. The food diary was similar to the food diary in the pilot study and included seven days for which participants were asked to register the snacks they consumed. The only difference with the pilot study was that participants were asked to register their unhealthy as well as *healthy* snack consumption. Each entry involved one column with 12 types of unhealthy snacks and one column with 13 types of healthy snacks. For both healthy and unhealthy snacks an ‘other’-option was also provided. The dependent variables were the average amounts of healthy and unhealthy snacks consumed per day. The healthy snacks were summed whereas the amount of unhealthy snacks consumed was, for similar reasons as in the pilot study, expressed in kilocalories.

Results

Descriptives

On average, participants consumed 1.7 healthy snacks per day ($SD = 1.2$; 73% of which were fruit and vegetables) and the mean amount of calories consumed from unhealthy snacks per day was 209 kcal ($SD = 147$). Participants were on average very motivated to eat more healthily ($M = 5.2$, $SD = 1.0$) and this motivation did not differ between the three study conditions (implementation intention with situational cue, implementation intention with motivational cue, or control), $F(2,105) = .43$, $p = .65$.

Type of Cue

A MANOVA was performed on healthy snack consumption and unhealthy snack consumption (in kcal) with study condition as independent variable, the results of which are depicted in Table 2. The multivariate test revealed a significant effect of condition, Wilks’ Lambda $F(4,208) = 3.08$, $p < .05$. However, univariate tests indicated that the effect of study condition was significant for healthy snacking, $F(2,105) = 5.84$, $p < .01$, but not for unhealthy snacking, $F(2,105) = .20$, $p = .82$.

A two-tailed Dunnet post-hoc test was subsequently performed to test our hypothesis and to specifically compare the two experimental conditions with the control condition. This revealed that for healthy snacking, implementation intentions specifying motivational cues differed significantly from the control group: mean difference (MD) = 1.0, $p < .01$ while implementation intentions specifying situational cues did not ($p = .12$). Participants in the motivational cue condition consumed significantly more healthy snacks than did participants in the control condition¹.

When the analyses were performed for each type of cue separately (with 5 conditions), the multivariate test also revealed a significant effect, Wilks’ Lambda $F(8,204) = 2.52$, $p < .05$, and the univariate tests also gave a significant effect for healthy snacking, $F(4,103) = 4.86$, $p < .01$, but not for unhealthy snacking, $F(4,103) = .12$, $p = .98$. The Dunnet test showed that the implementation

1. For Study 1, the results are similar when the number of unhealthy snacks is entered into the analyses instead of unhealthy snacks in terms of kilocalories. The Dunnett t-test again shows no significant effects for unhealthy snacking.

intentions specifying the cue ‘to be social’ resulted in a significant increase in healthy snacking, $MD = 1.1, p < .01$, as well as the implementation intentions specifying the cue ‘feeling bored’, $MD = .9, p < .05$, and ‘being alone’, $MD = 1.0, p < .05$.

Table 2

Average Intake of Healthy (sum) and Unhealthy (kcal) Snacks per Day

	Situational cue N = 45	Motivational cue N = 39	Control N = 24
Healthy snacks			
<i>M</i>	1.6	2.1	1.1
<i>SD</i>	1.1	1.4	0.7
Unhealthy snacks (kcal)			
<i>M</i>	217	207	194
<i>SD</i>	141	156	140

Discussion

Study 1 shows that subjective motivational cues can be successfully used in the if-part of implementation intentions to promote healthy snacking. More specifically, our results demonstrate that implementation intentions specifying motivational cues for performing the unwanted behavior are effective in promoting healthy snacking, whereas implementation intentions specifying situational cues were not effective. However, when analyzing the five conditions separately, one of the situational cues (alone) does show a significant effect on healthy snacking, indicating that for initiating healthy snacking, situational cues can probably both be effectively used in implementation intentions aimed to promote initiation of a certain behavior. This latter finding is also more in line with the meta-analytical evidence for the effectiveness of specifying when and where to act in implementation intentions for health promoting behaviors (e.g., Gollwitzer & Sheeran, 2006).

Although the implementation intentions specifying motivational cues for snacking were effective in increasing the frequency of healthy snacking, the frequency of unhealthy snacking remained unaffected. It is important to note, however, that because the aim of Study 1 was to test the assumption that subjective motivational cues can be effectively used in implementation intentions, participants were randomly assigned to one of four cues related to unhealthy snacking. As participants were not allowed to choose between different cues, the cue used in the formation of implementation intentions did not necessarily reflect individuals’ *personally* most relevant trigger for unhealthy snacking.

Triggers for snacking are most likely very personal and someone who snacks when feeling bored might not necessarily snack when s/he is feeling sociable. As it is essential for *substituting* unhealthy snacking by healthy snacking that the cues used in the implementation intentions are *habitually related* to eating unhealthy snacks (Holland et al., 2006), the efficacy of implementation intentions on diminishing unhealthy snacking should increase when participants are able to use their own *personally* most relevant cues for unhealthy snacking.

Study 2: Making Cues Personal

A third study was designed to test if *personally* relevant motivational cues for unhealthy snacking are more effective than *personally* relevant traditional situational cues when forming implementation intentions to decrease unhealthy snacking. In order to test this, participants in the two experimental conditions were asked to form an implementation intention using either their own personally most relevant motivational cue or their own personally most relevant situational cue, depending on the experimental condition they were assigned to.

In addition, we added an active control condition as participants in the control condition performed a task about healthy eating, which was not the case in Study 1. Participants in the active control condition were told that in order to help them eat more healthily we wanted them to think about which healthy snacks they liked and to list their ten favorite healthy snacks. By doing so we are able to eliminate the possibility that effects of making implementation intentions were caused by mere active thinking about healthy eating. It was hypothesized that although Study 1 showed that situational and motivational cues can both be effective in *initiating healthy snacking*, for *decreasing unhealthy snack consumption*, only personally relevant motivational cues and not personally relevant situational cues will be effective. This hypothesis was build on our assumption that in order to break habits, one needs to target the critical cue that triggers the unwanted behavior and for snacking these critical cues generally do not reflect specific times or places (see introduction).

Method

Participants

Participants were female students recruited at the Utrecht College of Social Work. Participants were included in the study if they responded positively to the question “Are you motivated to eat more healthily?”. Ninety-four participants received a food diary and 82 participants returned their diaries. After excluding two underweight participants (BMI < 18), two obese participants (BMI > 30), five participants who had specified an unhealthy snack (e.g., cookie) in their implementation intention, and one participant who was an outlier on healthy snack consumption (>3.5 SD), the final sample consisted of 72 students with a BMI ranging from 18.3 to 29.4 ($M = 22.5$, $SD = 2.6$).

Procedure

Participants were randomly assigned to one of two experimental conditions (implementation intentions specifying situational cues or implementation intentions specifying motivational cues) or to the control condition. Participants in the experimental conditions were asked to form an implementation intention and participants in the control condition were asked to list their favorite healthy snacks. Subsequently, the food diary was handed out. Procedures regarding instructions, returning the diaries, debriefing and reimbursement were similar to those in Study 1.

Implementation intentions. Participants in all conditions were told that we were interested in helping people to eat more healthily and that most people eat too many unhealthy snacks. On top of this, participants in the experimental conditions were instructed to choose a situation in which they generally ate unhealthy snacks and to plan to eat something healthy whenever they

found themselves in that specific situation. They were told to choose this cue from a list of six situational cues related to unhealthy snacking, or from a list of six motivational cues for unhealthy snacking, which were provided on a form, and to pick the cue that was for them most often related to unhealthy snacking. The list's content depended on the study condition: the list in the condition focusing on situational cues reflected the three most often mentioned places (at home, at school, on a visit) and company (alone, with friends, with family) as reported in the pilot study. Similarly, the list in the condition focusing on motivational cues consisted of those reasons for unhealthy snacking found to be of importance in the pilot study (to be social, feeling bored, enjoyment, politeness, distraction, because other people are eating).

Next, participants were asked to choose a healthy snack which they would eat whenever they were in the situation they had chosen and felt like having a snack. They were told to pick a snack that they really liked and that was usually available in the situation they chose. When they had chosen a specific healthy snack, participants were asked to complete the following sentence "If I [Situational cue or Motivational cue] and I feel like having a snack, then I will take a [healthy snack]". After sentence completion was verified by the experimenter, participants were, like in Study 1, explained that their plan would be most effective when they would picture the specific situation in their minds (Taylor et. al., 1998) and encouraged to visualize acting out their plan for a few minutes.

Food diary. The food diary differed from the diary in the second study only in that it consisted of *one entry* for healthy and unhealthy snacks per day instead of filling out the diary for each snacking occasion. By simplifying data recording this way, participants did no longer have to complete the diary several times a day, but could instead aggregate their snack consumption in one entry for the full day, making the study less demanding. The dependent variables were similar to Study 1.

Results

Descriptives

Participants consumed on average 1.6 healthy snacks ($SD = 1.0$; 75% of which were fruit and vegetables) and 220 kilocalories ($SD = 141$) on unhealthy snacks per day. Participants were, like in Study 1, highly motivated to eat more healthily, as measured by the item "How motivated are you to eat more healthily?" on a 7 point scale ($M = 5.6$, $SD = 0.8$) and motivation did not differ between the three conditions, $F(2,69) = .76$, $p = .47$.

Type of Cue

A MANOVA was performed on the dependent variables, with condition (implementation intention with situational cue, implementation intention with motivational cue, or control), as the independent variable. The multivariate test revealed a significant effect of condition, Wilks' Lambda $F(4,136) = 2.63$, $p < .05$. Univariate tests indicated that the effect of condition was significant for healthy snacking, $F(2,69) = 3.15$, $p < .05$, and marginally significant for unhealthy snacking $F(2,69) = 2.56$, $p = .08$. The means and standard deviations for healthy and unhealthy snacking for the three conditions are presented in Table 3.

To examine our hypothesis that implementation intentions specifying personal motivational cues for snacking are effective in reducing the consumption of unhealthy snacks and increasing the

consumption of healthy snacks, a two-tailed Dunnett post-hoc t-test was performed. This test revealed that for healthy snacking, the ‘motivational cue’ condition did indeed differ significantly from the control condition ($MD = 0.74, p < .05$), with participants in this condition eating on average 0.74 more healthy snacks per day than participants in the control condition. The ‘situational cue’ condition did not differ significantly from the control condition, $p = .31$. For unhealthy snacking, the Dunnett t-test also showed that the motivational cue condition differed significantly from the control condition ($MD = 90, p < .05$): the mean daily consumption of unhealthy snacks in this group was 90 kcal lower than for participants in the control condition. The situational cue condition did not differ significantly from the control condition on unhealthy snacking ($p = .29$)².

Table 3

Average Intake of Healthy (sum) and Unhealthy Snacks (kcal) per Day

	Situational cue N = 24	Motivational cue N = 27	Control N = 21
Healthy snacks			
<i>M</i>	1.6	1.9	1.2
<i>SD</i>	0.7	1.2	0.9
Unhealthy snacks			
<i>M</i>	217	183	273
<i>SD</i>	121	137	155

Discussion

Study 2 examined whether people replace unhealthy snacks by healthy snacks when they specify their *personal* motivational cue for unhealthy snacking in implementation intentions. Confirming our expectations, findings showed that implementation intentions only resulted in a lower consumption of unhealthy snacks and a higher consumption of healthy snacks, when the-if part specified the underlying personal motivational cue for unhealthy snacking. When personal situational cues that may coincide with unhealthy snacking, but that are not the *critical* triggers were used as the cue in the if-part of the plan, the habitual response was not replaced³.

- For Study 2, the pattern of results is similar when the number of unhealthy snacks is entered into the analyses instead of unhealthy snacks in terms of kilocalories. The Dunnett t-test shows a marginal significant effect for unhealthy snacking for the implementation intentions specifying motivational cues, $MD = 6.9, p < .08$, but no effect for the implementation intentions specifying situational cues, $p = .42$.
- Extra data collection showed that the ineffectiveness of situational cues was not due to a lack of specificity, as was suggested by one of the anonymous reviewers. When situational cues were made more specific by adding a time of the day (morning/afternoon/ evening) to the chosen situational cue, the analyses again revealed no significant difference in healthy snack consumption ($p = .50$) nor in unhealthy snack consumption ($p = .90$) for the situational cue condition compared to the control condition. The data also again indicated a beneficial effect of specifying motivational cues as people in the motivational cue condition consumed on average 0.5 more healthy snacks ($p < .05$) and 125 kcal less on unhealthy snacks ($p < .05$) per day than people in a control condition.

General Discussion

Thus far, research on implementation intentions in the health domain has mainly focused on health promoting behaviors (e.g., attending a cancer screening) that require the initiation of a new behavior (Gollwitzer & Sheeran, 2006). However, it has been suggested that when implementation intentions link the critical stimulus that typically elicits the habitual response to a new, desired response, they could also be effective in changing (habitual) behavior (Gollwitzer, 1999; Gollwitzer & Sheeran, 2006; Holland et al., 2006). Previously, Holland and colleagues (2006) showed that this approach was effective in altering recycling behavior. The present study aimed to test whether this approach could also be applied to more complex behavior, such as unhealthy snacking, that occurs in a diversity of circumstances and for numerous reasons (De Graaf, 2006; Jackson et al., 2003). It was expected that this approach would work, but only if the cues specified in the implementation intentions would concern motivational cues for the undesired behavior instead of external situational cues as unhealthy snacking was not expected to be triggered by simple context cues. We conducted a pilot and two studies to examine this hypothesis.

The pilot study was designed to identify the situational and motivational cues for unhealthy snacking. Study 1 then tested these cues for their effectiveness in implementation intentions and showed that implementation intentions specifying motivational cues (i.e., ‘feeling bored’ and ‘socializing’) for unhealthy snacking were effective in promoting healthy snacking, whereas ‘traditional’ implementation intentions that specified situational cues (i.e., ‘being alone’ and ‘being at home’) were not. However, when analyzing the data for each of the cues separately, ‘feeling bored’, ‘socializing’ and ‘being alone’ all proved to be effective cues for initiating healthy snacking.

Although forming implementation intentions using three of the four cues promoted the consumption of healthy snacks, no effects were found for unhealthy snacking in Study 1. Apparently, participants ate more healthy snacks, but these healthy snacks did not replace unhealthy snacks. This implies that we probably did not succeed in specifying the *critical* triggers for unhealthy snacking. As triggers for unhealthy snacking differ substantially between individuals, in Study 2, implementation intentions were tailored to target participants’ most relevant *personal* motivational or situational cues for unhealthy snacking. In this manner, we expected to truly target the critical cues.

Based on the rationale proposed in the introduction, it was expected that specifying personal motivational cues but not personal situational cues in implementation intentions would result in a decreased consumption of unhealthy snacks. The second study indeed revealed that when participants were asked to link their personal motivational cues for unhealthy snacking to a healthy alternative by means of implementation intentions, they consumed significantly more healthy snacks and less unhealthy snacks compared to participants in the control condition. This indicates that the formation of implementation intentions based on personal motivational cues was successful in promoting behavior change by substituting unhealthy snacks for healthy snacks.

Our finding that implementation intentions specifying motivational cues were effective in decreasing unhealthy snack consumption when participants were allowed to specify their personally most relevant cue and thus their truly critical cue, but not when participants were assigned a cue,

is in line with recent evidence indicating that implementation intentions are more effective when instructions are delivered in an autonomy-supportive manner (Koestner et al., 2006).

The reported findings extend prior research on implementation intentions in several ways. First of all, the present study tested the efficacy of implementation intentions in altering existing behavior patterns, whereas most studies in the health domain have merely focused on the initiation of health promoting responses. The results from the present study support the proposition that implementation intentions can be effective in changing health risk behaviors that require the substitution of an unwanted response by a wanted response (e.g., Gollwitzer, 1999). Second, the results support the notion that existing if-then patterns can be used to break unwanted habits, by linking the critical stimulus (e.g., ‘feeling bored’) that normally elicits the undesired response (e.g., ‘eating chocolate’) to the new, desired response (e.g., ‘eating an apple’) and is, to our knowledge, the first to apply this strategy to a more complex goal (i.e., snacking).

Finally, the present line of research revealed that not only external cues, but also internal, motivational cues can be used in the if-part of implementation intentions. In this respect the present study replicates earlier work by Achtziger et al. (2008), who already showed that implementation intentions can be successful in shielding goal striving from detrimental inner states by specifying responses that can alleviate the disruptive influence of these states.

Most importantly however, the present study also extends new work on implementation intentions such as the work by Achtziger et al. (2008) as it is the first to try and identify the ‘truly’ critical cues by specifically comparing the efficacy of implementation intentions specifying either ‘traditional’ situational cues such as ‘being at home’ or inner motivational triggers such as ‘feeling bored’ in the if-part of the plan. This comparison showed that *only* implementation intentions specifying personally relevant motivational cues for the behavior to be substituted yielded a significant decrease in unhealthy snack consumption, whereas implementation intentions specifying external situational cues related to unhealthy snacking did not.

This finding supports our earlier assumption that, for breaking habits regarding complex goals such as snacking, it may be more important to consider *why* an undesired behavior is performed rather than where and when it is performed. The present findings have some important implications as they suggest that for more complex behavioral change it may even be essential to specify the reasons that underlie the behavior to be substituted rather than the external cues that coincide with this behavior. For some simple behaviors, such as throwing away an empty cup, the underlying reason might be rather straightforward as it overlaps with the presence of a certain situational cue (e.g., ‘an empty cup’). However, for more complex behaviors, such as snacking, it seems necessary to make a distinction between the situational circumstances and the critical trigger that *causes* the unwanted behavior to occur, or in other words, the personal reason for the unwanted behavior. As the present research only concerns one type of behavior, (i.e., snacking) the most important question that needs answering based on the present findings seems to be which type of cue would be more important for different types of goals, and whether there may be some benefit to combining the two types of cues.

In addition to their theoretical relevance, the presented findings also have important social implications. The World Health Organization reported in 2005 that more than 1 billion adults worldwide were overweight. Considering that being overweight is a major risk factor for health diseases, stroke, type 2 diabetes and other chronic diseases (Visscher & Seidell, 2001), it is important to find strategies that can help to decrease the consumption of foods that cause individuals to become overweight. As Hill, Wyatt, Reed and Peters (2003) reported that weight gain in most populations can be effectively prevented by relatively small, but consistent changes in behavior that result in a decrease in caloric intake of 100 kcal, the present findings are rather promising. Our study has shown that one easily made implementation intention that targeted a single critical cue for unhealthy snacking already resulted in an average reduction of 90 kcal per day in energy intake from unhealthy snack consumption.

Limitations and Future Directions

Although this study provides some promising results, it also has several limitations, the most obvious one being that it only included women. Secondly, findings are based on self-reported snacking behavior and previous studies have shown that individuals have a tendency to underreport their caloric intake (e.g., Muhlheim, Allison, Heshka, & Heymsfield, 1998; Rennie, Coward, & Jebb, 2007). However, even though using an objective measure of eating behavior may increase the validity of the results, food diaries are among the most sophisticated naturalistic eating measures that are currently available (De Castro, 2000).

A further limitation concerns the short period of time, one week, in which snacking behavior was reported. As Holland and colleagues (2006) argue, two requirements need to be met before concluding that implementation intentions can break habits: (a) the change in behavior needs to be lasting and stable, and (b) the link between past behavior and future behavior needs to be consistently reduced. Future research should hence measure snacking behavior for a longer period, as well as before and after forming implementation intentions in order to further insight into the effectiveness of the presently used approach in changing snacking habits. Future research should also be concerned with using participants' own idiographic set of motivational cues instead of allowing participants to choose from a list of cues as this would result in more personally relevant cues, which could benefit the efficacy of the implementation intentions.

Additionally, despite of the fact that in Study 2 implementation intentions specifying motivational cues were effective when compared to a control condition, but 'traditional' implementation intentions specifying situational cues were not, we were not able to statistically show that the two types of implementation intentions differed significantly from each other. Future research should replicate our findings, using more participants, to ensure a large enough power to test whether the implementation intentions specifying motivational cues are superior to the implementation intentions specifying situational cues. Finally, as mentioned earlier, it would be particularly interesting to examine whether our approach using personal motivational cues would also be successful in altering other types of complex habitual behaviors and to investigate which type of cue works better for different goals.

Conclusion

To summarize, the present study shows that personal if-then patterns can be used to form implementation intentions aimed at breaking existing behavioral patterns. In addition, the present study stresses that in the case of more complex behaviors such as snacking, these if-then patterns should reflect personal motivational cues for the undesired behavior rather than situational cues associated with the this behavior. To alter more complex behaviors, it appears to be more informative to find out *why* the behavior is performed, rather than to identify the situational circumstances related to the behavior.

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Chapter 5

Breaking Habits With Implementation Intentions: A Test of Underlying Processes

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Abstract

Implementation intentions specifying the replacement of a habitual response with an alternative response in a critical situation can overrule habits. In three experiments the cognitive effects of such counter-habitual implementation intentions were investigated to increase understanding of the underlying processes that make these plans effective. Results showed that implementation intentions facilitated the cue-alternative response association and simultaneously inhibited the cue-habitual response association. Combined, these effects eliminated the cognitive advantage of the habitual means in the “horse race” with the alternative response. Although the cognitive advantage of the habitual means was removed, it was not replaced by an automatic activation of the alternative means. This suggests that formulating counter-habitual implementation intentions increases individuals’ flexibility to choose which behavior to perform in the critical situation, but that actual behavior will depart from their habits only to the extent that individuals have strong alternative goal intentions.

A substantial part of people's daily behavior is habitual (Aarts & Dijksterhuis, 2000; Ouellette & Wood, 1998). Mindlessly opening a bag of chips when watching television, routinely ordering a beer when hanging out with friends, or consistently reaching for a bar of chocolate when feeling sad are all examples of habitual behaviors. Habits develop as people repeatedly perform a specific behavior (e.g., opening up a bag of chips) in a stable situation (e.g., watching television) to pursue their goals. This co-occurrence between the situation and the behavior eventually creates a direct mental association between the situation and the behavior which is strengthened each time they subsequently co-vary (Aarts & Dijksterhuis, 2000; Bargh, 1990; Bargh & Gollwitzer, 1994; Wood & Neal, 2007). Finally, this situation-behavior association is strengthened to the extent that when the situation is encountered, the behavior follows *automatically* (Aarts & Dijksterhuis, 2000; Bargh, 1990; Bargh & Gollwitzer, 1994), that is, without awareness, unintentionally, efficiently, and with very limited controllability (Bargh, 1994).

Although habit formation allows individuals to perform their daily routines in a very efficient manner and relieves people from the cognitive load that comes with conscious decision making (Wood, Quinn & Kashy, 2002), it also has negative consequences. Individuals' intentions may change, for example, when someone with the habit of eating chips when watching television decides to start eating more healthily, while the association between the situation and the behavior still remains. As the activation of the habitual behavior upon encountering the critical situation occurs automatically, without the involvement of conscious intentions, chances are that one will find oneself sitting in front of the TV, stuffing a big handful of chips into one's mouth before even remembering the new intention to eat more healthily (e.g., Aarts & Dijksterhuis, 2000; Wood & Neal, 2007). In fact, a meta-analysis of studies of the intention-behavior relation showed that the most important moderator of this relation, and the most difficult factor to self-regulate, was the extent of habitual control of the behavior. When circumstances did not support habit formation, intentions had a large effect on behavior ($d = .74$). However, when circumstances supported the development of habits this effect size dropped substantially ($d = 0.22$; Webb & Sheeran, 2006).

Despite the numerous studies regarding how habits are created and affect behavior (e.g., Aarts & Dijksterhuis, 2000; Danner, Aarts & De Vries, 2008; Ouellette & Wood, 1998; Verplanken & Aarts, 1999), very little is known about effective ways to *change* habits once they are formed. One of the few approaches that have been suggested is to remove the critical stimulus that elicits the habitual response or to avoid the critical stimulus, for example by moving or changing jobs (Wood, Tam, & Witt, 2005; Verplanken & Wood, 2006). While there is persuasive evidence that this approach is effective (Wood et al., 2005), from a psychological perspective it is important to understand how people can self-regulate the habitual response in the presence of the critical stimulus. Such an approach would also be more practically applicable, as in real life it is often not possible to remove or avoid the critical stimulus; most people are unable to avoid 'feeling sad', and would not like to quit 'hanging out with friends', or 'watching television'.

Implementation Intentions

One self-regulatory strategy that has been proposed to support individuals in managing the critical stimulus in such a way that they are able to act upon their counter-habitual intentions, is to furnish one's intentions with implementation intentions (Adriaanse, De Ridder, & De Wit, 2009b; Gollwitzer, 1999; Gollwitzer & Sheeran, 2006; Holland, Aarts, & Langendam, 2006). Implementation intentions are simple action plans stipulating where, when, and how one will perform an intended behavior, which have been found to promote goal-directed action (Gollwitzer, 1999). Instead of simply specifying an end state one wants to reach, as is the case for intentions ("I intend to achieve Z"), implementation intentions specify the where, when, and how of reaching this end state 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 on this intention is identified (e.g., 'riding the bus home after work') and then linked to a specific goal-directed action (e.g., 'eating an apple') in the if-then plan, resulting in the following implementation intention; "If I am riding the bus home after work, then I will eat an apple".

Planning one's goal striving in this manner is helpful for two reasons. Firstly, by specifying a situation for enacting one's intentions in advance, the mental representation of this critical situation is highly accessible in memory and therefore more easily detected as a good opportunity to act upon one's intentions. Secondly, by linking this critical situation to a specific goal-directed behavior in an if-then structure, the control of the behavior is delegated from the self to the specified situational cue, resulting in automatic elicitation of this goal-directed behavior when the situation is encountered. This automatic activation of the goal-directed behavior upon encountering the situation increases the likelihood of acting upon one's intentions, as consciously remembering one's intentions in these critical situations is no longer required (Gollwitzer, 1999; Parks-Stamm, Gollwitzer, & Oettingen, 2007; Bayer, Achtziger, Gollwitzer, & Moskowitz, 2009). Indeed, numerous studies have demonstrated that implementation intentions promote the initiation of intended behaviors (e.g., Armitage, 2007; Milne, Orbell, & Sheeran, 2002; Sheeran & Orbell, 1999), and that as a result of forming an implementation intention, the intended goal-directed behavior is initiated immediately (Cohen, Bayer, Jaudas, & Gollwitzer, 2008; Gollwitzer & Brandstätter, 1997), effortlessly (Brandstätter, Lengfelder, & Gollwitzer, 2001; Gawrilow & Gollwitzer, 2008), and without conscious intent (Bayer et al., 2009).

Implementation Intentions as a Strategy for Breaking Habits

Several authors have noted that habits and implementation intentions seem to instigate similar automatic responses which only differ in origin; that is whether they are the result of repeated action (i.e., habits) or reflect conscious planning (i.e., implementation intentions; e.g., Aarts & Dijksterhuis, 2000). Based on this similarity, it has been suggested that implementation intentions could not only be used to promote the initiation of new, wanted behaviors, but also to break existing unwanted habits. Specifically, it has been argued that when attempting to alter existing behavior patterns, implementation intentions could be used to link a new, desired behavior

to the situation that previously triggered the habitual behavior (Adriaanse, De Ridder, et al., 2009b; Gollwitzer, 1999; Gollwitzer & Sheeran, 2006; Holland et al., 2006). To illustrate, if a person is familiar with his/her 'situation-behavior profile' (Gollwitzer & Sheeran, 2006) and thus knows which situations elicit the habitual response, this information could potentially be used to tailor the formation of implementation intentions to these critical situations. For example, a person who is aware that (s)he tends to eat chips when watching television can use this information to formulate the following counter-habitual implementation intention "If I am watching television and I want a snack, then I will reach for the fruit bowl and take an apple" (Adriaanse, De Ridder, et al., 2009b; Gollwitzer, 1999; Gollwitzer & Sheeran, 2006; Holland et al., 2006).

Indeed, in addition to the large body of studies demonstrating the efficacy of implementation intentions in promoting the initiation of new behaviors, evidence underscoring the potential of these counter-habitual implementation intentions in breaking existing habits has started to accumulate in recent years. Counter-habitual implementation intentions have been found effective in changing recycling habits (Holland et al., 2006), reducing switch costs in a task-switching paradigm and overcoming the automatic effects of spatial location in a Simon task (Cohen, Bayer, Jaudas, & Gollwitzer, 2008), reducing automatic stereotypical thoughts (Stewart & Payne, 2008), reducing spider fear in spider phobics (Schweiger Gallo & Gollwitzer, 2007; Schweiger Gallo, Keil, McCulloch, Rockstroh, & Gollwitzer, 2009), reducing prompted disgust reactions (Schweiger Gallo et al., 2009), decreasing unhealthy snack consumption (Adriaanse, De Ridder, et al., 2009b), and reducing smoking behavior (but only for people with weak or moderately strong smoking habits; Webb, Sheeran & Luszczynska, 2009).

Processes by Which Implementation Intentions Overrule Habits

Taken together, recent studies provide compelling evidence for the notion that implementation intentions that link a critical cue for a habitual response to an alternative response can effectively overrule habitual responses. Nevertheless, studies to date have been mainly concerned with establishing effects on behavioral outcomes, such as eating less unhealthy snacks (Adriaanse, De Ridder, et al., 2009b), or recycling plastic cups (Holland et al., 2006), and did not address the *processes* by which counter-habitual implementation intentions were effective in breaking habits. In the present paper, we aim to address this lack of understanding of underlying cognitive processes by investigating the extent to which counter-habitual implementation intentions result in a new cue–alternative response association and affect the existing cue–habitual response association, and how these combined effects explain the new response winning the "horse race" with the alternative response.

We hypothesize that the formation of a counter-habitual implementation intention *strengthens* the association between the critical cue and the alternative response, and simultaneously *inhibits* the association between the critical cue and the habitual response (i.e., reduces the activation of the mental representation of the habitual means upon encountering the critical cue). Using our horse race metaphor, the combination of these effects are expected to cancel out the advantage of the habitual over the alternative means in winning the race. These changes in strength of mental

links could explain the positive behavioral effects of counter-habitual implementation intentions that have been found previously (e.g., Adriaanse, De Ridder et al., 2009b; Holland et al., 2009). In other words, we posit that whereas before the formation of a counter-habitual implementation intention, individuals' (counter-habitual) goal intentions do not have a chance to win the race, this should change after the formation of a counter-habitual implementation intention.

Our horse race metaphor perspective is in line with earlier findings. Several studies have shown that one of the mechanisms underlying the efficacy of implementation intentions is that they create a strong association between the cue and the response specified in the if-then plan (Gollwitzer, 1999; Parks-Stamm, Gollwitzer, & Oettingen, 2007; Webb & Sheeran, 2007; Webb & Sheeran, 2008; Bayer et al., 2009). However, an intriguing and novel question then is why a new response would win the race with an old response when implementation intentions are geared towards breaking a habit. Holland and colleagues (2006) suggested that the newly created association between the situation and the alternative response may be stronger than the old association between the situation and the habitual action. However, it remains to be established whether a single act of planning can actually outweigh prolonged behavioral repetition. Although the association between the situation and the alternative response may -- as we argue above -- indeed be strengthened as a result of the counter-habitual implementation intention, it is unlikely that it is strengthened to such an extent that, without any changes to the situation-habitual response association, it will outrun the activation of the habitual response.

A further possibility suggested by Holland and colleagues (2006) is that the formation of a counter-habitual implementation intention inhibits the habitual response because it interferes with the alternative response specified in the implementation intention. This suggestion seems plausible when considering previous theoretical and empirical work. Kruglanski, Shah, Fishbach, Friedman, Chun, and Sleeth-Keppler's (2002) goal systems theory in particular offers a supportive conceptual rationale. Goal systems theory assumes that means that are instrumental in attaining a goal are connected to this goal by a facilitative link, while the connection between two alternative means to achieve the same goal is inhibitory (Kruglanski et al., 2002). In other words, according to goal systems theory, if a goal activates one means, the activation of an alternative means for this goal is inhibited. Related to this notion are findings that inhibitory links exist between two sub-goals serving the same overarching goal (in which case the two sub-goals could be considered the means for attaining the overarching goal; Shah, Friedman, & Kruglanski, 2002). Additionally, research by Danner, Aarts, and De Vries (2007) has shown that when participants repeatedly retrieve one means for a specific goal, competing means for this same goal become inhibited.

Still, the current research is not concerned with goal-means relations, but rather with associations between situations and behavioral responses. Nevertheless, it is generally agreed upon that habit formation is the result of repeatedly performing a certain behavior (e.g., eating chocolate) in the same concrete situation (e.g., feeling sad) in order to attain a specific goal (e.g., to soothe oneself), and that only after some repeated occurrence the behavioral response becomes triggered directly by the situation (Wood & Neal, 2007). It thus seems appropriate to extrapolate suggestions from goal systems theory (Kruglanski et al., 2002) and findings by Shah et al. (2002; Danner et al., 2007)

to situation-behavior associations. If this parallel can indeed be drawn, this would engender strong conceptual support for our hypothesis that when a situational cue becomes strongly linked to a new behavior through the formation of a counter-habitual implementation intention, the link with the old habitual behavior is weakened simultaneously, and these combined effects result in the habitual means no longer having an advantage in the race with the alternative means.

Research Overview

Three studies were designed to investigate our hypothesis. In Study 1, participants formulate implementation intentions that either specify the replacement of a habitual snack they usually take at home by an alternative snack, or that specify the replacement of a habitual drink they usually take in a bar by an alternative drink. A pilot study indicated that these are goals that students, the participants in our studies, frequently pursue in this context, and for which they generally use strong habitual means. The strength of the cue-response associations will subsequently be assessed in a lexical decision task with a priming procedure. Study 2 is similar to Study 1, except that this time participants are specifically asked to plan to replace their habitual snack/drink by a *healthier* alternative. In Study 3, the focus is on entirely personal habits; participants will not only be asked to generate their own personal habitual and alternative snacks, but also their own personal critical cue for snacking. Additionally, a more stringent control condition is put in place.

Study 1

In Study 1, a lexical decision task is used to compare the accessibility of the habitual response and the alternative response upon encountering the critical cue between a control condition and a counter-habitual implementation intention condition. This will allow for a closer look at the cognitive underpinnings of the effects of counter-habitual implementation intentions in breaking habits.

Methods

Participants

Sixty-four female students participated in exchange for €3 or course credit. After excluding two participants who were very slow in responding to the four targets in the lexical decision task ($SD > 3.5$), the final sample consisted of 62 participants with a mean age of 19.92 years ($SD = 1.91$), and a mean BMI of 21.35 ($SD = 2.69$).

Procedure and Design

The experiment had a 2 Type of Means (habit vs. alternative; within subjects) x 2 Strategy (implementation intention vs. control) within subjects design and consisted of three tasks. Participants started with a means-generation task in which they generated their habitual and an alternative means for snacking at home and drinking in a bar. Half of the participants were then asked to formulate an implementation intention to replace their habitual *snack* by an alternative *snack*, and the other half of the participants were asked to formulate an implementation intention to replace their habitual

drink by an alternative *drink*. So, for which behavior (snacking at home or drinking in a bar) the implementation intention was formulated was counterbalanced between participants. Lastly, a lexical decision task was employed to measure the accessibility of the two habitual and the two alternative means. All tasks were completed on a desktop computer and participants were seated in individual cubicles.

Materials

Means-generation task. In the means-generation task, participants were asked to provide a habitual and an alternative means for each of two situations; ‘snacking when being at home’ and ‘drinking in a bar’. After the habitual means was generated, participants listed an alternative means: they were asked which snack/drink they would eat/drink in this situation (at home/in a bar) if their habitual means were not available. These idiosyncratic habitual and alternative means were subsequently used as target stimuli in the lexical decision task.

Implementation intentions. After participants had generated their two habitual and two alternative means, they were asked to form an implementation intention for replacing one of their two habitual means by the corresponding alternative means. Which of the two alternative means (i.e., the alternative means for snacking or the alternative means for drinking) was supported by a counter-habitual implementation intention was counterbalanced between participants. The formulation of the implementation intention was designed in such a manner that the critical situation for the habitual means (i.e., being at home, or being in a bar) was linked to the corresponding alternative means (e.g., fruit, or soda).

The formation of the counter-habitual implementation intention was introduced in the next task. In order to increase commitment to the implementation intentions formed, participants were told the following story:

Flexibility is a very beneficial trait to have. People who have various means for the same goal are much more likely to achieve their goals. They are much more efficient and effective in achieving their daily goals. In order for you to become more efficient and effective, we would like you to make a plan which will increase your capacity to be flexible.

Then, participants received the following instructions to form the implementation intentions:

Screen 1: At the start of this study you indicated that you usually take [habitual means] to snack/drink when you are at home/in a bar. Now we would like to ask you to plan to take [alternative] next week every time that you are at home/ in a bar and want to snack/drink.

Screen 2: The plan we would like you to make has the following format: ‘If I am at home/in a bar, and I want to snack/drink then I will take [alternative]’. Please repeat this statement in your mind a few times. This is important because we would like you to try and stick to your plan in the coming week.

Screen 3: Now please try to envision yourself acting out your plan: ‘If I am at home/in a bar, and I want to snack/drink then I will take [alternative]’.

Screen 4: Now please type the plan you just envisioned yourself acting out below.

Lexical decision task. Before starting the lexical decision task, which was presented as a separate study, participants received instructions and were told that they should indicate as quickly and accurately as possible whether a word they saw on the computer screen was an existing word or not. Participants were asked to press a left or a right key to indicate as quickly as possible if a presented word was an existing word or not (which key corresponded to ‘word’ and which to ‘nonword’ was counterbalanced between participants). Furthermore, they were told that any individual trial consisted of a fixation cross ‘+’, a very brief presentation of a word, a string of xxxxxx-es, and then the word or non-word they were supposed to react to. Participants started with a practice run, consisting of 8 trials, before moving on to the actual lexical decision task which included the four critical targets. Before starting with the focal lexical decision task participants were informed that this task could include words they had generated in the previous experiment. This was done to ensure that participants would not be surprised to see these words and therefore respond slower.

The lexical decision task encompassed 16 different targets; the 4 means participants had generated, 4 irrelevant words and 8 nonwords. In total, there were 32 trials, which were divided over 2 blocks so that in each block of 16 trials each of the targets was presented once. The 4 means were always preceded by the corresponding situation, whereas the 4 irrelevant words were preceded by a related word (e.g., tower–clock). The nonwords were preceded by the same primes that were also used for the 4 targets and the 4 irrelevant words.

A trial in the lexical decision task started with a fixation cross (1000 ms). Then, participants were presented with a word (50 ms) which in case of the critical targets (the four means) was the critical situation (‘home’ or ‘bar’). Following this prime, a string of xxxxxx-es was presented as a backward mask (700 ms) and then one of the 16 targets appeared on screen. After participants responded, a blank intertrial screen (2000 ms) was presented.

Debriefing

At the end of the experiment participants were asked to write down anything they noticed about the experiment. Also, participants’ demographic characteristics were assessed (including height and weight) and participants were debriefed, thanked for their participation, and reimbursed with €3 or course credit.

Results

A repeated measures Analysis of Variance (ANOVA) was performed with Type of Means (habit vs. alternative) and Strategy (implementation intentions vs. control) as within-subjects variables and the natural log transformed reaction times for critical targets (i.e., the 4 means) to which subjects responded correctly as the dependent variable. In this analysis, reaction times for the two behaviors (snacking at home and drinking in a bar) were thus combined so that each participant had a score for each of the four targets (habitual means-control, alternative means-control, habitual means-implementation intention, alternative means-implementation intention). This combining of reaction times for the two behaviors was

justified as a similar analysis in which Behavior (snacking at home and drinking in a bar) was included as a between subjects factor did not yield any significant 2-way or 3-way interactions with Behavior (all p 's > .31) indicating that counterbalancing was effective and effects were similar for both behaviors.

The 2 Type of Means (habit vs. alternative) x 2 Strategy (implementation intentions vs. control) ANOVA revealed no significant main effects, $F_s < 1$, but did show a significant cross-over interaction of Type of Means x Strategy, $F(1,58) = 4.26, p < .05, \eta_p^2 = .07$, with means indicating an increased accessibility of the alternative means and a decreased accessibility of the habitual means as a result of formulating a counter-habitual implementation intention (see Table 1 for non-transformed mean response latencies).

One-tailed simple main effects within the habitual means condition revealed that the habitual means were significantly less accessible in the implementation intention condition compared to the control condition, $F(1,59) = 3.55, p < .05, \eta_p^2 = .06$. A similar analysis in the alternative means condition did not show a significant effect, $p = .22$. However, a repeated measures ANOVA with Type of Means as within subjects factor and mean difference in response latencies (RT to habitual means-control minus RT to habitual means-implementation intention, and RT to alternative means-control minus RT to alternative means-implementation intention) as dependent variable, indicated that the effect on the habitual means ($MD = 32.54, SD = 169.77$), was not significantly stronger than the effect on the alternative means ($MD = 34.26, SD = 248.21$), $F = .001$.

Additionally, main effects were examined within each of the two strategy conditions. Simple main effects within the control condition revealed that participants reacted quicker to the habitual means compared to the alternative means, $F(1,60) = 2.57, p = .05, \eta_p^2 = .04$. However, in the implementation intention condition there was a nonsignificant effect of type of means in the other direction (i.e., alternative means became more accessible; $p = .10$).

Table 1

Mean Response Latencies and Standard Deviations of the Habitual and Non-habitual Means, Study 1 (N = 61)

		Habitual means	Alternative means
Control	Mean	613.89	652.92
	SD	150.18	242.03
Implementation Intention	Mean	646.43	618.66
	SD	167.70	148.16

Discussion

We observed that the forming of counter-habitual implementation intentions simultaneously resulted in an increased accessibility of the alternative means (albeit not significantly) and a decreased accessibility of the habitual means. Together these effects had the result that the habitual means was no longer more accessible than the alternative means. It should be noted that when looking at the effects on the habitual and alternative means separately, only the effect on the habitual means and not the effect on the alternative means was significant. However, further analysis (and also just a

blunt observation of the means in Table 1) indicated that the inhibition effect was not significantly stronger than the facilitation effect. Rather it seems like the relatively large standard deviations for response latencies to the alternative means in the control condition prohibited this effect from being significant. Apparently, there is – compared to the habitual means – a rather large variety in accessibility of participants' alternative means upon activation of their critical cue, indicating that participants differ in the extent to which they have readily accessible alternatives available for their habitual behaviors.

One limitation of Study 1 is that, after close inspection, we found that the habitual and alternative means that participants generated for each of the situations were in general equally healthy or unhealthy (e.g., 'chocolate' as the habitual means for snacking and 'cookies' as the alternative means for snacking). In real life, and in previous studies on counter-habitual implementation intentions (e.g., Adriaanse, De Ridder et al., 2009b; Webb et al., 2009) the habits that people aim to change usually relate to replacing *unhealthy* responses by more *healthy* responses, such as replacing chocolate by apples. Replacing chocolate by cookies might be easier than replacing chocolate by apples, as cookies may be more similar to chocolate in terms of their hedonic value than apples, and may therefore already be more strongly linked to the critical situation. In order to test whether implementation intentions can also be used to replace an unhealthy habitual response with a healthy alternative, and to link our studies more closely to the studies on implementation intentions and breaking habits that have been conducted previously, Study 2 therefore used the same design as Study 1, except that participants were now asked to generate a healthier alternative means.

Study 2

In Study 2 it was tested whether our hypothesis could also be supported for implementation intentions linking a healthier alternative to a critical situation. Study 2 also included a measure of goal commitment. As it has been found that implementation intentions to perform a goal-directed behavior (i.e., eating less unhealthy snacks) are only effective when people are actually committed to this goal (Sheeran, Webb, & Gollwitzer, 2005), goal commitment can be considered an essential control variable. Measures of habit strength and healthiness of the means were included to assess whether the manipulation in the means-generation task was successful.

Methods

Participants

Thirty-four female students participated in exchange for €3 or course credit. Participants had a mean age of 20.76 years ($SD = 1.84$) and a mean BMI of 21.42 ($SD = 2.32$).

Procedure and Design

The procedure and design were similar to Study 1. The experiment again had a 2 Type of Means (habit vs. alternative; within subjects) x 2 Strategy (implementation intention vs. control) within

subjects design and consisted of three tasks; the means-generation task, the forming of implementation intentions; and the lexical decision task.

Materials

Means-generation task. The means-generation task was similar to Study 1 except that this time participants were asked to generate alternative means which were healthier than their self-generated habitual means for snacking when being at home and drinking in a bar.

Implementation intentions. The implementation intention formation task was also similar to Study 1, except for the cover story. This time no cover story about flexibility was required, as commitment to the goal was created by informing participants that they were asked to make a plan to take their alternative snack/drink next week to help them snack/drink more healthily.

Lexical decision task. The lexical decision task was similar to Study 1. Again, the lexical decision task encompassed 16 different targets; the 4 means participants had generated, 4 irrelevant words and 8 nonwords, and each of the 16 trials were presented twice (once in each of two blocks). Like in Study 1, the 4 trials including the means participants had generated as targets were always preceded by the corresponding situation, whereas the 4 irrelevant words were preceded by a related word. The nonwords were preceded by the same primes that were also used for the 4 targets and the 4 irrelevant words.

Measures. Several assessments were added. Firstly, after the means-generation task, participants were asked to indicate for each of the four means: (a) the frequency of using the means (“How often did you snack on/drink [means] at home/ in a bar in the past four weeks?”), and (b) the stability of the situation when using the means (“How similar are the circumstances every time you snack on/drink [means] at home/ in a bar?”), indicated on 9-point scales ranging from 1 (*very different circumstances*) to 9 (*very similar circumstances*). Habit strength was then calculated by multiplying the frequency and stability scores (Danner, Aarts, & De Vries, 2008; Wood, Tam, & Witt, 2005).

Subsequently, participants were asked to indicate the extent to which they were committed to the goals outlined in the description of the study (“I intend to eat less unhealthy snacks/drink less unhealthy drinks in the coming days”), with responses given on a five-point scale ranging from 1 (*totally disagree*) to 5 (*totally agree*). Participants were also asked to rate the healthiness of each of the means (“How healthy is [means]?”), on five-point scales ranging from 1 (*very unhealthy*) to 5 (*very healthy*).

Debriefing

Procedures for debriefing were similar to Study 1: Upon finishing the experiment participants were asked whether they noticed anything about the experiment, demographic characteristics were assessed, and finally participants were debriefed, thanked, and reimbursed with €3 or course credit.

Results

Descriptives

Participants had moderate intentions to eat fewer unhealthy snacks ($M = 3.18$, $SD = 1.09$), and to consume less unhealthy drinks ($M = 2.85$, $SD = .96$).

Manipulation Check

Habit strength. A repeated measures ANOVA was performed with Type of Means (habit vs. alternative) as a within subjects factor and habit strength as dependent variable. This analysis revealed

that our manipulation was effective: there was a significant main effect of type of means, $F(1,31) = 21.13, p < .01, \eta_p^2 = .41$, indicating that overall the habitual means ($M = 56.75, SD = 31.20$), were rated higher on habit strength than the alternative means ($M = 33.28, SD = 32.98$).

Healthiness. A similar repeated measures ANOVA was performed on healthiness. This analysis revealed that our manipulation was also effective with respect to healthiness: we found a significant main effect of Type of Means, $F(1,32) = 6.01, p < .05, \eta_p^2 = .16$, indicating that overall the habitual means ($M = 2.31, SD = .76$) were rated as less healthy than the alternative means ($M = 3.89, SD = 1.07$).

Main Analyses

A repeated measures ANCOVA was performed for the natural log transformed reaction times for targets to which subjects responded correctly, with Type of Means (habitual vs. alternative) and Strategy (implementation intentions vs. control) as within-subjects variables (for mean non-transformed response latencies, see Table 2). Similar to Study 1, reaction times for the two behaviors (snacking at home and drinking in a bar) were thus combined so that each participant had a score for each of the four targets (habitual means-control, alternative means-control, habitual means-implementation intention, alternative means-implementation intention). Again, a similar repeated measures ANCOVA in which Behavior was included as an extra between subjects factor, indicated that this combining of reaction times for the two behaviors was justified as this analysis did not yield any significant 2-way or 3-way interactions with Behavior (all p 's $> .16$).

Commitment to the goal for which the counter-habitual implementation intention was formulated was entered as a continuous covariate. These analyses revealed no significant main effects, $F_s < 1$, but did reveal a marginally significant two-way interaction of Type of Means x Strategy, $F(1,30) = 3.20, p = .08, \eta_p^2 = .10$, and, more importantly, a significant three-way interaction for Type of Means x Strategy x Goal Commitment, $F(1,30) = 4.51, p < .05, \eta_p^2 = .13$.

Table 2

Mean Response Latencies and Standard Deviations of the Habitual and Non-habitual Means, Study 2 (N = 32)

			Habitual means	Alternative means
Low Commitment	Control	Mean	628.94	599.47
		SD	218.21	173.34
	Implementation Intention	Mean	594.24	626.56
		SD	179.56	199.37
High Commitment	Control	Mean	630.57	730.33
		SD	151.35	251.99
	Implementation Intention	Mean	768.57	623.07
		SD	387.18	96.85

One-tailed simple comparisons using a median split for goal commitment were then conducted to interpret the effect of goal commitment in this three-way interaction. These analyses

showed a significant Type of Means x Strategy interaction, $F(1,14) = 3.48, p < .05, \eta_p^2 = .20$, when goal commitment was high but not when goal commitment was low, $F < 1$ (neither the analysis for low or high goal commitment revealed any main effects; $F_s < 1$).

Further simple comparisons within the high goal commitment condition revealed that the effect of Strategy on the habitual means was significant, $F(1,14) = 3.80, p < .05, \eta_p^2 = .21$, and the effect of Strategy on the alternative means was marginally significant, $F(1,14) = 2.40, p = .07, \eta_p^2 = .15$. A repeated measures ANOVA with Type of Means as within subjects factor and mean difference in response latencies as dependent variable, indicated that the effect on the habitual means was not significantly stronger than the effect on the alternative means, $F = .53$ (habitual means: $MD = 138.00, SD = 283.82$; alternative means: $MD = 107.27, SD = 244.02$).

Simple comparisons within the high goal commitment condition also showed that participants reacted significantly quicker to the habitual means compared to the alternative means in the control condition, $F(1,14) = 3.38, p < .05, \eta_p^2 = .19$, but not in the implementation intention condition, $p = .13$.

Discussion

Results from Study 2 showed that implementation intentions linking a critical cue for the habitual response to a healthier alternative can change the habitual and alternative cue-response associations. When not forming a counter-habitual implementation intention, the habitual means was more accessible than the alternative means. In contrast, after forming counter-habitual implementation intentions, the habitual means no longer showed stronger links to the critical cue than the alternative means. However, this effect only occurred when commitment to the health goal was high. Study 2 thus replicated results from Study 1 and extended our previous findings by showing that this effect can also be found when implementation intentions are aimed at replacing an unhealthy habit with a healthier alternative, and by showing that this effect is contingent on a high commitment to the goal.

However, the present findings do not rule out the possibility that similar effects could also be obtained by merely instructing participants to form strong intentions rather than by formulating implementation intentions. Therefore, a third study was conducted to rule out this possibility. Moreover, to provide a stronger test for our assumption that implementation intentions can be effective in breaking habits, the effects of implementation intentions on entirely personal critical cue-habitual response and personal critical cue-alternative response associations were assessed, rather than using pre-coded critical cues.

Study 3

Methods

Participants

Eighty female students participated in exchange for €3 or course credit. After excluding three participants with extreme scores on one of the two targets ($SD > 3.5$), and two participants with extreme scores on habit strength ($SD > 3.5$), the final sample consisted of 75 participants with a mean age of 21.20 years ($SD = 1.85$) and a mean BMI of 21.91 ($SD = 2.34$).

Procedure and Design

The experiment had a 2 Type of Means (habit vs. alternative; within subjects) x 2 Strategy (goal intention vs. goal intention + implementation intention; between subjects) design. Similar to Studies 1 and 2, the experiment consisted of three tasks; a means-generation task, a forming implementation intentions task, and a lexical decision task which were performed on a computer in separate cubicles.

Unlike Studies 1 and 2, in this study, only the goal of snacking was used. This was deemed necessary as a pilot study in which two goals were used (snacking and drinking, similar to Study 1 and 2) indicated that the personal critical cues participants listed for unhealthy snacking were often similar to the personal critical cue for unhealthy drinking, or they were semantically related to the means for drinking, and vice versa (e.g., it seems plausible that a person who lists 'party' as a critical cue for unhealthy snacking, may also have an association between 'party' and his/her habitual drink 'beer'). As such cross-over associations between the two goals would severely distort results in the lexical decision task, it was therefore decided to only use the goal 'snacking' in Study 3.

Materials

Means-generation task. The means-generation task was similar to Study 2 except that this time only means for the goal of snacking were used. Moreover, after generating their habitual snack, participants were now asked to generate a critical situation for eating this habitual snack themselves. Participants were instructed to describe in one word the critical situation for eating their habitual snack and were told that this critical situation should represent their most frequently occurring reason for eating the habitual snack (Adriaanse, De Ridder, et al., 2009b). Further, participants were told that this critical cue could be anything, such as a time of day, a feeling, a place, activity, or certain company. Similar to Study 2, participants were then asked to generate a healthier alternative snack which they could eat whenever they encountered their critical situation.

Implementation intentions. Participants in both conditions were asked to first formulate a goal intention to eat less of their habitual snack. They were asked to commit themselves to this intention and to repeat it to themselves several times. Participants in the implementation intention condition were then asked to supplement this goal intention with a counter-habitual implementation intention. Instructions for formulating the implementation intention were similar to Study 2.

Lexical decision task. The lexical decision task was similar to Studies 1 and 2, but because only means for the goal of snacking were included in this study, the 16 targets now entailed, next to 8 nonwords, 2 means, and 6 irrelevant words. Again, each of the 16 trials were presented

twice (once in each of two blocks), and the critical targets (the two snacking means) were always preceded by the corresponding situation, whereas the 6 irrelevant words were preceded by a related word.

Measures. The same assessments for habit strength, goal commitment, and healthiness that were used in Study 2 were included. However, goal commitment was now assessed using three items (“I intend/plan/want to eat less unhealthy snacks in the coming days”), with response scales ranging from 1 (*totally disagree*) to 5 (*totally agree*). Additionally, hedonic value of each of the two means was assessed to control for unintended differences in hedonic value between the two conditions. For both means hedonic value was assessed by three items (“Eating [means] is tasty/enjoyable/pleasant”) which could be answered on five-point scales ranging from 1 (*totally disagree*) to 5 (*totally agree*). The items assessing goal commitment showed good reliability, Cronbach’s $\alpha = .89$, and this was true for the items assessing hedonic value for the alternative snack and items assessing hedonic value for the habitual snack as well, Cronbach’s α ’s = .81.

Debriefing

Procedures for debriefing were similar to Studies 1 and 2; after enquiring whether participants noticed anything about the experiment, demographic characteristics were assessed and participants were debriefed, thanked, and reimbursed with €3 or course credit.

Results

Descriptives

On average, participants had strong intentions to eat fewer unhealthy snacks ($M = 3.95$, $SD = .68$). Participants rated both the habitual snack ($M = 4.25$, $SD = .50$) as well as the alternative snack as having high hedonic value ($M = 3.93$, $SD = .58$); a repeated measures analysis of variance showed however that the hedonic value of the habitual snack was significantly higher than the hedonic value of the alternative snack, $F(1,74) = 13.62$, $p < .01$, $\eta_p^2 = .16$.

Randomization Check

Separate ANOVA’s for age, BMI, intention, hedonic value of the habitual means, hedonic value of the alternative means, mean reaction time to nonwords, and mean reaction time to neutral words with Strategy (intention vs. intention + implementation intention) as the independent variable were performed to check whether randomization was successful. None of the ANOVA’s showed any significant effects, indicating successful randomization.

Manipulation Check

Habit strength. A repeated measures analysis was performed for habit strength scores with Type of Means (habit vs. alternative) as the within-subjects variable and Strategy (intention vs. intention + implementation intention) as a between subjects variable. This analysis revealed that our manipulation was effective, as there was a main effect of Type of Means, $F(1,73) = 47.77$, $p < .01$, $\eta_p^2 = .40$, indicating that overall the habitual means ($M = 60.96$, $SD = 40.25$) were rated higher on habit strength than the alternative means ($M = 26.37$, $SD = 29.11$). There was no significant Type of Means x Strategy interaction, $p = .32$, indicating that the effect of Type of Means on habit strength was equally strong across the two strategy conditions.

Healthiness. A similar repeated measures analysis was performed on healthiness. This analysis revealed that our manipulation was also effective regarding perceived healthiness, as there was a main effect of Type of Means, $F(1,73) = 404.74, p < .01, \eta_p^2 = .85$, indicating that overall the habitual means ($M = 2.01, SD = .65$) were rated as less healthy than the alternative means ($M = 4.32, SD = .74$). There was no significant Type of Means x Strategy interaction, $p = .64$, indicating that the effect of type of means on healthiness was equal across the two strategy conditions.

Main Analyses

A repeated measures analysis of variance was performed for the natural log transformed reaction times of trials to which subjects responded correctly with Type of Means as the within subjects variable and Strategy as the between subjects variables (for mean non-transformed response latencies, see Table 3). This analysis revealed no significant main effect of Type of Means, $p = .14$, but did reveal a significant interaction of Type of Means x Strategy, $F(1,73) = 4.64, p < .05, \eta_p^2 = .06$.

One-tailed simple main effects showed that neither the effect of Strategy on the habitual means ($p = .14$) nor on the alternative means ($p = .19$) was significant. However, simple comparisons within the two strategy conditions revealed that whereas in the goal intention condition participants reacted significantly quicker to the habitual means compared to the alternative means, $F(1,38) = 5.02, p < .05, \eta_p^2 = .12$, there was no significant effect of Type of Means within the implementation intention condition, $F < 1$.

Table 3

Mean Response Latencies and Standard Deviations of the Habitual and Non-habitual Means, Study 3 (N = 75)

		Habitual means	Alternative means
Control	Mean	599.14	698.78
	SD	175.82	348.05
Implementation Intention	Mean	646.42	624.28
	SD	221.43	155.57

Discussion

Study 3 replicates findings from Studies 1 and 2, as again a significant Type of Means x Strategy interaction was found, indicating that the habitual means diminished in accessibility whereas the alternative means increased in accessibility after formulating a counter-habitual implementation intention. While on their own neither of these effects was significant, combined they had the effect that the habitual means no longer showed a stronger mental link to the critical situation than the alternative means. One explanation for why, unlike in Studies 1 and 2, in Study 3 neither the effect on the habitual means nor the effect on the alternative means was by itself significant could be that only in this last study fully idiosyncratic habits were used.

As participants chose their own habitual snacks as well as their most important critical cue for eating this habitual snack, it is likely that the habits (cue-habitual means associations) that participants generated were stronger and thus more difficult to change. Support for this notion

comes from the means for habit strength: in Study 3 the difference in mean habit strength for the habitual vs. alternative means was about 1.5 times larger than in Study 2, even though in both studies participants were required to generate a healthier alternative. Nevertheless, despite the fact that, separately, the effects on the habitual and alternative means were not statistically significant, these effects combined resulted in the intended outcome: after formulating a counter-habitual implementation intention the habitual means no longer has a cognitive advantage in the horse race with the alternative means upon encountering the critical cue.

General Discussion

Recent research has shown that implementation intentions can be effective in overruling habitual behaviors when specifying that the habitual response shall be replaced with an alternative new response once the critical situation is encountered (Adriaanse, De Ridder, et al., 2009b; Cohen, Bayer, Jaudas, & Gollwitzer, 2008; Holland et al., 2006; Schweiger Gallo & Gollwitzer, 2007; Schweiger Gallo et al., 2009, Stewart & Payne, 2008). However, apart from some theoretical speculation (Holland et al., 2006), no empirical data is available that addresses the question *why* formulating these types of plans results in the new response winning the race with the habitual response. In the present research, we investigated the cognitive effects of forming counter-habitual implementation intentions to increase the understanding of the underlying processes that make counter-habitual implementation intentions such effective tools to overrule habits. We hypothesized that as a consequence of forming a counter-habitual implementation intention, the associative link between the cue and the alternative response is strengthened while the cue-habitual response link is simultaneously inhibited, and that these effects combined cancel out the advantage of the habitual over the alternative means once the race is started upon cue activation.

Three studies were conducted to investigate our horse race metaphor hypothesis. Study 1 supported this hypothesis and showed that while in the control condition the habitual means was more accessible than the alternative means, in the implementation intention condition this was no longer the case. This elimination of the advantage of the habitual means was the result of the *joint* increased accessibility of the alternative means and decreased accessibility of the habitual means upon cue activation. Study 2 replicated these findings for implementation intentions that linked the critical cue for a habitual response to a healthier alternative. Additionally, and in line with previous findings (Sheeran, Webb, et al., 2005), these conducive effects of implementation intentions were only obtained when commitment to the focal health goal (i.e., eating/drinking less unhealthy) was high.

Lastly, in Study 3 habits were entirely idiosyncratic as participants were now required to also self-generate the critical cue for their habitual snack. This is an important addition to Studies 1 and 2, as recent research has indicated that, to be most effective, counter-habitual implementation intentions should target truly personal critical cues that represent the actual reason for the habitual behavior (Adriaanse, De Ridder, et al., 2009b). Similar to Studies 1 and 2, results supported our hypothesis: in the implementation intention condition the advantage of the habitual means over the alternative

means was eliminated due to the joint increase in the accessibility of the alternative means and the decreased accessibility of the habitual means. However, in contrast to the previous two studies, neither the effect on the habitual means nor the alternative means was significant, which could be due to the fact that stronger habits were generated or to the stricter control condition that was used.

The inhibition of the cue–habitual means association in response to linking the cue to an alternative means in an if-then plan (Studies 1 and 2) is in line with findings from Shah et al. (2002; Danner et al., 2007) and with Kruglanski et al.'s (2002) goal systems theory. According to this theory, if a goal activates one means, the activation of an alternative means for this goal is inhibited. Premised on the equation of goal-means relations with situation-means relations, the present findings provide further support for this postulated inhibitory link between means for the same goal.

The strengthening of the cue-alternative means link was not by itself significant in any of the three studies. As participants chose the alternative means themselves, one reason for this could be that in the present studies the alternative means were already strongly related to the critical cue (Fishbach, Shah, & Kruglanski, 2004). Hence, linking an idiosyncratic alternative means to the critical cue in an if-then plan might not have as strong an effect as when the alternative means would be truly 'new' in the context of the situational cue. It could be argued that to counter this possibility, we should have asked participants to link their critical cue to a(n) (pre-coded) alternative that they did not consider to be a likely means to use in this situation. However, this would not only drastically reduce the ecological validity of our studies, it would most likely also not yield stronger results considering that the efficacy of implementation intentions has been found to depend on the extent to which the plan is self-concordant (Koestner et al., 2006).

Taken together, the present studies illuminate the cognitive effects that may be induced by formulating counter-habitual implementation intentions and thus shed some light on the processes that may underlie the efficacy of implementation intentions in breaking habits. Our results show that implementation intentions that link a critical cue for a habitual response to an alternative response cause the habitual and alternative means to become equally accessible. This signifies that, as a result of formulating counter-habitual implementation intentions, individuals return to the type of action control that existed before any habit was created in the first place -- that is, there is no habitual response that can easily outrun other responses. It is important to note, however, that our findings also suggest that the formation of a counter-habitual implementation intention does not immediately replace the old habit by a new habit, as the alternative means does not become significantly more accessible than the habitual means upon cue activation. In other words, the old habitual and the new alternative response are now truly competitive in winning the race of early activation.

However, while a new habit is not created as a direct result of forming a counter-habitual implementation intention, it is most likely only a matter of time before a new habit is established. In the first instance, for implementation intentions to show their effects a strong goal intention to use an alternative means is still required to quickly activate the alternative means in the critical situation. If this new alternative means is subsequently repeatedly chosen in the critical situation, the mental link between the situation and this new means is strengthened further which eventually will

lead to the automatic activation of this means upon encountering the situation (Aarts & Dijksterhuis, 2000; Bargh, 1990; Bargh & Gollwitzer, 1994). A presence of a strong goal intention is no longer required to back up the respective implementation intention; in other words, a new habit has been formed.

The present findings underscore the importance of establishing strong goal intentions in future research and interventions that seek to apply the forming of implementation intentions to overcome unwanted habits. Although most studies that use the formation of implementation intentions to support the initiation of new behaviors already ensure that participants hold strong underlying goal intentions (Sheeran, Webb, et al., 2005), for implementation intentions aimed at diminishing existing habits the importance of goal intentions may easily be overlooked. As habits are usually equated with automaticity and a lack of conscious control (Aarts & Dijksterhuis, 2000), intentions may not be perceived as important. The present research, however, stresses the importance of strong intentions in interventions using counter-habitual implementation intentions to break habits.

Although our findings are well in line with the positive findings reported in the majority of studies regarding the role of implementation intentions in breaking habits (Adriaanse, De Ridder et al., 2009b; Holland et al., 2006; Schweiger Gallo & Gollwitzer, 2007; Schweiger Gallo et al., 2009, Stewart & Payne, 2008), it should be noted that not all of these studies have found that implementation intentions are effective in breaking habits. Research by Webb et al. (2009) indicated that implementation intentions can be effective, but only when behaviors are targeted that are weakly or moderately habitual. However, one reason for why in the present study implementation intentions were effective in breaking habits may be that we instructed participants to mentally rehearse the situation-response link they specified in the implementation intention. Mental rehearsal of the situation-response link may be crucial for obtaining positive effects of implementation intentions, in particular when trying to overcome strong existing associations, as a greater depth of encoding of the specified situation-response association has been suggested to affect the strength of this association (Prestwich et al., 2003; Sheeran, Milne, Webb, & Gollwitzer, 2005); which in turn, has been found to affect the strength of implementation intention effects (Sheeran, Milne, et al., 2005; Webb & Sheeran, 2008).

Limitations

Several limitations have to be noted. In this series of experiments we only studied one specific type of counter-habitual implementation intention, whereas several variants of implementation intentions have been proposed for breaking or suppressing habitual responses (Sheeran, Milne, et al., 2005; Gollwitzer, Bayer, & McCulloch, 2005). In addition to implementation intentions that specify the replacement of a habitual response with an alternative response - as was tested in the present research - ('If x, then alternative response z'), implementation intentions specifying the negation of the habitual response ('If x, then not y') and implementation intentions specifying to ignore the triggering stimulus or critical cue ('If x, then ignore x'), have been suggested for overcoming habitual responses (Sheeran, Milne, et al., 2005; Gollwitzer et al., 2005).

However, in recent empirical tests negation plans have not been found effective in breaking habits (Adriaanse, Van Oosten, et al., 2009; Otis and Pelletier, 2008; but for positive findings see Sullivan & Rothman, 2008), and explanations for their lack of effects are being investigated (Adriaanse, Van Oosten, et al., 2009). In contrast, implementation intentions that specify an ignore-response have been found to be effective in overcoming habits (Achtziger, Gollwitzer & Sheeran, 2008; Mendoza, Gollwitzer, & Amodio, in press; Schweiger Gallo et al., 2009; Sheeran, Aubrey, & Kellet, 2007), but, similar to replacement implementation intentions, little is known about the underlying processes that make this type of plan effective in overruling habitual responses. A further investigation of underlying processes is thus also warranted for implementation intentions that specify to ignore a critical stimulus. Furthermore, it would be particularly important to compare the efficacy of ignore and replacement implementation intention as it may be that the planned replacement of a habitual response is effective in some cases (i.e., when replacements are readily available, or when goal intentions are strong), whereas in other cases ignoring the critical stimulus may be the better option (i.e., when no replacements are available, or when people have weaker goal intentions).

A second limitation of the present studies is that, although we investigated the cognitive effects of counter-habitual implementation intentions and theoretically these effects can explain the behavioral effects that have been found earlier, an ultimate test of the importance of underlying processes involves simultaneously investigating both types of effects and establishing their relation to each other. While future research should certainly be conducted to relate cognitive effects to behavioral outcomes, it is important to appreciate that when measuring actual behavior, a direct relation between changes in the cognitive accessibility of means and changed actions may be difficult to obtain, in particular for long term behavioral assessment (e.g., food intake over several days). The accessibility of the cue-means relations is not static: by repeatedly enacting the implementation intention the association between the cue and the new behavior will strengthen even further, so after several instances of enacting the if-then plan, it may be difficult to relate accessibility measured right after the manipulation to the behavior (Holland et al., 2006).

A third limitation is that, although we tried to target participants' personal habits by letting them identify their own personal critical cues (Study 3), this procedure may not have been optimal. For many behaviors such as snacking or drinking, identifying critical cues may be challenging as these cues may often reflect rather subjective internal states (e.g., 'boredom' or 'socializing') rather than clear-cut situational cues, such as time or place (e.g., 'being at home'; Adriaanse, De Ridder, et al., 2009b). Identification of these subjective internal states as critical triggers for unhealthy behaviors requires a large degree of introspection which many people may lack (Nisbett & Wilson, 1977). In particular for behaviors such as eating or drinking that may be related to 'hot' cues (e.g., feeling upset or trying to act socially) identifying these cues in a cold and rational state of planning may be difficult (e.g., Loewenstein, 1996; Loewenstein, Nagin, & Paternoster, 1997). Additionally, and specifically with regard to eating behaviors, there is evidence to suggest that people may hold false beliefs about the causes of their eating. Studies by Adriaanse, De Ridder, and Evers (in press) and Evers, De Ridder, and Adriaanse (2009), for example, suggest that people may hold false beliefs regarding the emotional states that trigger their eating behavior.

In light of these findings it seems unlikely that participants were fully able to specify the critical cue for their habitual behavior. When future research wants to employ cues that are truly critical, in the sense that they represent the actual triggers for performing the habitual behavior, it seems important to either use a diary to help identify the most important antecedents of the unwanted behavior (Adriaanse, De Ridder et al., 2009b), or, alternatively, to combine the formation of counter-habitual implementation intentions with strategies that aid individuals in clarifying their personal critical cues, such as mentally contrasting the desired future outcomes of eating and drinking healthily with the obstacles of present reality (Adriaanse, Oettingen, Gollwitzer, Hennes, De Wit, & De Ridder, 2009; Stadler, Oettingen, & Gollwitzer, 2009; Oettingen, Pak, & Schnetter, 2001).

Conclusion

Counter-habitual implementation intentions that specify the replacement of a habitual response by an alternative response in a critical situation can change the strength of mental links between a habitual means and this critical situation. After forming such replacement implementation intentions, the cognitive accessibility of the habitual means is reduced upon cue presentation whereas the cognitive accessibility of the alternative means is enhanced. However, replacement implementation intentions do not immediately replace the old habit by a new habit, as the alternative means becomes equally accessible and not significantly more accessible than the habitual means upon encountering the critical situation. The present findings are important as they address the underlying cognitive processes that contribute to the efficacy of implementation intentions in breaking habits. Moreover, our findings guide future research to focus on conditions that seem essential for counter-habitual implementation intentions to be effective, in particular the presence of strong counter-habitual goal intentions.

Chapter 6

When Planning is not Enough: Fighting Unhealthy Snacking Habits by Mental Contrasting with Implementation Intentions (MCII)

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Abstract

In two experiments a self-regulatory strategy combining mental contrasting with the formation of implementation intentions (MCII) was tested for its effectiveness in diminishing unhealthy snacking habits. Study 1 ($N = 51$) showed that participants in the MCII condition consumed fewer unhealthy snacks than participants in a control condition who thought about and listed healthy options for snacks. In Study 2 ($N = 59$) MCII was more effective than mental contrasting or formulating implementation intentions alone and mental contrasting was found to increase perceived clarity about critical cues for unhealthy snacking. Together, these findings suggest that MCII is an effective strategy for fighting habits and that one of the underlying processes making MCII superior to implementation intentions alone may be that mental contrasting produces clarity about the critical cues for the unwanted habitual behavior.

Maintaining a healthy diet is presently one of the most often adopted health goals (e.g., for the Netherlands see: Covenant Obesity, 2007). However, most people adopting healthy eating goals experience difficulties with changing their eating behavior (Jeffery et al., 2000). Acknowledging the problems associated with changing unhealthy eating patterns, the present studies tested a new approach combining two established self-regulation strategies (i.e., mental contrasting with implementation intentions; MCII), for its utility in fighting unhealthy snacking habits¹.

MCII: Mental Contrasting with Implementation Intentions

MCII combines two established self-regulatory strategies (mental contrasting and implementation intentions) to form one powerful strategy for behavior change (e.g., Stadler, Oettingen, & Gollwitzer, 2009; Schramm, Oettingen, Dahme, & Klinger, in press). In mental contrasting people think about an important wish regarding behavior change (e.g., ‘eating fewer unhealthy snacks’), imagine the positive future in the event of successful behavior change (e.g., ‘fitting into a favorite pair of jeans again’), and then mentally contrast their images of the positive future with the negative reality that stands in the way of reaching this desired future (e.g., ‘having the tendency to eat chocolate when bored’). In mental contrasting, both the positive future and the negative reality become mentally accessible and they form a strong mental association. In addition, the negative reality is perceived as an obstacle that potentially hinders attaining the desired future. If attaining the desired future is perceived as feasible, a person forms a strong goal commitment to realize the desired future (e.g., Oettingen, 2000; Oettingen, Mayer, Sevincer, Stephens, Pak, & Hagenah, 2009; Oettingen, Pak, & Schnetter, 2001).

Additionally, it has been argued that mental contrasting aids the identification of obstacles, or critical cues, that hinder goal realization (Oettingen, Pak, & Schnetter, 2001; Oettingen, Mayer, & Thorpe, in press; Stadler et al., 2009). Specifically, mental contrasting has been proposed to be an effective tool for identifying critical cues that hinder goal realization, as it “puts a person in touch with her past experiences and knowledge” (Oettingen, Mayer, Thorpe, Janetzke & Lorenz, 2005, p. 263). Indeed, a recent study (Kappes & Oettingen, 2009) indicated that the aspects of negative reality that were elaborated during mental contrasting of a feasible wish were perceived as unpleasant and as something “standing in the way” of their desired future that hence needed to be overcome. Moreover, the results indicated that this perception of the generated reality as something that needs to be overcome fostered persistence in goal striving.

After going through the mental contrasting procedure, MCII requires that implementation intentions are formulated. Implementation intentions are simple action plans specifying when, where, and how a goal should be acted upon. An implementation intention supporting the goal to

1. A snack is defined as any type of food that is consumed between the three regular meals (De Graaf, 2006). A focus on snacking was deemed relevant because identification of the cues that habitually elicit unhealthy eating (which is essential for formulating effective plans) might be difficult for snacking (Adriaanse, De Ridder, et al, 2009b). This makes changing unhealthy snacking habits difficult, and hence likely to benefit from MCII rather than from mental contrasting or from implementation intentions alone. Moreover, several studies have indicated that the consumption of unhealthy snacks is one of the main contributors to overweight (De Graaf, 2006; Zizza, Siega-Riz, & Popkin, 2001).

eat more fruit could for example be “If I get hungry in between meals, then I will eat an apple”. By specifying one’s goal striving in this manner, a critical situation (getting hungry in between meals) is linked to a specific action (eating an apple), with the result that one becomes perceptually ready to encounter this situation and is hence less likely to miss it as a good opportunity to act. Moreover, since the situation is automatically linked to a specific behavior, one no longer has to decide *in situ* what goal-directed behavior to perform when the situation arises (Gollwitzer, 1999; Parks-Stamm, Gollwitzer, & Oettingen, 2007). In MCII, implementation intentions are formulated in such a manner that the obstacles that hinder wish fulfillment, which were identified during mental contrasting, are specified as the critical cues in the ‘if-part’ of the implementation intention.

Mental contrasting and implementation intentions mutually support each other to form one powerful strategy for behavior change in two important respects. First of all, implementation intentions need to be based on strong goal commitment in order to be effective (Sheeran, Webb, & Gollwitzer, 2005) and mental contrasting can create this strong goal commitment. Secondly, implementation intentions provide the tool to put one’s goals into action. Mental contrasting aids in recognizing the obstacles for behavior change and these obstacles are subsequently addressed by implementation intentions in which the obstacle (if-part) is linked to actions to overcome the obstacle (then-part; Oettingen & Gollwitzer, in press; Stadler et al., 2009).

So far, four studies have shown the efficacy of MCII compared to a control condition in different domains; increasing exercise behavior in healthy adults (Stadler et al., 2009) as well as in chronic back pain patients (Schramm et al., in press), practicing PSAT questions (Duckworth et al., 2009), and improving time-management (Oettingen, Barry, et al., 2009). However, all of the described studies focused on promoting the *initiation* of new behaviors rather than *changing* existing habits. Changing existing habitual behaviors is arguably more difficult than initiating new behaviors (Holland, Aarts, & Langendam, 2006) and is of particular relevance in the domain of eating behavior, where one of today’s most pressing problems is reducing unhealthy eating habits, such as unhealthy snacking (De Graaf, 2006; Jahns et al., 2001; Zizza et al., 2001).

Fighting Habits

One approach that has been proposed for changing habits is to link a critical cue that generally triggers the unwanted, habitual behavior to a new, desired behavior by means of implementation intentions (Gollwitzer, 1999; Gollwitzer & Sheeran, 2006; Holland et al., 2006). To illustrate, if a person is aware that (s)he has a tendency to snack on chocolate when bored, this awareness of one’s ‘situation-behavior profile’ (Gollwitzer & Sheeran, 2006) could be used to link the critical cue (‘being bored’) to a new, desired response (e.g., ‘making myself a fruit salad’), resulting in the implementation intention: “If I am bored and I want a snack, then I will make myself a fruit salad”. Although this approach to fighting habits makes intuitive sense, the few studies that investigated it gave mixed results (Adriaanse, De Ridder, & De Wit, 2009b; Holland, et al., 2006, Webb, Sheeran, & Luszczynska, 2009), and imply that for fighting habits MCII might be more effective than implementation intentions alone.

Holland and colleagues (2006) tested the effectiveness of forming counter-habitual implementation intentions in a study on recycling habits. These authors found that implementation intentions were effective in breaking the old habit of throwing plastic cups and wastepaper into a bin and in creating the new habit of recycling these items. However, in two other studies where goal-striving concerned changing more *complex* behaviors (i.e., smoking or eating unhealthy foods) results were less straightforward.

Webb and colleagues (2009, Study 2) found in their study on smoking cessation that implementation intentions were only effective in decreasing smoking among participants with weak smoking habits, but not among participants with strong habits. Moreover, Adriaanse, De Ridder, et al. (2009b) found in a study on snacking habits that for counter-habitual implementation intentions to be effective participants needed to specify *personally* critical cues for the unwanted behavior in the if-part of the implementation intention; participants who were assigned cues for making implementation intentions proved unable to change their habits. In addition, personal implementation intentions were only effective when participants specified underlying reasons (e.g., 'feeling bored') for their unwanted behavior rather than simple context cues related to the unwanted behavior (e.g., 'being at home').

The finding by Adriaanse, De Ridder et al. (2009b) that for implementation intentions to be effective in changing habits, individuals should specify their *personal* critical cues for the habitual behavior could explain the lack of findings for participants with strong smoking habits in the study by Webb et al. (2009). In this study participants were assigned four specific cues for the if-part of their implementation intentions rather than being allowed to identify their own personal cues, which could have had the result that the implementation intentions did not directly target *critical* cues for smoking.

MCII and Fighting Habits

Adriaanse, De Ridder, et al.'s (2009b) findings suggest that for implementation intentions to be effective in changing habits, individuals should specify their personal critical cues for the habitual behavior. However, although identifying critical cues may be straightforward for simple behaviors that can be directly linked to context cues (e.g., throwing away a cup), for more complex behaviors such as snacking or smoking, this can be more complicated. For these types of behaviors, critical cues might reflect more subjective internal states (e.g., 'boredom') rather than objective situational cues regarding time or place (e.g., 'being at home' or 'having an empty cup'), which require accurate introspection regarding the cues triggering one's behavior (Adriaanse, De Ridder, et al., 2009b).

Unfortunately, people generally have poor introspection regarding the antecedents of their own behavior (Nisbett & Wilson, 1977). This problem is illustrated by findings showing that when people are in cold states (e.g., not hungry, not sexually aroused), as is most likely the case when formulating plans, they systematically underestimate the effect of future hot states (e.g., feeling hungry or sexually aroused) on their behavior (e.g., Loewenstein, 1996; Loewenstein, Nagin, & Paternoster, 1997).

Based on these findings it seems that without any help people will have a difficult time specifying critical cues for their unhealthy snacking habits and therefore will not be able to formulate effective implementation intentions. Considering that mental contrasting has been proposed to aid clarity about one's critical cues (Oettingen et al., 2001; in press; Oettingen, Mayer, et al., 2009), an intervention where MC is combined with II (MCII) might therefore be particularly effective for fighting unhealthy snacking habits.

Research Overview

The present research investigates the effectiveness of combining mental contrasting with implementations intentions in altering snacking behavior. In Study 1, MCII will be compared to a control condition for its efficacy in decreasing unhealthy snack intake over a period of one week, as measured by a food diary. In Study 2, MC, II and MCII conditions will be compared to rule out the possibility that the effects of MCII were based on the mental contrasting or implementation intention part of the intervention alone. Additionally, this study investigates our hypothesis that MC aids the efficacy of II by increasing clarity about the cues that trigger the unwanted behavior.

Study 1: Fighting Habits by MCII

Method

Participants

Fifty-two female students aged 17-27 years participated in our study (MCII: $N = 26$; Control: $N = 25$). After excluding one participant with a BMI [Body Mass Index = weight/height x height] < 18 , the final sample consisted of 51 female students with a mean BMI of 21.40 ($SD = 2.15$) and a mean age of 20.76 years ($SD = 2.18$). There were no obese participants in the sample².

Procedure

Participants were recruited by means of flyers which invited female students who were interested in reducing their unhealthy snack intake to come to our lab. When arriving at the lab, all participants were informed about the experiment and told that it entailed (a) filling out a questionnaire, (b) performing a mental exercise which might help them to attain their goal of eating fewer unhealthy snacks (MCII or control, randomly assigned), and (c) keeping a food diary for a period of one week. Upon returning their diaries, participants received 5 Euro or course credit.

Questionnaire

The questionnaire included some general questions about age, education, and living situation. In addition, habit strength, intention, and expectations were measured. Habit strength was measured by the Self-Report Habit Index (SRHI; Verplanken & Orbell, 2003). The SRHI consists of 12 items, which, for the present study, reflected the habit of eating unhealthy snacks.

2. Underweight (BMI < 18) and obese (BMI > 30) people might differ from normal weight and overweight people in the way they regulate their eating behavior and can be considered to have a pathological relationship with food (i.e., Nasser, 2001; Vaidya & Malik, 2008).

Each item consisted of a statement about eating unhealthy snacks (e.g., 'Eating unhealthy snacks is something I do without thinking about it', Cronbach's $\alpha = .90$), and participants were asked to indicate the extent to which they agreed with each statement. Responses ranged from 1 (*not at all*) to 7 (*very much*).

Intention to eat fewer unhealthy snacks was measured by the item: "I intend to eat fewer unhealthy snacks in the coming week." Expectation about eating fewer unhealthy snacks was measured by the item "I expect to eat fewer unhealthy snacks in the coming week." Participants answered on 7-point Likert scales ranging from 1 (*totally disagree*) to 7 (*totally agree*).

Mental Exercise

Participants in both conditions were told that most students eat too many unhealthy snacks and that in order to help them eat fewer unhealthy snacks they would be asked to go through a mental exercise.

MCII condition. Instructions for the MCII exercise were derived from Oettingen, Barry, et al. (2009) and Stadler et al. (2009), and were read out loud to all participants. Participants were provided with a form to write down keywords or thoughts when asked to do so during critical parts of the exercise. At the start of the MCII exercise participants were asked to relax and close their eyes. Then, they had to name a wish concerning a specific unhealthy snacking habit they wanted to change. They were told to specify a wish that would be challenging for them to realize, but also possible to implement in the coming week. After participants wrote the wish on their form, they were asked to elaborate a positive aspect they associated with having successfully realized their wish and an obstacle standing in its way. The oral instructions for naming and elaborating the positive aspect were:

Please consider the most positive outcome you associate with successfully realizing your wish and write it down in one keyword. Now try to depict in your thoughts the events and experiences that you associate with the most positive outcome. Give your thoughts and images free reign and write them down.

The oral instructions for naming and elaborating the obstacle were:

Sometimes a wish does not become fully realized, even if one is very motivated to realize the wish. What situations could make it hard for you to diminish your bad snacking habit? Think about which is the most important obstacle to eating fewer unhealthy snacks for *you personally* and write it down in one keyword. Now depict in your thoughts the events and experiences that you associate with this obstacle. Give your thoughts and imagination full scope and write them down.

Then the implementation intention component of the MCII intervention followed (adapted from Adriaanse, De Ridder, et al., 2009b), in which participants were asked to plan to eat a piece of fruit whenever they encountered their earlier specified most critical obstacle for eating unhealthy snacks in the coming week. Participants completed the following statement: "If I [obstacle] and I feel like having a snack, then I will eat a(n) [choice of fruit]". After sentence completion was verified by the experimenter, participants were encouraged to visualize acting out their plan for about 2 minutes.

Control condition. The instructions for the control condition were derived from Adriaanse, De Ridder, et al. (2009b, Study 3). Participants were told that in order to help them eat fewer

unhealthy snacks, we would like them to think about options for *healthy* snacks that they liked and could consume whenever they wanted to eat a snack. Participants were asked to think carefully about this, and then to list their top ten healthy snacks. This control condition was chosen in order to eliminate the possibility that any superior effects of the MCII condition were caused merely by thinking about eating fewer unhealthy snacks by participants in this condition. Moreover, this type of active control condition allowed us to introduce both exercises similarly; that is, by stating that they would go through an exercise which could *help them eat fewer unhealthy snacks* we tried to keep experimenter demand equal between the two conditions.

Food Diary

After going through the exercise, participants received their food diary which was similar to the diary used by Adriaanse, De Ridder, et al. (2009b). The food diary was constructed together with a registered dietician and consisted of 6 tables for each of 7 days (so a total of 42 tables). During seven consecutive days participants were asked to fill out a table in the diary for each snacking occasion (defined as a 30 minute period in which snacks were consumed).

Each table consisted of one column with 12 categories of unhealthy snacks and one column with 13 categories of healthy snacks. For both healthy and unhealthy snacks 'other' options were also provided. Categories were constructed based on advice from the dietician to ensure that only snacks that were about equal in their caloric value were grouped together into one category. In other words, although categories of snacks were used, care was taken to ensure that the labels used for these categories discriminated between snacks that have a different caloric value. To illustrate, rather than using one category for cakes, cookies and biscuits, the diary included separate categories for (a) small biscuits/cookies, (b) large cookies, and (c) cakes and pies.

Participants were asked to indicate the amount of each category of snacks they consumed by using the portion size that was indicated for each category, like 'units/pieces' for candy bars, and 'handful' for chips. The diary was orally explained to participants, but also included instructions and an example of a completed table on the first page of the diary.

Results

Descriptives

On average, participants had moderately strong unhealthy snacking habits ($M = 4.12$, $SD = 1.00$), strong intentions to eat fewer unhealthy snacks ($M = 5.49$, $SD = 1.33$), and high expectations about eating fewer unhealthy snacks ($M = 4.94$, $SD = 1.26$). Results from the food diary showed that participants consumed on average 6.80 pieces of fruit during the week ($SD = 4.63$). As the categories of unhealthy snacks that were used in the diary varied considerably in size and calories (e.g., 1 candy bar cannot be considered equal to 1 small cookie), scores for each category were 'weighed' by the average number of kilocalories (kcal) it contained (based on guidelines from the Dutch Nutrition Centre; <http://www.caloriechecker.nl>, and validated by a professional dietician). In this manner, the mean number of kcal derived from unhealthy snacks was calculated and used as the dependent measure. The mean number of kcal per week derived from unhealthy snacks was 2296.61 kcal ($SD = 1595.50$). Table 1 presents the means, standard deviations, and correlations for the variables under study.

Table 1
Study 1: Means, Standard Deviations, and Correlations

	1	2	3	4	5	6	7
BMI (1)	-						
Age (2)	-.07	-					
Habit Strength (3)	.11	-.27	-				
Intention (4)	.13	-.26	.05	-			
Expectation (5)	-.07	-.05	-.09	.77**	-		
Fruit Intake (pieces) (6)	.02	-.19	.14	.13	.13	-	
Unhealthy Snack Intake (kcal) (7)	-.20	-.12	.39**	-.12	-.26	-.09	-
<i>M</i>	21.40	20.76	4.12	5.49	4.94	6.80	2296.61
<i>SD</i>	2.15	2.18	1.00	1.33	1.26	4.63	1595.50

* $p < .05$; ** $p < .01$

Randomization Check

A one-way multivariate analysis of variance (MANOVA) with age, BMI, habit strength, intention and expectation as the dependent variables and condition (control vs. MCII) as the independent variable was performed to check whether randomization was successful. The MANOVA did not reveal a significant multivariate effect and no significant univariate effects, indicating successful randomization (all p 's $> .13$).

Unhealthy Snack and Fruit Consumption

A one-way multivariate analysis of covariance (MANCOVA) with condition (MCII vs. control) as the independent variable and unhealthy snack intake (in kcal) and fruit intake as the dependent variables was performed to investigate the effectiveness of the MCII strategy on snacking behavior. As habit strength was strongly related to unhealthy snack consumption ($r = .39$, $p < .01$), it was entered as a covariate. Unhealthy snack intake (in kcal) was log-transformed before entering into the analysis as this variable was positively skewed. However, for the sake of interpretation, mean scores are presented for the non-transformed variable.

The MANCOVA revealed a significant multivariate effect for condition, $F(2,47) = 3.51$, $p < .05$, $\eta_p^2 = .13$, and a significant effect of the covariate habit strength, $F(2,47) = 7.10$, $p < .01$, $\eta_p^2 = .23$. Univariate effects were significant for unhealthy snack intake, $F(1,48) = 7.17$, $p < .01$, $\eta_p^2 = .13$, with participants in the MCII condition on average consuming less calories on unhealthy snacks than participants in the control condition, but not for fruit intake, $p = .67$ (see Table 2).

Table 2
Mean Fruit and Unhealthy Snack Intake (kcal)

		MCII	Control
Fruit	<i>M</i>	7.1	6.5
	<i>SE</i>	0.9	0.9
Unhealthy snacks (kcal)	<i>M</i>	1745	2870
	<i>SE</i>	269	274

Potential Moderators of MCII effects

Habit strength. To rule out the possibility that the MCII intervention was only effective among participants with weak habits, multiple linear regression analyses with habit strength as a continuous, mean centered predictor, condition as a categorical predictor, and the interaction term of habit strength x condition were conducted for unhealthy snack intake (in kcal) and fruit intake separately. For unhealthy snack intake, the model was significant, with condition and habit strength as significant predictors. The interaction term did not significantly predict unhealthy snack intake (see Table 3). No significant effects were found for fruit intake, p 's > .49.

Table 3
Results of Regression Analysis of Habit Strength on Unhealthy Snack Consumption in Kcal

	β	ΔF	ΔR^2
<i>Model</i>		5.6	26.4%**
Condition		-.35**	
Snack Habit Strength		.41**	
Condition x Snack Habit Strength	.08		

* $p < .05$; ** $p < .01$

Note. Final β s are presented.

Intention. To assess whether the effects of the MCII intervention were moderated by intention strength, two multiple linear regression analyses for unhealthy snack intake and fruit intake were also performed with intention as a continuous, mean centered predictor, condition as a categorical predictor, and the intention x condition interaction term as the third predictor while controlling for habit strength. For unhealthy snack intake, the model proved to be significant ($p < .01$) and explained 20.5% of the variance (adj. R^2), with condition ($\beta = -.33$, $p < .05$) and habit strength ($\beta = .46$, $p < .01$) as significant predictors. Intention, and the intention x condition interaction did not significantly predict unhealthy snack intake, p 's > .73. No significant effects were found for fruit intake, p 's > .27.

Expectation. Moderation effects of expectation were also assessed in separate multiple linear regression analyses for unhealthy snack intake and fruit intake. Expectation was entered as a continuous, mean centered predictor, condition as a categorical predictor, and the expectation x condition interaction term as a third predictor while controlling for habit strength. For unhealthy snack

intake, the model was significant ($p < .01$) and explained 22.3% of the variance (adj. R^2). Condition ($\beta = -.30, p < .05$) and habit strength ($\beta = .44, p < .01$) were significant predictors. Expectation, and the expectation x condition interaction did not significantly predict unhealthy snack intake, p 's $> .50$. No significant effects were found for fruit intake, p 's $> .29$.

Discussion

Study 1 showed that participants in the MCII condition consumed significantly fewer calories from unhealthy snacks than participants in the control condition, suggesting that the MCII strategy was successful in diminishing habitual unhealthy snacking behaviors. The lack of interaction effects with habit strength further indicated that this beneficial effect of MCII was not restricted to participants with weak unhealthy snacking habits.

Intentions to reduce snacking behavior did not moderate MCII effects either. This finding implies that the MCII exercise has beneficial effects for those who strongly intend to reduce snacking as well as for those whose intentions are less strong. However, note that for the present study we specifically recruited participants who wanted to decrease their unhealthy snack intake. Consequently, most participants had very strong intentions (only 9.8% of participants in Study 1 had intentions < 4.00). It might very well be that people with very low intentions to reduce snacking would not benefit from the MCII exercise. They may not be able to positively fantasize about a future of reduced snacking, and thus MC would not engender high commitment for the particular snacking behavior picked for the mental contrasting exercise (a prerequisite for implementation intentions to be effective).

Similar explanations apply to the lack of moderation effects by expectation. In view of the fact that previous studies have indicated that mental contrasting is more effective when people hold high expectations of success (Oettingen, 2000), we asked participants to specify a wish that would be challenging for them to realize, but which they also expected to be able to realize in the coming week. As a result, most participants had high expectations of success (only 19.8% of participants had expectations < 4.00). Thus the absence of an interaction effect with expectation is not surprising.

Although the focal goal of the study was to decrease unhealthy snack intake, considering that the then-part of all implementation intentions referred to eating more fruits, it has to be noted that fruit consumption did not differ significantly between the two conditions. Certainly, this does not imply that participants in the MCII condition failed to achieve their goal of eating fewer unhealthy snacks by substituting their unhealthy snacks with fruits. Rather, it seems possible that *both* the control group and the MCII group increased their fruit intake. All participants in this study were highly motivated, and were actively encouraged, to eat less unhealthily which might have been sufficient to increase fruit consumption (e.g., Jackson et al., 2005; Jackson et al., 2006). Alternatively, the procedure could have led control participants to form spontaneous implementation intentions to increase their fruit intake (Gollwitzer & Brandstätter, 1997; Jackson et al., 2005; Jackson et al., 2006). However, because in Study 1 we did not assess participants' snacking behavior at baseline by using a diary measure, we cannot check whether the explanation that both groups increased their fruit intake is valid or not. Also, the effects on fruit intake were rather small and our study was underpowered for detecting a small effect.

Despite the fact that fruit intake did not differ from the control group, Study 1 provides convincing evidence for the effectiveness of MCII in diminishing unhealthy snack intake (a difference of 1125 kcal per week), which was the main goal of the MCII intervention. However, the results from Study 1 do not demonstrate that both components (MC and II) of the manipulation are needed for this effect to occur. It is possible that the effects were based on the mental contrasting, or, implementation intention part only.

As stated in the introduction, it is expected that mental contrasting increases clarity about the cues triggering one's unwanted habit. This clarity may by itself not be enough to change habits as one also needs the 'tools' (i.e., implementation intentions) to translate this clarity into action. On the other hand, for formulating effective implementation intentions people should benefit from mental contrasting as it provides clarity about the critical cues. Specifically, mental contrasting should provide clarity about the cues that trigger the unwanted behavior (e.g., boredom as the critical cue for eating chocolate) which is needed to formulate implementation intentions that are effective in substituting this unwanted habit with a new response (e.g., when bored consuming a healthy instead of an unhealthy snack). Following these considerations, we therefore expect that an MCII intervention will be more effective in fighting unhealthy snacking habits than MC or II alone. In order to test this assumption, we conducted a second study separating the two components of MCII. Additionally, this study investigated the role of cue clarity as one of the mechanisms underlying the expected superiority of MCII compared to MC or II alone.

Study 2: Disentangling the Two Components of MCII

In the second study, the effectiveness of separate MC, II, and MCII interventions were compared. Although the instructions for MC and II were essentially the same as instructions for the MC and II components from the MCII intervention in Study 1, Study 2 differed in three important respects. First of all, in order to further standardize the MCII procedure, all instructions were provided in written form. Secondly, to allow for a stricter test of our hypotheses, our dependent measures specifically addressed the one habit that participants aimed to decrease rather than looking at an aggregate of their unhealthy snack consumption in general. Lastly, in order to increase the chance that the then-part of the implementation intention specified a response that was applicable to the specific obstacle, participants in the second study were entirely free in formulating the then-part of their plan.

Method

Participants

For this study, 77 female participants were drawn from New York University's research pool. Of the initial 77 participants, 64 participants (83%) returned after one week for their appointment to fill out a final questionnaire with our dependent measures. After excluding one obese (BMI > 30) and two underweight (BMI < 18) participants, one participant who reported having several food allergies,

and one participant who failed to indicate which unhealthy food/drink item she wanted to reduce, the final sample consisted of 59 participants (MCII: $N = 19$; MC: $N = 20$; II: $N = 20$) with a mean BMI of 21.65 ($SD = 2.43$) and a mean age of 19.36 years ($SD = 1.21$).

Procedure

Participants were invited to the lab and were randomly assigned to the MCII, MC, or II condition. Participants in all conditions received a booklet which started with several general questions and a practice mental exercise (MC, II or MCII, depending on condition). This practice exercise concerned a wish in a domain that was not associated with the topic of the study (academia) and intended to give participants the opportunity to familiarize themselves with the procedure of the exercise. After these general questions and the practice exercise, the booklet continued with some questions and the actual mental exercise concerning participants' unhealthy snacking habit. When participants finished the booklet, they made an appointment to fill out the final questionnaire one week later. Participants received course credit upon finishing the first session in which they completed the booklet and \$10 for returning to the lab and filling out the final questionnaire one week later.

Booklet

The booklet started with questions about age, weight, and height. Then participants were asked to go through the practice exercise for their most important academic wish. After that, the focal part of the experiment concerning participants' most important unhealthy snacking habit started.

Questions about unhealthy snacking habit. Participants were asked to name their single most important unhealthy snacking habit that they felt they would be able to diminish in the next week, but that was also challenging for them to change. It was explained that "unhealthy snacking habit" referred to an unhealthy food or drink that they regularly consumed and of which they wanted to consume less (e.g., junk food, soda, cookies), and not a healthy food or drink of which they wanted to consume more (e.g., vegetables, fruit, water).

After naming their unhealthy snacking habit, participants answered several questions regarding this habit; the *extent* to which they wanted to diminish the food or drink they specified in their habit ("By how much would you like to diminish the consumption of the food or drink you just specified above?"), their *expectations* of achieving this ("Within the next week, how likely is it that you will diminish the consumption of your food/drink to the extent you just indicated?") and the *importance* of diminishing their bad habit ("Within the next week, how important is it to you to diminish the consumption of your food/drink to the extent you just indicated?"). Responses on all three items ranged from 1 (*not at all*) to 7 (*very much*). In addition, the SRHI (Verplanken & Orbell, 2003) was administered. The SRHI was adapted so that participants could fill in their own specific unhealthy habit and showed excellent reliability (Cronbach's $\alpha = .89$).

Mental exercise. Then, participants went through the mental exercise for their unhealthy snacking habit. The MC instructions for the positive future read:

Please consider the best aspect you associate with diminishing your bad habit. What is it that would make it so good for you personally if you diminished your bad habit? Please keep this best aspect in the front of your mind and really think about it. Imagine the relevant events

and experiences as vividly as possible! Let your mind go! Do not hesitate to give your thoughts and images free reign.

The MC instructions for naming and elaborating the obstacle read:

Sometimes things do not work out as well as we would have liked. What is the most important obstacle that stands in the way of diminishing your bad habit? What could make it hard for you to diminish your bad habit? What is it in you personally that might impede you from diminishing your bad habit? Please name the central obstacle. Please keep this obstacle in the front of your mind and really think about it. Imagine the relevant events and experiences as vividly as possible! Let your mind go! Do not hesitate to give your thoughts and images free reign.

The II instructions were adapted from Study 1 in such a manner that participants could now name any behavior that could help them overcome their obstacle in the then-part of the plan. In the MCII condition instructions referred to the obstacle *that participants had just named in the MC part*:

Now please make an if-then plan in which you link the obstacle that you just named to a response which will help you to overcome this obstacle when it occurs. The if-then plan has the following format: “*If* (here you refer to the obstacle you specified) *then I will* (here you name the behavior to overcome the obstacle)”. Now please complete the if-then plan below.

If....., *then I will*.....

Now say this plan slowly in your head one more time.

In the II condition, participants were asked to choose an obstacle:

Please make an if-then plan in which you link an obstacle to diminishing your bad habit to a response which will help you to overcome this obstacle when it occurs. The if-then plan has the following format: “*If* (here you name your obstacle) *then I will* (here you name the behavior to overcome the obstacle)”. Now please complete the if-then plan below.

If....., *then I will*.....

Now say this plan slowly in your head one more time.

Participants in the MCII and II condition were then asked to make sure that their plan had the format of: “*If* (your personal critical obstacle), *then I will* (your behavior to overcome the obstacle).”

Upon finishing their mental exercise, participants were asked to try to be successful in diminishing their bad habit in the coming week by going through the exercise every morning when they woke up. The booklet ended with the same expectation and importance items that participants filled out before going through the exercise.

Final Questionnaire

The final questionnaire was administered approximately one week after the mental exercise. It contained three items regarding the *success in diminishing* the habit, two items regarding *clarity* about the content of the habit and two *control items*. The two control items were added to ensure that any possible effects were due to the nature of the exercise (MC, II or MCII), and not to a more frequent use of the exercise, or demand effects.

Success in diminishing the habit. Success in diminishing the habit was measured by three items that addressed the extent participants were able to diminish the consumption of their chosen food item. The first item: “Compared to the week before you did the exercise, how well did you do on overcoming your unhealthy habit in the week after you did the exercise?”, could be answered on a 7-point Likert scale ranging from 1 (*much worse*) to 7 (*much better*). The other two items were: “Compared to the week before you did the exercise, how many times were you able to not consume your unhealthy food/drink when you had the urge to in the week after you did the exercise?”, and “Compared to the week before you did the exercise, how many times did you consume your unhealthy food/drink in the week after you did the exercise?”. These items were answered on scales ranging from 1 (*much less*) to 7 (*much more*). The last item was reverse coded so that an index in which higher scores reflect more success in diminishing the habit could be calculated using these three items (Cronbach’s $\alpha = .67$).

A pilot study ($N = 41$) targeting the habit of eating chocolate tested the predictive validity of these items. This pilot study showed that these three items (adapted to address the success in diminishing chocolate consumption) negatively correlated with actual caloric intake on chocolate, $r = -.46$, $p < .01$, and with the frequency of eating chocolate, $r = -.34$, $p < .05$, as measured during a one week period in a food diary.

Clarity. Clarity was measured by two items; “To what extent did the exercise help you get a better understanding of your unhealthy habit?” and “To what extent did the exercise help you think about your unhealthy habit in a different way?” (Cronbach’s $\alpha = .71$). Seven-point scales ranged from 1 (*not at all*) to 7 (*very much*).

Control items. The control items referred to participants’ frequency of using the exercise (“How often did you use the exercise in regard to diminishing your unhealthy food/drink?”), and to potential demand effects (“How much did the experimenter want you to succeed in diminishing your unhealthy food/drink item in the week after the exercise?”). Scales ranged from 1 (*not at all*) to 7 (*very much*).

Results

Descriptives

Prior to the mental exercise, participants wanted to reduce their unhealthy habit by quite a lot ($M = 5.59$, $SD = 1.51$), had high expectations of success ($M = 4.80$, $SD = 1.42$), and thought it was important to diminish their bad habit ($M = 5.34$, $SD = 1.37$). After the exercise, overall, mean expectations were higher ($M = 5.28$, $SD = 1.28$; $F(1,55) = 8.38$, $p < .01$) than before the exercise, but mean importance remained the same ($M = 5.29$, $SD = 1.24$).

A MANOVA showed that the extent to which participants wanted to diminish their habit, their expectations of success, the importance of diminishing the habit before the exercise, and the expectations and importance of diminishing the habit after the exercise did not differ between conditions (all p 's $> .26$). An overview of means, standard deviations, and correlations of the variables under study can be found in Table 4.

Randomization Check

A MANOVA with age, BMI and habit strength as the dependent variables and condition (MCII vs. MC vs. II) as the independent variable was performed to check whether randomization was successful. The MANOVA did not reveal any significant effects (all p 's > .31), indicating successful randomization.

Table 4

Study 2: Means, Standard Deviations, and Correlations

	1	2	3	4	5	6	7	8
BMI (1)	-							
Age (2)	.03	-						
Habit Strength (3)	.32*	.27*	-					
Extent of Reducing Habit (4)	-.14	.21	.27*	-				
Expectation (5)	.02	-.10	-.14	.18	-			
Importance (6)	.05	.13	.20	.67**	.45**	-		
Success in Diminishing the Habit (7)	.04	-.21	-.02	.15	.21	.18	-	
Clarity (8)	.16	-.11	.08	.04	.01	.08	.18	-
<i>M</i>	21.65	19.36	4.14	5.59	4.80	5.34	4.63	4.66
<i>SD</i>	2.43	1.21	1.21	1.51	1.42	1.37	1.31	1.40

* $p < .05$; ** $p < .01$

Note. Expectation and Importance refer to the level of these variables before the mental exercise.

Success in Diminishing the Habit

A one-way analysis of variance (ANOVA) was performed with condition (MCII, MC, II) as the independent variable and participants' success in diminishing the habit as the dependent variable. This ANOVA revealed a significant main effect of condition, $F(2,56) = 5.68$, $p < .01$, $\eta_p^2 = .17$. Planned contrasts showed that the MCII condition ($M = 5.37$, $SD = .99$) significantly outperformed the II ($M = 4.08$, $SD = 1.25$), $p < .01$, $\eta_p^2 = .25$, and the MC ($M = 4.47$, $SD = 1.37$), $p < .05$, $\eta_p^2 = .13$, conditions³. The difference between MC and II was not significant, $p = .32$.

Potential Moderators for Success in Diminishing the Habit

Habit strength. Similar to Study 1, moderating effects of habit strength were investigated by means of a multiple linear regression analysis. This analysis included two dummy variables for condition (MC and II), habit strength as a continuous, mean centered predictor, and interaction terms of habit strength with each of the two dummies. The model was significant, with the MC and II dummies as significant predictors. Habit strength and the interaction terms with habit strength did not predict success in diminishing the habit (see Table 5).

3. To make sure that this effect could not be attributed to one or two items in the index, one-tailed, one-way ANOVA's were performed for the three items separately. These three analyses all showed a significant main effect of condition (all $ps < .05$). Additionally, one-tailed planned comparisons showed that for all three items the MCII condition significantly outperformed the II and the MC condition (all $ps < .05$), and the difference between MC and II was not significant.

Table 5

Results of Regression Analysis of Habit Strength on Success in Diminishing the Habit

	β	ΔF	ΔR^2
<i>Model</i>		2.60	19.7%*
MC	-.34*		
II	-.46**		
Unhealthy Snack Habit Strength	-.04		
MC x Unhealthy Snack Habit Strength	.17		
II x Unhealthy Snack Habit Strength	-.05		

* $p < .05$; ** $p < .01$ *Note.* Final β s are presented.

Importance. A similar regression analysis was performed to investigate interaction effects with goal importance. The model proved to be significant ($p < .05$) and explained 14.1% of the variance (adj. R^2), with the MC ($\beta = -.33$, $p < .05$) and II dummies ($\beta = -.46$, $p < .01$) as significant predictors. Goal importance and the interaction terms with goal importance did not predict success in diminishing the habit, p 's $> .20$.

Expectation. Moderation effects of expectations were also assessed in a similar multiple linear regression analysis. The model was again significant ($p < .05$), explaining 15.6% of the variance (adj. R^2). Dummy variables for MC ($\beta = -.34$, $p < .05$) and II ($\beta = -.47$, $p < .01$) were again the significant predictors. Expectation and the MC x expectation and II x expectation interactions did not predict success in diminishing the habit, p 's $> .40$.

Clarity

Planned contrasts were conducted to compare the two conditions that included MC (i.e., MCII and MC) to the group that did not (i.e., II) on scores for clarity. As clarity was not normally distributed, planned contrasts were computed by means of Mann-Whitney U tests. Corresponding effect sizes were calculated from the Mann-Whitney U test by applying the formula $\theta = U/mn$ (Newcombe, 2006). The value of θ is equal to 0.5 when no difference between two groups exists and is either 0 or 1 in case of a perfect effect (i.e., when there is no overlap between the two groups, meaning that the independent variable has perfect discriminatory ability).

A first contrast comparing the two conditions that included MC (i.e., MCII and MC) with the condition that did not (i.e., II) revealed that participants in the conditions that included MC reported more clarity ($M = 4.88$, $SD = 1.50$) than participants in the condition that did not include MC ($M = 4.23$, $SD = 1.11$), $z = 2.25$, $p < .05$, $\theta = .32$. Follow up contrasts then compared the MCII and MC condition separately to the II condition. Participants in the MCII condition reported more clarity ($M = 4.95$, $SD = 1.35$) compared to participants in the II condition, $z = 2.09$, $p < .05$, $\theta = .31$. Participants in the MC condition reported marginally more clarity ($M = 4.83$, $SD = 1.66$) compared to participants in the II condition, $z = 1.79$, $p = .07$, $\theta = .34$. The MCII and MC conditions did not differ significantly from each other, $p = .94$.

Within-Cell Correlations⁴

To investigate our hypothesis that the increased clarity in the MCII and MC condition would only be translated into better outcomes in the MCII condition, as only in this condition participants received the ‘tools’ to help translate their clarity into actions, within-cell correlations were conducted. Within-cell correlations for each of the conditions indicated that, as expected, clarity was only related to success in diminishing the habit in the MCII condition, $r = .46, p < .05$, but not in the other two conditions (MC: $r = .10, ns$; II: $r = -.16, ns$).

Control Items

To make sure that the effects of condition were not due to differences in frequency of performing the exercise or experimenter demand, a MANOVA with condition as the independent variable was performed for these two control variables. The MANOVA revealed no significant multivariate or univariate effects (all p 's $> .53$).

Discussion

Participants in the MCII condition reported being more successful in diminishing their unhealthy snacking habit than participants in the MC or II only conditions. Similar to Study 1, the effect on success in diminishing the habit was not moderated by habit strength, goal importance, or expectations. The lack of interaction effects with habit strength again strengthens our findings as it rules out the possibility that the obtained effects on success in diminishing the habit were restricted to participants with weak unhealthy snacking habits. The fact that no moderation effects were found for goal importance and expectations may, similar to Study 1, be explained by the fact that most participants scored high on importance to eat less unhealthy snacks (in Study 2 only 6.8% of the participants scored < 4.00) and had high expectations of success (in Study 2 only 20.3% of the participants scored < 4.00). Moreover, the results indicated that the superior effect of MCII compared to II could be related to more clarity about the critical cues for the unwanted habit: Participants who went through an MC procedure (MCII and MC condition) reported more clarity, and when they were allowed to make plans based on this clarity (MCII condition), clarity was related to success in diminishing the unhealthy snacking habit.

In order to address the particular habit that participants aimed to change, our dependent measure concerned three items tapping into participants' evaluation of their success in fighting the specific habit rather than a food diary assessing their overall unhealthy snack consumption (Study 1). As this measure necessarily relied on participants' retrospective memory of their performance over a one week period rather than being based on multiple diary entries per day, responses may have been

4. As we expected the relation between the mediator (clarity) and the dependent variable (success in diminishing the habit) in the MCII condition to differ from the relation of these variables in the MC and II condition, a standard Baron and Kenny (1986) simple mediation analysis was considered inappropriate for testing the proposed underlying effect of clarity in Study 2 (Spencer, Zanna, & Fong, 2005). Specifically, we expected clarity to only be related to success in diminishing the habit when participants had gained increased clarity as a result of MC and additionally had received the tools (II) to be able to translate this increased clarity into actual behavior (MCII condition). In such instances where the effect of the mediator on the dependent variable is expected to differ between levels of the independent variable, Spencer et al. (2005) propose that looking at within-cell correlations is more appropriate.

subject to self-presentation biases or demand characteristics. However, our findings that participants in the three conditions did not differ in (a) expectations of being able to diminish their unhealthy snack consumption, (b) importance of diminishing their unhealthy snack consumption before or after the exercise, (c) retrospectively reported frequency of using the exercise, or (d) experimenter demand indicate that this dependent measure should not have been affected by such methodological problems.

One limitation of Study 2 is that there were no respective control conditions for the MC, the II, and the MCII conditions. Hence, the present data do not permit conclusions about whether the combined MCII intervention has additive or interactive effects compared to the MC and II interventions in isolation. Future research is required to investigate this question.

General Discussion

In two studies the effectiveness of a new strategy combining mental contrasting with implementation intentions (MCII) for fighting snacking habits was investigated. In the first study, the effectiveness of MCII in diminishing unhealthy snack intake was compared to a control condition in which participants thought about and listed ten options for healthy snacks. Results indicated that participants in the MCII condition consumed on average 1125 kcal less per week than participants in the control condition, suggesting that the MCII intervention was effective in achieving the focal goal of the intervention: decreasing unhealthy snack intake. Fruit intake did not differ between the two conditions, which is somewhat unexpected, but this could be due to a lack of power. Alternatively, it could be a reflection of both groups increasing their fruit intake. All participants were highly motivated and actively encouraged to eat less unhealthily, which may have been sufficient for increasing fruit consumption (e.g., Jackson et al., 2005). Moreover, their high motivation could even have led participants in the control condition to form spontaneous implementation intentions to increase their fruit intake (e.g., Gollwitzer & Brandstätter, 1997).

Our second study was designed to test whether the power of MCII to fight unhealthy habits is indeed due to the combination of MC with II rather than one of the components alone. Additionally, it was investigated whether the superiority of MCII to II could be related to an increased clarity regarding the cues that drive the unwanted habit. Confirming our expectations, participants in the MCII condition reported more success in diminishing their unhealthy snacking habits than participants in the MC or II conditions. Moreover, participants who went through mental contrasting (MCII or MC) reported higher levels of clarity regarding critical cues for their habit, but only in the MCII condition was this clarity related to the outcome measure.

Our results suggest that mental contrasting and forming implementation intentions are complementary mental strategies that together can help fight unwanted habits. Earlier studies already suggested that MC and II are complementary mental strategies (Duckworth et al., 2009; Oettingen, Barry, et al., 2009; Schramm et al., in press; Stadler et al., 2009), but the present study is the first to actually compare the effectiveness of MC, II, and MCII strategies. Additionally, the present research was the first to apply MCII to fighting habits and to show that mental contrasting fosters clarity about

the cues driving the unwanted habit. Moreover, the results suggest that this increased clarity may be partially responsible for MCII being more effective than II alone.

The present studies address recent suggestions in the literature that implementation intention interventions might not, on their own, be sufficient to diminish habits (Webb et al., 2009). In particular, our research shows that mental contrasting as a strategy aimed at helping to identify critical cues for the unwanted behavior increases the effectiveness of counter-habitual implementation intentions. Additionally, our studies employing MCII as a strategy to fight habits are an important extension to the approach of using person-specific situation-behavior profiles to formulate counter-habitual implementation intentions (Adriaanse, De Ridder, et al., 2009b; Gollwitzer, 1999; Gollwitzer & Sheeran, 2006). The MCII strategy allows participants to identify their cues for action, increasing the chance that participants use their personally critical cues which in turn increases the chance that the implementation intentions are effective in diminishing habits.

Our results also have important applied implications. The effect of the MCII intervention in the first study is promising considering that the average difference per day in unhealthy snack intake between the MCII and control condition was about 160 kcal, and a consistent reduction of caloric intake of 100 kcal prevents weight gain in most populations (Hill, Wyatt, Reed, & Peters, 2003). As the MCII technique is easily applicable, our results suggest that the MCII strategy could ultimately be taught as a meta-cognitive strategy aiming to eat more healthily; people could then apply and adapt the strategy to different circumstances without much help from others (Oettingen, Barry, et al., 2009; Stadler et al., 2009).

There are some limitations of the current study. First, both studies only included women, limiting the generalizability of our findings. A second concern with regard to the population of both studies is that they consist of college students with a normal BMI ($18 < \text{BMI} < 30$). It could be argued that decreasing unhealthy eating habits was not particularly relevant for these relatively healthy women. However, the present sample concerns young female students who are at the beginning of their lives as independent young adults. As these women are often moving into their own living situation for the first time this is a period when personal eating habits are created. Unfortunately, the eating habits that these college students tend to develop during their college years are often rather unhealthy and result in weight gain (Gores, 2008). In fact, students aged 18-29 years are at greatest risk for weight gain (Mokdad, Serdula, Dietz, Bowman, Marks, & Koplan, 1999).

Even though only 11.2% of the participants could be classified as overweight ($\text{BMI} \geq 25$) in Study 2, young people such as those studied here are at risk for weight gain and thus constitute important targets for intervention. Support for this idea comes from Anderson, Shapiro, and Lundgren (2003), who showed that about one quarter of college students gained at least 5 pounds from September to mid December in their freshmen year. If the students in our second study each gained 5 pounds, the proportion of overweight participants would be 16.7%. Moreover, as BMI in early adulthood is strongly predictive of overweight later in their adult life (Guo, Roche, Chumlea, Gardner, & Siervogel, 1994), prevention of weight gain before participants are already overweight is of particular importance for this population.

This being said, it of course remains an important question whether the MCII intervention could also be beneficial for students for whom their unhealthy eating habits have already resulted in an unhealthy weight. Additionally, it still needs to be established whether the MCII technique will be equally effective when it is delivered in applied settings (but see Stadler, Oettingen, & Gollwitzer, 2009, for evidence regarding the efficacy of an MCII intervention for increasing physical activity among women in their midlife in applied settings), and whether adherence to the MCII technique will be equally high in such a setting. As these questions cannot be answered in the present study, future research should replicate our findings for overweight and obese participants in applied settings.

A second limitation concerns the fact that we cannot claim that very strong habits were diminished in the present studies. As mean scores for habit strength were around the midpoint of the scale, it could be argued that snacking was not very habitual for the present sample. However, the frequency items from the SRHI (i.e., ‘unhealthy snacking’ is something that I do frequently/ is something that I have been doing for a long time), had a mean score of 4.90 in Study 1 (62.7% scored 5.0 or higher) and 5.52 in Study 2 (71.2% scored 5.0 or higher), indicating that participants had a high frequency of performing the behavior that was the topic of the MC/II/MCII intervention. Additionally, the fact that in both studies participants were specifically instructed to pick a specific unhealthy snacking *habit* they wanted to change also strengthens our confidence that the interventions did target habitual behaviors.

Nevertheless, it has to be noted that firm conclusions regarding the extent to which habits were actually ‘broken’ cannot be drawn from the present data. In order to strictly show that MCII can break habits, the change in behavior needs to be lasting and stable, and the link between past behavior and future behavior needs to be consistently reduced (Holland et al., 2006). Future research should therefore measure snacking behavior for a longer time period, as well as employ a pre-post test design to provide conclusive evidence that MCII is an effective approach to breaking unhealthy snacking habits.

Lastly, although the present study is the first to show that MCII can diminish habitual behaviors and to indicate that clarity concerning the cues driving one’s habit may play an important role in MCII’s effectiveness, measures of clarity need to be improved in future research. In the present study, participants were asked about the clarity regarding their habit in general, rather than about the cues driving their habit specifically. This was done in order to make these items easier to understand for participants, and in order to make these items also meaningful for participants in the II condition, who did not do a specific exercise to identify their critical cue. In order to reliably conclude that clarity concerning the cues driving one’s habit is the underlying mechanism of MCII effects, future research should measure clarity more directly, for example by using procedural measures instead of only self-report measures as used in the present research. Future research would also benefit from assessing clarity right after the MCII intervention to rule out the possibility that -- as may have happened in the present study -- clarity scores were driven by changes in behavior rather than being the mechanism of MCII effects. Alternatively, to provide an even more direct test, future research could also manipulate the difficulty of identifying cues or use an individual difference measure of introspective ability or metacognition.

Conclusion

MCII can be an effective strategy for decreasing unhealthy snack intake and it is more effective in fighting habits than MC or II alone. Our results also showed that this superiority of MCII over II alone may relate to an increased clarity concerning the cues driving the unwanted habit. These findings are important as they suggest that MCII may be a promising strategy for fighting unwanted habits, which is a type of behavior change that was perceived as difficult to achieve by implementation intentions only or by other self-regulatory strategies (e.g., Verplanken & Wood, 2006). Moreover, our findings provide evidence for the notion that although planning (forming implementation intentions) can be helpful in fighting habits, its utility can be increased by taking additional measures such as engaging in MC prior to plan formation. In order to make *effective* plans, one first needs to obtain a clear picture of the cue that triggers one's habit by MC, and then formulate plans tailored to this insight.

Chapter 7

Summary and General Discussion

In the introduction of this dissertation (*Chapter 1*) it was argued that breaking unwanted habits is difficult, and that, in general, global ‘plans’ or goal intentions to break habits are not sufficient to ensure positive outcomes (Webb & Sheeran, 2006). However, it was also noted that there is a theoretical basis to expect that when such general goal intentions to change habits are furnished with another, more specific type of planning, labeled ‘implementation intentions’, the possibility of successful goal-striving substantially increases (Gollwitzer, 1999). As empirical evidence for the proposed efficacy of implementation intentions in breaking habits was lacking, the main objective of the research presented in this dissertation was to test this hypothesis. The reported findings confirm the proposition that implementation intentions can be effective in breaking habits. However, findings also illustrated that there are some crucial “buts” to this conclusion, as it is certainly not the case that *any* type of implementation intention is conducive to break habits. Specifically, in addition to the positive effects that were demonstrated, the present studies also identified some important boundary conditions for the efficacy of implementation intentions in breaking unwanted habits. These boundary conditions pertained to the structure of the implementation intention (i.e., negation or replacement implementation intention), and to the cue to be specified in the if-part of the implementation intention.

In this final chapter, the main findings of each of the empirical chapters will be briefly summarized before discussing these boundary conditions of implementation intention efficacy more elaborately. In doing so, the behavioral effects as well as the cognitive processes underlying some of these behavioral effects will be discussed. Subsequently, I will discuss the implications and scientific relevance of the present findings. Finally, limitations and suggestions for future research will be provided, before I will present an overall conclusion.

Summary of Findings

In *Chapter 2*, the efficacy of spontaneous plans specifying the avoidance of unwanted behaviors (consuming unhealthy snacks) was tested. In line with earlier findings showing that avoidance food planning is related to more eating concerns and bulimic symptoms (Otis & Pelletier, 2008), results indicated that avoidance planning was related to a heightened consumption of unhealthy snacks. Participants high in controlled motivation were most inclined to use this maladaptive planning strategy, and these participants also reported to make plans with the objective of postponing rather than promoting goal-directed action. Based on these findings, it was argued that measuring - as compared to manipulating - the use of planning strategies limits the ability to draw strong conclusions about their efficacy as there may be substantial variations in the actual content and objectives of these plans. It was therefore decided that future studies should employ experimental designs in which the use of avoidance planning is manipulated in order to more stringently test the assumption that planning to *not* perform a certain behavior is an ineffective strategy for breaking habits.

This research question was taken up in *Chapter 3*, in which the efficacy of implementation intentions that specify not to perform an unwanted habitual behavior, or ‘negation implementation

intentions' ("If situation X arises, then I will *not* perform habitual behavior Y") were experimentally tested. Based on Ironic Process Theory (Wegner, 1994), and literature on the processing of negations (Hasson & Glucksberg, 2006), it was expected that making a negation implementation intention would, ironically, *strengthen* rather than inhibit the habit one aims to break. Indeed, results demonstrated that this type of planning resulted in (a) a heightened cognitive 'situation-habitual response' association compared to an 'intention only' control condition and (b) a higher consumption of unhealthy snacks compared to an intention condition or compared to an alternative type of implementation intention, especially amongst those individuals with strong habits. In the discussion section of this chapter, it was argued that when aiming to break habits, if-then plans linking a critical cue for a habitual behavior to an alternative behavior (i.e., 'replacement implementation intentions') would probably yield better outcomes than negation implementation intentions.

Chapter 4 tested whether replacement implementation intentions ("If situation X arises, then I will perform alternative behavior Z") were effective in reducing unwanted habits. Additionally, this chapter investigated the efficacy of specifying different types of cues in these implementation intentions. It was expected that replacement implementation intentions could be effective in breaking habits, but that their efficacy is contingent on the extent to which participants succeed in specifying the cue that actually causes their habitual behavior (motivational cues). Relevant situational (where/when) as well as motivational (why) cues for unhealthy snacking were identified in a pilot study. Subsequently, it was tested if a specification of motivational cues in the if-part of replacement implementation intentions indeed led to better outcomes than a specification of situational cues. Results showed that replacement implementation intentions were successful in diminishing unhealthy snack intake while increasing healthy snack (fruit) intake. However, effects on unhealthy snack intake were only found when personally relevant reasons (motivational cues) and not situational cues that had arbitrary associations with unhealthy snacking were specified. It was concluded that for more complex behaviors, such as snacking, a distinction needs to be made between situational circumstances (where/when) and motivational cues (why) that may *cause* the unwanted behavior to occur. Only when implementation intentions link a critical cue that causes the unwanted habitual behavior to an alternative behavior, the old habit will be diminished.

Chapter 5 built upon the positive results for replacement implementation intentions by investigating the underlying cognitive effects that make these plans effective in breaking habits. Specifically, the effects of these implementation intentions on the critical cue-habitual response association (the habit), as well the critical cue-alternative response association were examined. Results showed that implementation intentions facilitated the cue-alternative response association and simultaneously inhibited the cue-habitual response association. Combined, these effects eliminated the cognitive advantage of the habitual means in the 'horse race' with the alternative response. However, while the cognitive advantage of the habitual means was removed, it was not immediately replaced by an automatic activation of the alternative means upon cue activation. Therefore, it was concluded that holding strong alternative goal-intentions is essential for these cognitive effects to translate into positive behavioral outcomes.

Replacement implementation intentions were found to be more effective when specifying ‘truly’ critical cues, in the sense that these should address one’s personally most important reason (motivational cue) for eating unhealthily (Chapter 4). Based on this finding, *Chapter 6* tested whether combining replacement implementation intentions with mental contrasting - a strategy proposed to foster identification of critical cues (Oettingen, 2000) - enhances implementation intention efficacy. Results indicated that mental contrasting indeed enhanced the efficacy of implementation intentions by producing clarity about the critical cues that trigger the unwanted habitual behavior. These findings thus indicated that the efficacy of replacement implementation intentions can be augmented by including supplementary strategies that help to identify the cues that trigger the habit.

Boundary Conditions and Underlying Processes

Boundary Condition One: Don’t Negate

Taken together, the present findings indicate that a first boundary condition to implementation intentions’ efficacy in changing existing habits is that these plans need to have an approach rather than an avoidance orientation. That is, plans should be formulated in such a manner that they link a critical cue for the habitual behavior to a wanted alternative behavior (replacement implementation intention) rather than specifying *not* to perform the habitual behavior (negation implementation intention). When plans of the latter type are formulated, these have the ironic effect that the unwanted behavior is actually performed more, instead of less, frequently. An investigation of the cognitive effects of formulating negation plans implied that the negation is processed incorrectly and that this strengthens rather than weakens the habitual association. This explains why formulating negation implementation intentions has such detrimental effects on goal striving.

This failure of correctly processing negation implementation intentions is in line with previous research demonstrating that negations can result in the activation of incongruent associations when a readily accessible opposite schema is absent (Gawronski, Deutsch, Mbirkou, Seibt, & Strack, 2008; Mayo, Schul, & Burnstein, 2004). In other words, as a plan specifying ‘not to eat chocolate in situation X’ does not stipulate an alternative response for *not* eating chocolate, it results in a heightened activation of the ‘situation-chocolate’ association. If this indeed explains the ironic effects, negations followed by an alternative response (e.g., “If I am bored, then instead of chocolate, I will eat an apple”), should be less likely to result in ironic rebound effects. This was precisely what was found in Study 3.3, yielding further evidence for the notion that it is the negation of the cue-habitual response association in the absence of an alternative response that causes negation implementation intentions to be ineffective.

It was also found that the likelihood of negation implementation intentions resulting in ironic rebound effects depends on the strength of the habit (cue-habitual response association) that is being negated. When the habit to be negated was strong, ironic rebound effects were more likely to occur than when the habit was weak. This finding stresses that the stronger this situation-habitual

response association is already represented in memory when forming the negation implementation intention, the more difficult subsequent negation becomes.

Although the finding that negation implementation intentions have detrimental effects on unhealthy eating behavior may seem at odds with results from numerous studies that have demonstrated beneficial effects of implementation intentions on goal striving in general (Gollwitzer & Sheeran, 2006) and eating behavior specifically (for a review see: Adriaanse, De Ridder, & De Wit, & Vinkers, 2009a), this finding is in line with studies indicating that *avoidance* plans tend to be related to negative outcomes (Otis & Pelletier, 2008). Furthermore, our findings concur with suggestions from *Ironic Process Theory* (Wegner, 1994), which states that trying to suppress an unwanted thought is most likely to result in this thought actually becoming more prevalent.

Although negation implementation intentions were not effective, the research presented in this dissertation indicated that another type of implementation intentions *can* yield beneficial results. Specifically, implementation intentions linking a critical cue for a habitual behavior to an alternative behavior (i.e., replacement implementation intentions) were found to be effective in reducing unhealthy snack consumption (Chapter 4). Aside from demonstrating these behavioral effects, results from cognitive measures demonstrated that formulating a replacement implementation intention creates a strong associative link between the critical cue and the alternative response, while simultaneously inhibiting the cue-habitual response link. Combined, these effects cancel out the cognitive advantage of the habitual response over the alternative response once the ‘horse race’ between these two responses is started upon cue activation. As a result, conscious intentions to perform the alternative behavior have a chance to be acted upon again. As throughout this dissertation six studies have been reported that show positive effects (cognitive and behavioral) for replacement implementation intentions, while five studies yielded negative cognitive and behavioral effects for negation implementation intentions, it seems valid to conclude that the format of implementation intentions targeting habits constitutes a boundary condition for their efficacy.

Boundary Condition Two: Getting Right on Cue

Another boundary condition for implementation intention efficacy in breaking habits can be inferred from the observation that, in Chapter 4, replacement implementation intentions only yielded a significant decrease in unhealthy snack consumption when specifying personally relevant motivational cues for unhealthy snacking. When external situational cues that had arbitrary associations with unhealthy snacking were specified, implementation intentions failed to have an effect on unhealthy snack intake. Findings from Chapter 4 thus indicate that to effectively break habits it is essential that implementation intentions specify motivational cues that actually represent one’s personally critical trigger for the unwanted habitual behavior.

A specification of the actual trigger of the unwanted behavior is central to the efficacy of implementation intentions, because an automatic association can only be changed if the plan to replace this association addresses the actual cue-behavior link. When a replacement implementation intention specifies a cue that does not necessarily represent the actual trigger of the unwanted behavior, one merely adds a behavior to participants’ repertoire instead of replacing an old behavior. The observation

that implementation intentions need to specify personally relevant critical cues in order to be most effective is in line with findings by Koestner and colleagues (2006). They showed that implementation intentions are more effective when instructions to formulate plans are administered in an autonomy supportive manner that encourages participants to adapt their plan to their personal obstacles and circumstances.

Implementation intentions have typically been introduced as an effective self-regulatory tool that has the advantage of being quite ‘simple’ and easy to use (Gollwitzer, 1999). However, in view of this second boundary condition, the label ‘simple’ does not really seem to apply anymore when implementation intentions are targeting existing habits. Obviously, implementation intentions to break habits are still simple in the sense that they are only one sentence long and easy to carry out (i.e., behavioral enactment occurs automatically upon encountering the critical cue). However, when aiming to break a habit, *formulating* an effective implementation intention is not that simple. That is, implementation intentions to break habits cannot merely stipulate any cue representing *a* good opportunity to act, as for effectively breaking habits *the* critical cue needs to be specified. As mentioned earlier, for more complex behaviors such as snacking, identification of critical cues can be rather complicated, since the critical cues for these behaviors may more often relate to subjective internal states (e.g., ‘boredom’) rather than to easy-to-identify objective situational cues that are traditionally used in implementation intentions.

Detection of such subjective cues requires a level of introspection into one’s own behavior that, as Nisbett and Wilson (1977) already noted decades ago, most people unfortunately tend to lack. This seems to apply particularly to complex behaviors like eating that tend to be triggered by ‘hot’ cues such as emotions. It has been found, for example, that people in cold, rational states systematically underestimate the effect of these ‘hot’ cues on their behavior (e.g., Loewenstein, 1996; Loewenstein, Nagin, & Paternoster, 1997). Further, there is evidence suggesting that people may even hold false beliefs about the causes of their eating, as research indicated that people have astoundingly inaccurate ideas about the emotional states that trigger their eating behavior (Adriaanse, De Ridder, & Evers, in press; Evers, De Ridder, & Adriaanse, 2009).

Implications

Additional Strategies to Foster Cue Identification

The observation that implementation intentions are no longer ‘simple’ tools for successful goal-striving when targeting habits has some important theoretical implications. For example, in view of the above outlined difficulties associated with identifying critical cues for one’s behavior, it seems crucial to investigate whether there are strategies that may advance the process of cue identification. In Chapter 6, one such strategy was tested, namely mental contrasting (Oettingen, 2000). This strategy was chosen as it had previously been used together with implementation intentions as a complementary self-regulatory strategy (Duckworth, Grant, Loew, Oettingen, & Gollwitzer, 2009; Oettingen, Barry, Guttenberg, & Gollwitzer, 2009; Schramm, Oettingen,

Dahme, & Klinger, in press; Stadler, Oettingen, & Gollwitzer, 2009). Moreover, mental contrasting had been theorized to foster identification of critical cues (Oettingen, Mayer, Thorpe, Janetzke, & Lorenz, 2005; Oettingen, Mayer, & Thorpe, in press; Oettingen, Pak, & Schnetter, 2001; Stadler et al., 2009).

In line with earlier suggestions, findings indicated that mental contrasting promotes clarity about the cues driving the unwanted habit, and that combining implementation intentions with mental contrasting enhanced implementation intention efficacy. This provides further evidence for the notion that the efficacy of implementation intention interventions in diminishing unwanted habits is dependent on whether people can accurately specify critical cues for their habitual behavior. Moreover, these findings highlight the potential of supplementing the use of implementation intentions with strategies that foster identification of critical cues. In the present studies it has been shown that mental contrasting is such a strategy, but other approaches, such as monitoring the reasons for one's eating behavior in a comprehensive diary, or inducing a 'hot' state before asking participants to think about critical cues (De Ridder, Ouweland, Stok, & Aarts, in press) may be useful as well.

Measuring or Manipulating the Use of Planning

The observation that the formation of effective implementation intentions can hardly be called 'simple' when aiming to break habits, also has implications for the designs to be used in implementation intention research. When examining the literature, it becomes apparent that there are two types of approaches to investigate whether planning where, when, and how to act is an effective self-regulatory strategy. Some studies employ experimental designs in which the use of implementation intentions is manipulated (e.g., Armitage, 2004; Orbell, & Sheeran, 2000), whereas in other studies the use of this strategy is measured with questionnaires (e.g., Luszczynska & Cieslak, 2009; Sniehotta, Schwarzer, Scholz, & Schüz, 2005). The present findings suggest that when plans are directed at diminishing habitual behaviors, this latter approach most likely does not yield meaningful results, because knowing the extent to which implementation intentions have been formulated tells us little about the actual format and content of these plans. As implementation intentions need to adhere to certain boundary conditions in order to be effective, information about the format and content of plans is essential. As a result, it seems prudent to specifically instruct participants to formulate plans according to a predefined format and to check the content of their plans when studying the effects of planning on diminishing unwanted habits.

Further indications for the limitations of measuring rather than manipulating the use of implementation intentions come from the observation that people (especially those high in controlled motivation) may have a tendency to use planning as an end in itself rather than as a means to promote goal-directed action (Chapter 2). These individuals seem to make action plans to provide themselves with a feeling of 'working on their goal', without actually intending to act on their plan in the near future. Furthermore, several studies have suggested that people are generally rather poor at making plans (see also De Ridder, Ouweland, et al., in press; De Vet, Oenema, & Brug, 2009; Van Osch, Lechner, Reubsaet, & De Vries, 2008), and one study even suggested that high levels of planning are

not necessarily beneficial and may even be associated with increased eating disorder symptomatology (Adriaanse, De Ridder, & De Wit, 2009d). The following examples of plans, made by individuals scoring high on planning to avoid unhealthy foods, nicely illustrate that scoring high on a planning scale tells us little about the quality or appropriateness of the plan that has been formulated:

“If I can see that I have gained weight, then I will stop eating unhealthily”

“I more or less follow the Sonja Bakker diet a little bit”

“I will not eat anymore and simply resist all temptations!”

Intentions

The present findings, and in particular the findings from Chapter 5, underscore the importance of establishing strong goal intentions in interventions that aim to break habits by means of implementation intentions. This may not seem a novel implication of the present findings, as intention strength is a well-know moderator of implementation intention effects (Sheeran, Webb, & Gollwitzer, 2005). However, the moderating role of intentions has mainly been demonstrated for implementation intentions directed at the initiation of new behaviors. For habitual behaviors, which are equated with automaticity, one may easily forget that when automatic habitual responses are removed, action control again becomes a conscious process. So, although the automatic nature of habits may lead researcher to overlook the importance of goal intentions when aiming to break habits, this is unjustified. Counter-habitual implementation intentions merely do the groundwork by removing the cognitive advantage of the habitual means over the alternative means (Chapter 5). Goal-intentions, however, are still required to make actual use of this groundwork.

In addition to underscoring the importance of having strong goal intentions when aiming to break habits, it should be acknowledged that one’s type of motivation may also influence the efficacy of implementation intentions. In Chapter 2, it was concluded that ineffective plans tend to be made by participants who have strong controlled, as opposed to autonomous, motivation. Throughout the other chapters of this dissertation, little attention has been given to this difference in controlled versus autonomous motivation, because we had turned to manipulating instead of measuring planning. However, it cannot be ruled out that the type of motivation participants hold also influences the efficacy of implementation intentions formed in experimental studies. Indeed, a recent study (Adriaanse, De Ridder, & De Wit, 2009e) provided some evidence that replacement implementation intentions are only effective in translating motivation into actual goal striving when this motivation is autonomous, but not when motivation is controlled. This finding is corroborated by research by Koestner, Otis, Powers, Pelletier and Gagnon (2008), who found similar results and concluded that the level of autonomous motivation should be seen as a “particularly sensitive indicator of the extent to which a goal intention is strongly held” (p. 1225).

Scientific Relevance

Taken together, the present research makes an important theoretical contribution as it taps into a major gap in the literature on habits and implementation intentions. That is, at the time of starting the research described in this dissertation, very few studies had actually demonstrated that in addition to promoting new wanted behaviors, implementation intentions could also be effective in diminishing unwanted habits. Although a demonstration of the efficacy of replacement implementation intentions in breaking habits is thus relatively novel, over the past years, similar findings have been reported by other researchers. In addition to changing recycling habits (Holland et al., 2006), replacement implementation intentions have now been found effective in reducing switch costs in a task-switching paradigm and overcoming the automatic effects of spatial location in a Simon task (Cohen, Bayer, Jaudas, & Gollwitzer, 2008), reducing automatic stereotypical thoughts (Stewart & Payne, 2008), reducing spider fear in spider phobics (Schweiger Gallo & Gollwitzer, 2007; Schweiger Gallo, Keil, McCulloch, Rockstroh, & Gollwitzer, 2009), and reducing prompted disgust reactions (Schweiger Gallo et al., 2009).

Still, the research on replacement implementation intentions presented in this dissertation constitutes one of the few investigations of the *cognitive* effects underlying these positive behavioral outcomes (although it has to be noted that future research is needed to assess both cognitive and behavioral effects in one and the same study and conduct formal mediation analyses in order to truly establish that these cognitive effects underlie our behavioral outcomes). Moreover, the cognitive measures employed in the present studies are relatively unique in their idiosyncratic nature as the primes and targets in the lexical decision tasks were specific to each participant's personal habit and implementation intention (for a similar approach, see Adriaanse, Danner, & Aarts, 2008 and Danner, Aarts, & De Vries, 2009). Furthermore, the present studies are unique in applying replacement implementation intentions to complex behavior, that is, behavior that is generally not triggered by simple context cues, but rather by subjective internal states and feelings. Behaviors such as recycling, or fear reactions to spiders, tend to be triggered by 'simple' contextual cues, like the mere presence of an empty cup or a spider. In contrast, unhealthy snacking is generally related to motivational cues such as boredom or wanting to socialize. This makes identification of critical cues for unhealthy snacking much more difficult than for other more context-dependent types of behaviors, as it requires (retrospective) insight into the reasons for one's unwanted behavior.

Moreover, the present research is innovative in distinguishing between different formats of implementation intentions, and in demonstrating that, even for a highly effective strategy such as formulating implementation intentions, there are certain boundary criteria for its efficacy when it comes to avoiding a habitual response. Additionally, while results demonstrating the efficacy of replacement implementation intentions have been accumulating, the studies investigating negation implementation intentions that are presented in this dissertation are still among the few to have tested this specific type of implementation intention.

Limitations

Some limitations of the presented studies have to be noted. The first and most important limitation concerns the fact that the large majority of effects presented in this dissertation were demonstrated for unhealthy snacking habits only. In discussing the present findings, however, I tend to refer to breaking habits in general, rather than to breaking unhealthy snacking habits specifically. Although it could be argued that such a generalization is not justified, there are no reasons to expect that the effects obtained for unhealthy snacking do not generalize to a broad spectrum of other complex behaviors as well, like, for example, excess alcohol consumption or smoking. In fact, results from the two studies that did examine effects of replacement implementation intentions on another type of behavior, namely drinking (Studies 5.1 & 5.2), did not show any significant differences between these two behaviors.

A second limitation concerns the samples of the present studies. All samples consisted of women only, as a motivation to eat less unhealthily was a prerequisite for participating, and this motivation appeared to be much more prevalent among women. Also, previous research has indicated that men and women differ in their eating behaviors (Nguyen-Rodriguez, Unger, Spruijt-Metz, 2009; Thøgersen-Ntoumani, Ntoumanis, Barkoukis, & Spray, 2009) and respond differently to strategies promoting healthy eating behavior (Renner et al., 2008; Sepúlveda, Carrobbles, Gandarillas, Poveda, & Pastor, 2007). Unfortunately, doubling the sample sizes to assess gender effects was not feasible. Future research is therefore necessary to investigate whether the obtained results will also hold in a male sample.

A further limitation of the samples was that only normal or overweight young females ($18 < \text{BMI} < 30$) were included. There were good reasons for excluding underweight ($\text{BMI} < 18$) and obese ($\text{BMI} > 30$) individuals. Previous research has shown that a BMI below 18 (the WHO even draws the line at a BMI of 18.5) indicates unusual thinness and potentially even the presence of eating pathology such as anorexia nervosa (Yates, Edman, & Aruguete, 2004). Obese people differ from normal weight and overweight people in the way they regulate their eating behavior (e.g., they show poor compensation for food preload compared to normal weight people: Rolls, Harris, Fischman, Foltin, Moran, & Stoner, 1994) and are considered to have a pathological relationship with food (i.e., have increased hedonic responses to palatable food stimuli and/or a stronger motivation to eat: Mela, 2006; Nasser, 2001; Vaidya & Malik, 2008). Moreover, some authors have concluded that treatment and prevention programs that focus on improving self-regulation skills are not effective for obese individuals (Lowe, 2003; Nestle & Jacobson, 2000). This restriction to relatively healthy weight women led some reviewers of the papers presented in this dissertation to question whether participants were actually motivated to change their eating behavior, as - given their healthy weight - this was not a pressing issue for these women. However, participants were all recruited on the basis of being motivated to eat less unhealthily and intentions to reduce unhealthy snack consumption were relatively high across studies.

More in general, the fact that all of our studies included student samples limits our ability to generalize findings to healthy weight women of other ages and with lower education levels. It

may very well be that introspective ability or the ability to formulate accurate implementation intentions is different in other samples. Future research is hence needed to replicate our findings in more representative samples.

The present studies were also limited with regard to the measure used for snack intake. All data regarding snack intake are based on self-reports, which could be seen as problematic as self-reports (in particular of undesirable behaviors such as unhealthy eating) tend to be influenced by memory or self-representation biases (e.g., Muhlheim, Allison, Heshka, & Heymsfield, 1998; Rennie, Coward, & Jebb, 2007). However, when aiming to obtain data for food intake over multiple days, food diaries are presently one of the best options for naturalistic assessment of eating behavior (De Castro, 2000). Moreover, throughout studies, participants were either asked to report snacking behavior several times a day or once a day, which makes a strong influence of memory biases rather unlikely. Additionally, several of the presented studies controlled for variables such as honesty and seriousness of filling in the snack diaries. These variables did not influence any of the results, which strengthens the confidence that findings for snack intake were not affected by self-presentation biases.

A final limitation concerns the short time period for which snacking behavior was reported. In order to reliably conclude that implementation intentions can break habits, (a) the change in behavior needs to be lasting and stable, and (b) the link between past behavior and future behavior needs to be consistently reduced (Holland et al., 2006). As stated in the two chapters reporting positive effects of implementation intentions on snack intake (Chapters 4 and 6), the fact that snacking behavior was only measured for a relatively short period (one week) and that snack intake before forming implementation intentions was not assessed, limits the ability to conclude that habits have been 'broken'. Future research should therefore measure effects over a longer time period and measure snack intake before and after implementation intention formation.

Suggestions for Future Research

Several suggestions for future research have already been made throughout this general discussion. Most importantly, I noted that there is a need to investigate strategies that may help participants to obtain insight into the triggers of their unwanted habits. Such an insight may be helpful and enable individuals to formulate more effective implementation intentions when aiming to break their habits. In the present studies, it was found that mental contrasting helps to foster insight into critical cues, but future research should investigate whether other approaches, such as monitoring, or inducing a 'hot' state (De Ridder, Ouweland, et al., in press) could be effective as well. Moreover, I also argued that the present findings should be replicated in different male and obese samples as well as in non-student samples and that effects on eating behavior should be assessed over a longer period of time. Lastly, I noted that future research should assess cognitive and behavioral effects in one study to more stringently test whether these cognitive effects truly underlie the behavioral effects that were observed. In addition to these suggestions, several other suggestions

for future research can be inferred from the present findings as well. These additional suggestions for future research will be outlined below.

Mental Rehearsal

A first suggestion for future research concerns the role of mental rehearsal of the if-then links. As was noted in Chapter 5, replacement implementation intentions ensure a strong new link between the critical cue and an alternative behavior, while at the same time inhibiting the link between the critical cue and the habitual behavior. In the studies demonstrating this effect, participants were asked to mentally rehearse the situation-response link they specified in the implementation intention. As Webb, Sheeran and Luszczynska (2009) noted, such mental rehearsal may be crucial to replacement implementation intentions' efficacy. Mental rehearsal most likely enhances the depth of encoding of the specified situation-response association, which in turn has been suggested to affect the strength of this association (Prestwich, Lawton, & Conner, 2003; Sheeran, Milne, Webb, & Gollwitzer, 2005), and the corresponding magnitude of implementation intention effects (Sheeran, Milne, et al., 2005; Webb & Sheeran, 2007; 2008). This need for mental rehearsal also makes intuitive sense: If habitual associations that have been created through many instances of repetition could be inhibited by simply writing down an antagonistic if-then plan, then most people would not have difficulties with breaking their bad habits.

In fact, many implementation intention interventions already seem to use some kind of mental rehearsal of the if-then plan (i.e., visualizing oneself acting out the plan, silently repeating the plan several times to oneself, repeating the plan aloud, or writing the plan down several times), in order to facilitate the formation of strong cue-behavior links (e.g., Achtziger, Gollwitzer, & Sheeran, 2008; Gollwitzer & Brandstätter, 1997; Holland et al., 2006; Webb et al., 2009). Yet, empirical evidence demonstrating the impact of mental rehearsal on the strength of cue-behavior links and on corresponding behavior change is limited. It would therefore be interesting to empirically test the effect of mental rehearsal of replacement implementation intentions on the creation of strong antagonistic cue-behavior links and the inhibition of existing cue-behavior links. Additionally, it seems worthwhile to investigate the effects of different types of rehearsal, such as comparing the effects of mentally simulating the enactment of the plan, and oral or written rehearsal of the if-then plan on implementation intention efficacy.

Other Types of Implementation Intentions for Breaking Habits

The fact that negation plans were not effective in breaking habits, but replacement implementation intentions were, seems to suggest that when no suitable alternatives are available to replace the habitual response, implementation intentions should not be employed to break habits. However, the fact that the present studies focused on two types of implementation intentions does not mean that these are the only two types that may be useful for breaking habits. Another type of implementation intention that has only recently been suggested for breaking existing habits is one that, instead of linking a critical cue to an alternative behavior, specifies

to *ignore* the critical cue when it presents itself (“If situation X arises, then I will ignore that situation”: e.g., Schweiger Gallo et al., 2009).

Over the past few years, several studies have shown that these ‘ignore implementation intentions’ are effective in diminishing habitual responses, such as fear reactions to spiders (Schweiger Gallo et al., 2009), cancelling psychotherapy due to unwanted negative affect (Sheeran, Aubrey, & Kellet, 2007), consuming unhealthy foods in response to cravings about tempting foods (Achtziger et al., 2008, Study 1), and poor performance in a tennis match due to negative inner states of irritation and performance anxiety (Achtziger et al., 2008, Study 2). Based on the positive findings that have been obtained for ignore implementation intentions, it certainly seems sensible to compare the efficacy of ignore and replacement implementation intentions in future research. Unlike replacement implementation intentions, the ignore plan does not require the presence of suitable alternatives. This may make ignore implementation intentions particularly useful for reducing habitual behaviors that are difficult to replace, such as smoking or nail biting, or for changing habitual behaviors that generally occur in circumstances where alternatives are not available (e.g., when you want to quit eating unhealthy snacks at your friend’s house who never has anything healthy in the fridge).

Optimal Number of Plans

In the present studies, participants were asked to just make one implementation intention targeting one unhealthy habit. However, it seems probable that for any type of unwanted behavior (e.g., smoking, eating unhealthy snacks) most people will have several critical cues that instigate this behavior. To illustrate, I might have a tendency to eat chocolate when I am bored, but also when I have some of my friends over to chat and socialize. Although substantial effects were already obtained by asking participants to specify just one critical cue and make one implementation intention, asking them to identify multiple cues and make multiple plans may enhance implementation intention efficacy. On the other hand, it has also been suggested that when multiple plans targeting the same critical cue are formulated, these plans are competing and actually result in less optimal outcomes (Gollwitzer, 2006). In view of the apparent difficulties many people already have with formulating a good plan (De Ridder, Ouweland, et al., in press; De Vet et al., 2009; Van Osch et al., 2008), it may be too difficult for people to make multiple good, non-competing implementation intentions. Hence, future research is necessary to determine the optimal number of plans to be formulated.

Conclusion

Taken together, the present findings show that when aiming to quit or diminish eating chocolate, chips, or whatever other type of unhealthy foodstuff you are consuming too much of, it helps to plan ahead. The plan (implementation intention) to be made looks relatively easy - it is only one sentence - and it may also be very easy to carry out, as the behavior specified

in the plan is instigated *automatically* upon encountering the critical situation. However, the hard part seems to be to formulate a *good* simple plan. The plan, or implementation intention, to be formulated should specify an alternative course of action, rather than a negation of the existing habit. In addition, it needs to capture the actual critical cue for the unwanted behavior to be diminished. So, in other words, ‘just’ planning is not enough when trying to break habits. Rather, a *good* plan, using the right format, and focusing on critical situations, is necessary to effectively break habits. Since the quality of plans people make without any help tends to be rather low, formulating high-quality plans may require additional self-regulation strategies. Future research should, in addition to attending to the issues outlined above, henceforth focus on how to help people formulate effective plans, as this may be the key barrier when using implementation intentions to break existing habits.

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Nederlandse Samenvatting

(Dutch Summary)

Van goede voornemens, bijvoorbeeld om meer fruit te eten of om meer te gaan bewegen, komt in de regel weinig terecht. Dit komt onder andere doordat het vertalen van zulke bewuste voornemens in daadwerkelijk gedrag afhankelijk is van beperkt beschikbare bronnen, zoals geheugen, aandacht en zelfcontrole. Omdat deze bronnen beperkt beschikbaar zijn, kunnen er verschillende problemen ontstaan die de uitvoering van goede voornemens in de weg staan. Als we moe of druk bezig zijn, kunnen we onze goede voornemens simpelweg vergeten, of missen we goede kansen om onze voornemens uit te voeren. Een voorbeeld hiervan is wanneer iemand zich heeft voorgenomen om meer fruit te gaan eten, en zich bij een bezoek aan een restaurant niet realiseert dat hij/zij ook een fruitsalade als toetje kan bestellen.

Een strategie die kan helpen om deze problemen te voorkomen is het formuleren van ‘implementatie intenties’. Implementatie intenties zijn simpele, concrete actieplannen die specificeren waar, wanneer en hoe een bepaald voornemen uitgevoerd gaat worden. Deze actieplannen worden geformuleerd volgens een vaste structuur die er als volgt uitziet: “Als situatie x zich voordoet, dan voer ik gedrag y uit!”. Een implementatie intentie om het voornemen om meer fruit te eten te ondersteunen is bijvoorbeeld “Als ik op het werk pauze heb om vier uur, dan loop ik naar de kantine om een appel te halen!”.

Er zijn twee processen die ervoor zorgen dat het maken van zo’n implementatie intentie ertoe bijdraagt dat men beter in staat is om voornemens in daadwerkelijk gedrag om te zetten. Ten eerste wordt er in de implementatie intentie een specifieke situatie (pauze op het werk om vier uur) benoemd, waardoor deze situatie verhoogd toegankelijk wordt in het geheugen. Dit heeft als gevolg dat wanneer men deze situatie tegenkomt, deze eerder wordt herkend als een mogelijkheid om zich naar het goede voornemen te gedragen. Ten tweede wordt met de implementatie intentie de specifieke situatie aan een specifiek doelgericht gedrag gekoppeld en ontstaat er een als–dan link. Deze koppeling zorgt ervoor dat er een *automatische* associatie wordt gecreëerd tussen de situatie en het gedrag. Dit betekent dat er geen bewuste aandacht vereist is om het gedrag uit te voeren wanneer men zich in de specifieke situatie bevindt.

Er zijn al veel studies die hebben laten zien dat implementatie intenties effectief kunnen zijn voor het initiëren van nieuw, gewenst gedrag, zoals meer bewegen, vitamine C tabletten innemen, of het eten van meer fruit. Veel van onze goede voornemens hebben echter betrekking op het *verminderen* van *ongewenste* gewoontes, zoals roken, te veel alcohol drinken of ongezond eetgedrag. Helaas zijn voornemens om zulke bestaande ongewenste gewoontes te verminderen nog weer moeilijker te realiseren dan voornemens die betrekking hebben op het uitvoeren van nieuw gewenst gedrag. Bij het doorbreken van gewoontes komt er namelijk nog een probleem bij.

Gewoontes ontstaan wanneer mensen herhaaldelijk een bepaald gedrag uitvoeren in dezelfde situatie, bijvoorbeeld wanneer iemand tijdens het TV kijken altijd naar een zak chips grijpt. Dit herhaaldelijk samenvallen van de situatie (TV kijken) en het gedrag (chips eten) zorgt ervoor dat er een mentale associatie wordt gecreëerd tussen deze situatie en het gedrag. Naarmate de situatie en het gedrag vaker samenvallen, wordt deze associatie sterker, totdat de situatie *automatisch* het gedrag uitlokt. Dit betekent dat zodra iemand zich in de specifieke situatie bevindt, het gewoontegedrag wordt geactiveerd en uitgevoerd zonder dat hier bewuste aandacht of controle voor nodig is. Dit automatische

karakter van gewoontes heeft als gevolg dat bewuste voornemens weinig tot geen invloed hebben op het uitvoeren, of juist het *niet* uitvoeren, van gewoontegedrag. Dat maakt het extra lastig om ongewenste gewoontes (in vergelijking met het initiëren van nieuw gedrag) te veranderen.

In dit proefschrift is onderzocht of implementatie intenties ook effectief kunnen zijn in het realiseren van voornemens wanneer deze betrekking hebben op het doorbreken van ongewenste gewoontes. In tegenstelling tot de grote hoeveelheid onderzoeksliteratuur over de effectiviteit van implementatie intenties in het initiëren van nieuw, gewenst gedrag, was er bij de start van het onderzoek (september 2006) dat beschreven wordt in dit proefschrift nog weinig bekend over de effectiviteit van implementatie intenties in het doorbreken van gewoontes. Aangezien informatie over de effectiviteit van implementatie intenties in het doorbreken van ongewenste gewoontes een belangrijke toevoeging zou kunnen zijn aan de literatuur over implementatie intenties enerzijds en gewoontedoorbreking anderzijds, staat deze kwestie centraal in dit proefschrift.

Alhoewel het empirisch bewijs beperkt was, waren er bij de start van het huidige onderzoek wel theoretische redenen om aan te nemen dat implementatie intenties gewoontes konden doorbreken. Er werd bijvoorbeeld geopperd dat implementatie intenties en gewoontes dezelfde soort automatische associaties creëren en dat implementatie intenties daarom mogelijk ingezet kunnen worden om de ‘oude’ automatische associatie te verbreken door middel van een nieuwe automatische associatie. Bovendien werd gesuggereerd dat er mogelijk zelfs meerdere soorten implementatie intenties zouden kunnen zijn die het doorbreken van gewoontes ondersteunen. Het eerste type implementatie intentie (vermijdings-implementatie intentie) dat werd voorgesteld voor het doorbreken van bestaande gewoontes, is een plan dat specificeert om *niet het ongewenste gewoontegedrag* uit te voeren wanneer men de kritieke situatie tegenkomt (bijvoorbeeld “Als ik TV aan het kijken ben, dan pak ik geen zak chips!”). Het andere type implementatie intentie (vervangings-implementatie intentie) dat was gesuggereerd voor gewoontedoorbreking specificeert een *alternatief gedrag* dat kan worden uitgevoerd wanneer men in de kritieke situatie is (bijvoorbeeld “Als ik TV aan het kijken ben, dan neem ik een handje rozijnen!”). In het huidige proefschrift zijn beide typen implementatie intenties getest op hun effectiviteit in het doorbreken van ongewenste gewoontes. Daarnaast is gekeken naar het onderliggende mechanisme dat deze twee typen implementatie intenties (in)effectief maakt en naar de randvoorwaarden waarbinnen implementatie intenties effectief zijn in het doorbreken van ongewenste gewoontes.

In dit proefschrift is gekozen om deze onderzoeksvragen te toetsen binnen het domein van eetgedrag, en meer specifiek voor ongezond snackgedrag. De voornaamste reden voor deze keuze is dat het verminderen van ongezond eetgedrag een moeilijk en complex gedrag is waarin mensen vaak falen, ook al zijn ze in hoge mate gemotiveerd. Verder is gekozen voor ongezond snackgedrag als een specificatie van ongezond eetgedrag in het algemeen, omdat specifieke doelen (zoals het verminderen van ongezond snackgedrag) vaak tot betere uitkomsten leiden dan globale doelen (zoals minder ongezond eten). Tenslotte heeft het verminderen van ongezond snackgedrag ook een sterke maatschappelijke relevantie, omdat de consumptie van ongezonde snacks een belangrijke factor is in het ontstaan van overgewicht.

In het eerste empirische hoofdstuk, *Hoofdstuk 2*, is gekeken naar de effectiviteit van spontaan geformuleerde implementatie intenties die specificeren om *geen* ongezonde snacks te eten.

In overeenstemming met eerder onderzoek waaruit bleek dat het spontaan maken van plannen om ongezond eten te vermijden was gerelateerd aan zorgen over eetgedrag en bulimische symptomen, lieten onze resultaten zien dat mensen die dit type plannen maakten juist meer ongezonde snacks gingen eten (gerapporteerd in een 7-daags snackdagboek). Omdat spontaan geformuleerde implementatie intenties met betrekking tot het niet eten van ongezonde snacks averechts bleken te werken, werd ook gekeken welke mensen gebruik maakten van deze strategie. Dat bleken vooral mensen te zijn die extrinsiek gemotiveerd zijn om minder ongezond te eten. Bovendien bleek dat deze mensen dit type plannen maakten om hun gedrag uit te stellen in plaats van direct uit te voeren. Gebaseerd op deze bevindingen werd geconcludeerd dat vermijdings-implementatie intenties waarschijnlijk niet effectief zijn, maar dat additioneel onderzoek nodig is waarin het gebruik van deze strategie experimenteel wordt gemanipuleerd om sterke conclusies te kunnen trekken. Het spontaan rapporteren van wat mensen beschouwen als plannen geeft immers weinig inzicht in de structuur, inhoud en de reden van hun plan.

In *Hoofdstuk 3* werd daarom het gebruik van vermijdings-implementatie intenties ('Als kritieke situatie x zich voordoet, dan voer ik *niet* gewoontegedrag Y uit!') niet gemeten, maar gemanipuleerd in een experiment. Gebaseerd op bevindingen dat het verwerken van ontkenningen, zoals nodig is in het geval van een vermijdings-implementatie intentie, vaak tot problemen leidt en op de observatie dat het proberen te onderdrukken van gedragingen er paradoxaal genoeg juist voor kan zorgen dat dit gedrag vaker wordt uitgevoerd, werd verwacht dat het maken van een vermijdings-implementatie intentie ertoe leidt dat de gewoonte die men probeert te verbreken juist versterkt wordt. Deze ironische effecten werden onderzocht op cognitief niveau (m.b.v. een lexicale decisietaak waarin de 'kritieke situatie - gewoontegedrag associatie' kon worden gemeten) en voor daadwerkelijk eetgedrag (m.b.v. een 7-daags snackdagboek). De resultaten lieten inderdaad zien dat het maken van dit soort plannen er voor zorgde dat (a) de associatie tussen de kritieke situatie en het gewoontegedrag versterkt werd in vergelijking met mensen die alleen gevraagd waren om een algemeen voornemen te vormen en (b) het aantal ongezonde snacks dat werd gegeten juist groter was vergeleken met de groep die alleen een algemeen voornemen of een ander soort plan had gevormd. Dit resultaat gold vooral voor mensen met sterke gewoontes.

In *Hoofdstuk 4* is gekeken of vervangings-implementatie intenties ('Als kritieke situatie x zich voordoet, dan voer ik *alternatief gedrag Z* uit!') mogelijk betere resultaten opleveren voor het doorbreken van gewoontes. Bovendien werd getest of de effectiviteit van deze implementatie intenties afhankelijk was van het type kritieke situatie dat gespecificeerd werd. De helft van de proefpersonen formuleerde alleen het voornemen om minder te snacken, en de andere helft van de proefpersonen werd gevraagd om daar bovenop een vervangings-implementatie intentie te maken. Vervolgens werd alle proefpersonen gevraagd een snackdagboek bij te houden voor een periode van zeven dagen. De resultaten lieten zien dat vervangings-implementatie intenties effectief waren in het vervangen van ongezonde snacks door gezonde snacks, maar alleen wanneer zij de daadwerkelijke onderliggende reden (i.e., de voor hen persoonlijk relevante situatie) voor het gewoontegedrag specificerden.

In *Hoofdstuk 5* werd voortgebouwd op deze resultaten door de onderliggende mechanismen voor de effectiviteit van vervangings-implementatie intenties te onderzoeken. Dit werd gedaan door het effect van vervangings-implementatie intenties op de 'kritieke situatie - gewoontegedrag' (de gewoonte) en de 'kritieke situatie - alternatief gedrag' associaties te onderzoeken met behulp van een lexicale

decisietaak. De resultaten lieten zien dat implementatie intenties de kritieke situatie - alternatief gedrag associatie versterken en tegelijkertijd de kritieke situatie - gewoontegedrag associatie afzwakken. Samen hebben deze twee effecten als resultaat dat het gewoontegedrag niet langer automatisch wordt uitgelokt wanneer de kritieke situatie is geactiveerd. In andere woorden, de implementatie intenties hebben het cognitieve voordeel van het gewoontegedrag in de 'race' met het alternatieve gedrag opgeheven. Hoewel dit cognitieve voordeel van het gewoontegedrag wordt geëlimineerd, wordt dit echter niet meteen vervangen door een automatische activatie van het alternatieve gedrag. Er werd daarom geconcludeerd dat bewuste intenties een belangrijke rol spelen om ervoor te zorgen dat het alternatieve gedrag daadwerkelijk gekozen wordt.

Tenslotte werd in *Hoofdstuk 6* getest of het combineren van vervangings-implementatie intenties met 'mental contrasting', een strategie die kan helpen om de daadwerkelijke kritieke situatie voor het gewoontegedrag te identificeren, de effectiviteit mogelijk kon verhogen. De resultaten lieten zien dat mental contrasting er inderdaad voor zorgt dat proefpersonen meer inzicht kregen in de kritieke situaties die hun gewoontegedrag uitlokken en dat de vervolgens gemaakte implementatie intenties effectiever waren in het doorbreken van ongewenste gewoontes.

In het laatste hoofdstuk van dit proefschrift, *Hoofdstuk 7*, werden de resultaten van de voorgaande hoofdstukken geïntegreerd en bediscussieerd en werden de belangrijkste implicaties, de wetenschappelijke relevantie, beperkingen en suggesties voor toekomstig onderzoek besproken. De conclusie die daaruit volgde was dat een implementatie intentie een effectief middel is om ongewenst eetgedrag te verminderen. De implementatie intentie die gemaakt moet worden ziet er eenvoudig uit, is maar een zin lang, en is ook makkelijk uit te voeren, aangezien de implementatie intentie ertoe bijdraagt dat het beoogde gedrag zonder bewuste inspanning kan worden toegepast. Echter, hoe simpel dit plan op het eerste gezicht ook lijkt, het blijkt lastig te zijn om een *goed* plan te maken, omdat er twee belangrijke randvoorwaarden zijn. Ten eerste moet de implementatie intentie een alternatief gedrag specificeren en niet een vermindering van het bestaande gewoontegedrag. Bovendien moet de implementatie intentie de daadwerkelijke uitlokker van het ongewenste gewoontegedrag specificeren om effectief te zijn in het doorbreken van gewoontes. Met andere woorden, de belangrijkste conclusie van het huidige proefschrift was dat 'gewoon' een plan maken niet genoeg is wanneer men gewoontes wil doorbreken. Een implementatie intentie is alleen effectief in het doorbreken van ongewenste gewoontes wanneer het concreet is, de juiste structuur heeft en een kritieke situatie specificeert.

Aangezien uit onderzoek is gebleken dat de kwaliteit van spontane plannen die mensen maken zonder dat daartoe specifieke instructies worden gegeven erg laag is, werd verder geconcludeerd dat het waarschijnlijk nodig is om additionele zelfregulatie strategieën toe te voegen om ervoor te zorgen dat kwalitatief goede implementatie intenties worden geformuleerd. Toekomstig onderzoek zou zich daarom onder andere moeten richten op de vraag hoe mensen geholpen kunnen worden om effectieve plannen te maken, omdat dit een essentieel obstakel lijkt te zijn in het doorbreken van ongewenste gewoontes door middel van implementatie intenties.

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Marieke Adriaanse,

Utrecht, december 2009

Curriculum Vitae

Marieke Adriaanse was born on March 4, 1983 in Amsterdam, the Netherlands. In 2001 she graduated from secondary school (VWO, Willem Blaeu College in Alkmaar). The same year, she started her undergraduate studies in Social Sciences at University College Utrecht. During her undergraduate studies Marieke Adriaanse also studied for one semester at Griffith University, Australia. After receiving her Bachelor's degree (cum laude) in 2004, she did a pre-Master in Social Psychology and then a Master in Social Psychology at Utrecht University. She obtained her MSc degree (cum laude) in 2006. From September 2006 until December 2009 Marieke Adriaanse worked on her PhD project at the Department of Clinical and Health Psychology at Utrecht University where she was supervised by Prof. Denise de Ridder and Prof. John de Wit. She conducted part of this PhD project at New York University, in collaboration with Prof. Peter Gollwitzer and Prof. Gabriele Oettingen. Besides conducting research, she also worked as a junior teacher in the Psychology Undergraduate Program at Utrecht University for one day a week during the first two years of her PhD project. After defending this dissertation, she will be working as an assistant professor at the Department of Clinical and Health Psychology at Utrecht University.

Publications

International publications

- Adriaanse, M. A.**, De Ridder, D. T. D., & Evers, C. (in press). Emotional Eating: Eating when emotional or emotional about eating? *Psychology and Health*.
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Submitted manuscripts

- Adriaanse, M. A.**, Gollwitzer, P. M., De Ridder, D. T. D., De Wit, J. B. F., & Kroese, F. M. Breaking habits with implementation intentions: A test of underlying processes.
- Adriaanse, M. A.**, van Oosten, J. M. F., De Ridder, D. T. D., De Wit, J. B. F., & Evers, C. Planning what not to eat: Ironic effects of implementation intentions negating unhealthy habits.
- Adriaanse, M. A.**, De Ridder, D. T. D., & De Wit, J. B. F. Planning for the wrong reasons: Individuals with controlled motivation make plans to avoid unhealthy foods that are ineffective.
- Adriaanse, M. A.**, De Ridder, D. T. D., De Wit, J. B. F., & Vinkers, C. D. W. Do implementation intentions promote healthy eating behaviors? A systematic review of the empirical evidence.
- Stok, F. M., De Ridder, D. T. D., **Adriaanse, M. A.**, & De Wit, J. B. F. Looking Cool or Attaining Self-Rule: Different Motives for Autonomy and Their Effects on Unhealthy Snack Purchase.
- Voorneman, I. M. M., De Ridder, D. T. D., & **Adriaanse, M. A.** Don't be SMART, but think about what you desire: The importance of desirability over feasibility information in health goals.
- Van Oosten, J. M. F., **Adriaanse, M. A.**, & De Ridder, D. T. D. 'Dan zal ik vermijding vermijden'. Onderzoek naar de effectiviteit van implementatie intenties gericht op het vermijden van ongezonde snacks.

Selection of Conference Presentations

International presentations

- Adriaanse, M. A., Van Oosten, J. M. F., De Ridder, D. T. D., & De Wit, J. B. F.** (2009, September). Planning what not to eat: Ironic effect of suppression plans. Presentation at the 23rd annual conference of the European Health Psychology Society, Pisa, Italy.
- Adriaanse, M. A., De Ridder, D. T. D., & De Wit, J. B. F.** (2008, July). Breaking unhealthy snacking habits: The effectiveness of mental contrasting and implementation intentions. Invited talk at Forschungskolloquium zur Pädagogischen Psychologie und Motivationspsychologie, Hamburg University, Germany.
- Adriaanse, M. A., De Wit, J. B. F., & De Ridder, D. T. D.** (2008, June). Where do I snack or why do I snack? The efficacy of specifying situational and motivational cues in implementation intentions aimed at breaking snacking habits. Presentation at the 15th general meeting of the European Association of Experimental Social Psychology (EAESP), Opatija, Croatia.
- Adriaanse, M. A., De Ridder, D. T. D., & De Wit, J. B. F.** (2008, May). Using mental contrasting and implementation intentions as a combined strategy to diminish unhealthy snacking. Presentation at the 7th Conference on Psychology and Health, Lunteren, The Netherlands.
- Adriaanse, M. A., De Ridder, D. T. D., & De Wit, J. B. F.** (2008, January). Breaking unhealthy eating habits by means of implementation intentions (and maybe also mental contrasting). Presentation at Motivation Lab, NYU, New York City, USA.
- Adriaanse, M. A., De Ridder, D. T. D., De Wit, J. B. F. & Evers, C.** (2007, October). Emotional Eating: A reflection of the tendency to eat when emotional or an indicator of concerns about eating? Presentation at the Psychology and Health Post Conference of Tilburg's 4th international conference on The (Non)Expression of Emotions in Health and Disease, Utrecht, The Netherlands.
- Adriaanse, M. A., De Wit, J. B. F., & De Ridder, D. T. D.** (2007, August). Pursuing complex health goals: Meaningful cues for action. Presentation at the 21st annual conference of the European Health Psychology Society, Maastricht, The Netherlands.
- Adriaanse, M. A., De Wit, J. B. F., & De Ridder, D. T. D.** (2007, July). Planning with a motive in mind. Presentation at Summer School on Self-Regulation, Konstanz, Germany. Organized by the University of Konstanz, Research Group "Limits of Intentionality".

National presentations

- Adriaanse, M. A., De Ridder, D. T. D., & De Wit, J. B. F.** (2008, November). (Hoe) kunnen implementatie intenties ongezone snack gewoontes doorbreken? Presentation at the Annual Knowledge Network Day of the Netherlands Nutrition Centre. Utrecht, The Netherlands.
- Adriaanse, M. A., De Ridder, D. T. D., & De Wit, J. B. F.** (2009, February). (Hoe) kunnen ongezone snack gewoontes doorbroken worden? Presentation at the Netherlands Nutrition Centre. The Hague, The Netherlands.
- Adriaanse, M. A., Danner, U. N., & Aarts, H.** (2007, December). De positieve gevolgen van negatief affect: Het cognitief doorbreken van gewoontes met behulp van negatief affect. Presentation at the annual Dutch conference of the Associatie van Sociaal-psychologische Onderzoekers (ASPO). Wageningen, The Netherlands.

