Facilitating food-related planning

Applying metacognition, cue-monitoring, and implementation intentions

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Planning voor eetgedrag faciliteren

De toepassing van metacognitie, cue-monitoren en implementatie intenties
(met een samenvatting in het Nederlands)

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Table of Contents

1

General introduction

"I am very motivated to eat more healthily. But still I don't do it. It is weird, because I know what I am doing and that it is not good. I tried many different things... But I have never been able to change my habit."

This quote from a female participant in a pilot study preceding this dissertation describes the typical struggle of people who are motivated to eat more healthily but are unable to achieve this goal. Many people are occupied with their food consumption and aim to adopt a healthier diet (De Ridder, Adriaanse, Evers, & Verhoeven, 2014). Despite their strong motivation, as well as the growing availability of diet books, guidelines from lifestyle coaches, and attention for dieting in the media, most people are unable to enact their dietary intentions (Kamunyika et al., 2000).

Fortunately, although changing unwanted behavior is difficult, it is not impossible. A promising tool to help people attain their goals is the use of so-called 'implementation intentions'. Implementation intentions are simple if-then plans that specify when and how one's good intention will be put into practice, such as 'If I am watching TV, then I will take an apple!' in the case of intending to eat more healthily (Gollwitzer, 1999). The efficacy of this behavior change tool has been demonstrated convincingly in various domains (e.g., Gollwitzer & Sheeran, 2006), including the promotion of a healthy diet (Adriaanse, Vinkers, De Ridder, Hox, & De Wit, 2011). The compelling findings obtained in implementation intention research combined with the practical applicability of these simple plans make implementation intentions a promising venue for health behavior change interventions. Nonetheless, so far, research has not been able to convincingly illustrate its potential in applied settings. Typically, implementation intentions' efficacy is demonstrated using controlled lab studies. Yet, employing implementation intentions in real life settings involves different challenges and considerations that needs to be addressed before this tool can be generalized to such contexts. The research presented in this dissertation aims to investigate barriers and solutions to effectively applying implementation intentions as a behavior change strategy in practice, specifically when targeting unhealthy eating behavior.

Unhealthy snacking: focusing on small but stable changes

When aiming at changing unhealthy eating practices, unhealthy snack consumption is a particularly relevant target behavior. Unhealthy snacks are the foods consumed in addition to the three main meals (i.e., breakfast, lunch, and dinner) that contain high amounts of unhealthy ingredients such as sugar, salt, or fat, and are high in energy density (Dutch Nutrition Centre, 2011). People are constantly confronted with the availability of unhealthy snacks, virtually any place and anytime, limiting the monitoring of their unhealthy food consumption and jeopardizing their ability to control this behavior (Wansink & Sobal, 2002). Additionally, while people have increased the number of unhealthy snacks they consume on a daily basis, portion sizes of unhealthy snacks continue to expand. As a

result, the contribution of unhealthy snacks to the total energy intake and to weight gain is greater than ever (Drummond, Crombie, & Kirk, 1996; Forslund, Torgerson, Sjostrom, & Lindroos, 2005; Piernas & Popkin, 2010). Changing unhealthy snack consumption is thus a pressing issue.

Globally, prevalence rates from 2008 show that 35% of adults were overweight and 11% were obese (World Health Organization [WHO], 2014), which is related to severe lifestyle related diseases, including diabetes type 2, vascular diseases, and different types of cancer (WHO, 2014). The worldwide prevalence of obesity can largely be reduced by surprisingly small changes in the energy balance, that is, the intake of kilocalories in relation to its expenditure. On a population level, a daily reduction of merely 100 kilocalories is sufficient to prevent weight gain in the majority of adults (Hill, Wyatt, Reed, & Peters, 2003). To illustrate, this equals only two hands of crisps you consume while watching television or those two small cookies accompanying your cafe latte. Hence, aiming to change unhealthy snacking behavior is a clinically relevant matter which, for a large group of people, requires small but stable modifications in daily life. This thesis therefore specifically focuses on using implementation intentions to reduce unhealthy snacking behavior. Below, we further elaborate on important theories and current insights that form the foundations of the aims of the present dissertation.

The chains of habit

It is a well-documented finding that people have a hard time acting upon their good intentions; an observation which is referred to as the intention-behavior gap (Sheeran, 2002; Webb & Sheeran, 2006). It has been found that a large change in goal intentions evokes only a small to medium effect in behavior change (Webb & Sheeran, 2006). One explanation for this intention-behavior gap is that most of our daily behaviors are habitual. Such habitual behaviors include health behaviors like exercising (De Bruijn & Rhodes, 2011) and fruit and vegetable consumption (De Bruijn, Kremers, De Vet, De Nooijer, Van Mechelen, & Brug, 2007). Also with regard to unhealthy snacking behavior, increasing evidence points to the role of habits (Van ’t Riet, Sijtsema, Dagevos, & De Bruijn, 2011; Verplanken, 2006). Habits develop when a specific act is performed repeatedly under stable conditions in order to attain a particular goal. Ultimately, a mental association will be created between the situation, or a critical cue in this context, and the behavioral response (Aarts & Dijkserhuis, 2000; Ouellette & Wood, 1998; Verplanken & Aarts, 1999). Consequently, upon encountering this cue, the urge to perform the behavior is triggered automatically (Gardner, 2014). To illustrate, if you are watching television and you reach to the bowl of crisps in order to achieve the goal of relaxing a little, eventually, merely being in the situation of watching TV will automatically prompt you to grab a handful of crisps.

Automatic behaviors are characterized by four features, the so-called 'four horsemen of automaticity' (Bargh, 1994): they are performed efficiently, unintentionally, out-

side of awareness, and with limited controllability. Most of our behaviors are automatic, which is beneficial, and even necessary, as we do not have to think about every behavior that we perform on a daily basis. In this way, our limited mental capacity is conserved for other things that require attention (Wood, Quinn, & Kashy, 2002). However, these very same characteristics make it difficult to change the behavior if it becomes unwanted, for example, if you decide to cut down on your crisps consumption. Because of its deeply-rooted automatic cue-response association, changing unwanted habits is not easily accomplished. While the majority of interventions aim to inform and educate people about what constitutes a healthy diet and motivate them to eat more healthily, strong automatic behaviors are performed regardless of one's good intentions (Verplanken, Aarts, van Knippenberg, & Moonen, 1998). Although motivation is an essential pre-condition (Ajzen, 1985) it is insufficient to accomplishing actual behavior change when targeting habitual behaviors. As a result, interventions oftentimes have disappointing effects because they do not tackle the underlying automaticity (Verplanken & Wood, 2006). In the present dissertation, the role of habits in unhealthy snacking is therefore further explored and taken as a point of departure to design effective ways for behavior change.

Changing habits with implementation intentions

One of the most promising strategies for habitual behavior change is the use of implementation intentions (Adriaanse, Vinkers et al., 2011; Gollwitzer, 1999; Gollwitzer & Sheeran, 2006). The concept of implementation intentions was introduced over two decades ago as a facilitating tool for peoples' goal attainment (Gollwitzer, 1993). In contrast to goal intentions which only describe a desired end-state ('I intend to achieve X!'), implementation intentions specify when and how the behavior necessary to obtain this goal is performed. Implementation intentions have the format of detailed 'if-then' plans specifying a critical cue while linking this to a goal-directed response ('If situation Y arises, then I will perform goal directed behavior Z!'). For example, someone who intends to eat more fruits can formulate the plan 'If I am having lunch, then I will eat an apple!'.

Two essential pathways allegedly form the basis of implementation intentions' effectiveness (Webb & Sheeran, 2007). First, they facilitate the detection of the critical situation identified in the 'if' part of the plan as a good opportunity to perform the goal-directed behavior. Second, implementation intentions create a strong cue-response link, which enables the specified response to be induced automatically. As a result, the behavior is initiated more effectively, performed more efficiently, and shielded from unwanted influences that might distract someone from goal pursuit (Gollwitzer & Sheeran, 2006). Thus, while habits consist of strong cue-response links resulting from rewarding repetition in service of a particular goal, implementation intentions create a similar mental association through the process of deliberative planning, thereby mimicking the strong effects of habits and effectively inducing the desired behavior.

A large body of literature demonstrates the effectiveness of implementation intentions in goal pursuit. Besides promoting new desirable behaviors like exercising (Bélanger-Gravel, Godin, & Amireault, 2013) and fruit and vegetable consumption (Adriaanse, Vinkers et al., 2011; Wiedemann, Lippke, & Schwarzer, 2011), implementation intentions can also be employed to alter existing habitual behavior. Breaking existing habits is more complicated than facilitating the execution of new behaviors, however, as it does not only require the development of a new cue-response link, but also overcoming an already established mental association. When implementation intentions are utilized to alter existing habits, they typically specify the relevant critical cue that triggers the habitual response in the 'if'-part of the plan while linking this to a desirable goal-directed alternative in the 'then'-part. For example, if someone aims to change their unhealthy snacking habit when watching TV, the plan could be: 'If I am watching TV, then I will take an apple!'.

As a result of making an implementation intention, the mental association between the cue and the unwanted response becomes inhibited while a new association is created with the goal-directed action (Adriaanse, Gollwitzer, De Ridder, De Wit, & Kroese, 2011). In this way, implementation intentions are effective in breaking existing habitual behaviors, such as changing recycling behavior (Holland, Aarts, & Langedam, 2004) and smoking (Webb, Sheeran, & Luszscynska, 2009). Also with regard to changing unhealthy (snack) food intake, the evidence is compelling (Adriaanse, De Ridder, & De Wit., 2009; Adriaanse, Gollwitzer et al., 2011; Verplanken & Faes, 1999). A meta-analysis on the effectiveness of implementation intentions and eating behaviors (Adriaanse, Vinkers et al., 2011) indicated a small to medium effect size for diminishing unhealthy food intake (Cohen's d = .29), reducing caloric intake with approximately 90–125 kilocalories per day (Adriaanse et al., 2009; Adriaanse, Oettingen, Gollwitzer, Hennes, De Ridder, & De Wit, 2010; Sullivan & Rothman, 2008). The efficacy of implementation intentions in facilitating goal pursuit is thus convincingly demonstrated in the current literature.

Implementation intention interventions: not as easy as pie

Next to its efficacy in facilitating behavior change (e.g., Adriaanse, Vinkers et al., 2011; Bélanger-Gravel et al., 2013; Gollwitzer & Sheeran, 2006), implementation intentions also seem very suitable to include in large scale health behavior change interventions (Hagger & Luszscynska, 2014). Implementation intentions have a simple format (a single if-then sentence), are easy to use, can be distributed among large population groups without difficulty, and are cheap to implement. Nonetheless, employing such plans in practical settings is not as easy as it may appear. So far, the majority of research has been restricted to laboratory studies or selective student samples rather than community samples in the context of everyday life. Studies that did target applied settings yielded mixed results, with, for example, studies that did replicate the promising findings for weight reduction among overweight and obese members of a weight loss program (Luszczynska, Sobczyk, & Abraham, 2007), while others did not

demonstrate beneficial effects among a large community sample (De Vet, Oenema, Sheeran, & Brug, 2009). Thus, although if-then plans increasingly receive attention as a tool for behavior change interventions, there is limited evidence that they can be successfully applied in real world settings. The lack of implementation intention success outside the lab suggests that implementation intentions face different challenges when employed in real life, especially when they are utilized for breaking complex habits such as unhealthy snacking habits.

To illustrate, one concern is that if-then plans must be tailored to the right critical cue in order to truly target peoples' personal triggers for their unhealthy snacking behavior. Yet, formulating good quality implementation intentions is not straightforward and people oftentimes experience difficulties when personalizing plans. Additionally, while behaviors targeted in lab studies oftentimes focus on a single cue-response action, unhealthy snacking is a multifaceted behavior that is triggered by various cues. Adopting a single if-then plan is therefore expected to be insufficient to engender a meaningful change in unhealthy snack intake. Also, unhealthy snacking situations are subject to changes over time and the effectiveness of implementation intentions may be limited by the inflexibility of if-then plans as merely one specific cue-response association is targeted. The present dissertation sets out to explore the implications of such boundary conditions for applying implementation intentions in everyday life and to investigate ways to effectively employ implementation intentions for changing unhealthy snacking habits.

A cue-monitoring plus planning intervention

As described above, a first challenge is that formulating a good plan is rather complicated. When using implementation intentions to change existing habitual behaviors, the plan should target the right personally relevant trigger of the unwanted behavior in order to truly tackle the habitual cue-response association (Adriaanse et al., 2009). However, people have limited insight into the reasons for their behavior in general (Nisbett & Wilson, 1977), which is especially problematic for habitual behaviors because of their automatic nature (Bargh, 1994). Also, people oftentimes experience difficulties when formulating ‘if-then’ plans in a specific and precise manner. Yet, as this is essential for successful goal pursuit, poor quality of implementation intentions can seriously jeopardize its effectiveness (De Vet, Gebhardt, Sinnige, Van Puffelen, Van Lettow, & De Wit, 2011).

In order to improve the effectiveness of implementation intentions as a behavior change technique suitable for a wide audience, this tool could benefit from a supplementary strategy that enhances insight into one’s personal triggers for unhealthy snacking. A meta-analysis examining various behavior change strategies demonstrated that the effectiveness of intervention techniques is significantly improved when it is combined with one particular strategy: monitoring (Michie, Abraham, Whittington, McAteer, & Gupta, 2009). Monitoring is a key element in self-regulation and regards the reflection upon one’s progress towards one’s goal (Carver & Scheier, 1998). Monitoring can take different forms,

such as keeping a food-diary or checking weight, and is in itself already an effective strategy for weight loss (Burke, Wang, & Sevick, 2011). To improve the effectiveness of implementation intentions, we propose that this tool may benefit from a specific form of monitoring, labeled cue-monitoring. Cue-monitoring involves reflecting upon one's unhealthy snacking behavior as well as its critical triggers. It is therefore relevant for improving cue-identification to facilitate implementation intention formation. Additionally, cue-monitoring can be done without professional guidance, which makes this strategy suitable for large scale health interventions. Nonetheless, monitoring strategies in itself are likely to be mostly effective on the short term, as the automatic cue-response associations inducing the unwanted behavior remain and no new habitual behaviors are developed. Therefore, combining cue-monitoring and implementation intentions benefits from the best of both tools.

Dealing with multiple snacking situations

A second issue relates to the observation that most behaviors in daily life, including unhealthy snacking, are performed in multiple situations. While implementation intentions' efficacy largely relies on a specific cue-response link, this also means that merely one situation is targeted at a time. While many behaviors in lab studies regard the performance of a single cue-response action, unhealthy snacking in real life is a multifaceted behavior induced in various situations. To illustrate, unhealthy snacking can be triggered when watching TV, but also when feeling bored, or attending a birthday party, to name just a few. However, most research has focused solely on forming a single plan targeting one critical cue. A solution would be to formulate multiple plans, a plan for each cue that elicits unhealthy snacking. On the one hand, it seems reasonable that making more plans creates more opportunities to enact one's intention. On the other hand, it could be expected that when multiple if-then associations are created at once, each mental link develops less strongly. For that reason it has been suggested that the effect of implementation intentions might become 'diluted' among the different plans (Webb, 2006). As a consequence of such weakened mental links, implementation intentions success could be endangered. In the present thesis, it is therefore examined how the formation of multiple plans affects implementation intentions' effectiveness.

Implementation intentions as a metacognitive strategy

Besides the observation that multiple cues for unhealthy snacking behavior exist, the cues inducing the unwanted habit are not static. People should therefore be able to accommodate changes in personal needs for goal striving. To illustrate, it is likely that over time the triggers for unhealthy snacking change. Or, perhaps, after having successfully changed the behavior in one situation, other cues might become relevant to be targeted with an implementation intention. Furthermore, it is possible that after a plan is formulated, people find out that the alternative response in the 'then' part is implausible (for

example, you never have any apples around when watching TV). To deal with such issues, it might be beneficial to teach people how to use and adjust implementation intentions themselves, rather than merely instructing them to fill out a pre-specified if-then format while being supervised by a skilled experimenter. Therefore, in the present dissertation, it is explored whether implementation intentions can be taught as a *metacognitive strategy*. This strategy comprises three essential steps: *planning* to change unhealthy snacking behavior by means of an if-then plan, *monitoring* one's snacking behavior and its triggers, and *evaluating* the relevance and usefulness of one's present plan in light of their current snacking behavior and its triggers, followed by returning to the planning step. In this way, people are taught to independently employ this strategy by learning how to adjust their personal plans to changing needs for every day goal striving.

The present dissertation: Aims and chapter overview

Despite decades of implementation intention research it is still a challenge to successfully use this strategy in behavior change interventions. When aiming to change unhealthy snacking behavior in everyday life, different considerations for using implementation intentions are identified and new fundamental questions are raised that have not been examined previously. This dissertation aims to address these vital issues by applying insights from health, social, and educational psychology. Strategies such as metacognition, cue-monitoring, and implementation intentions are combined in order to push the field forward towards an approach that successfully employs implementation intentions tackling unhealthy snacking habits in practice. The studies described in this thesis are characterized by a diversity of research methods as we conducted studies in lab settings, using cognitive and behavioral measures, as well as in applied context including community samples, employing prospective studies and experimental designs. The present dissertation contains five empirical chapters. These chapters may also be read independently and might therefore consist of overlap to some extent.

Specifically, in **Chapter 2** the importance of targeting the habitual nature of unhealthy snacking in health behavior change interventions is investigated. Among a large and representative group from the general population, the role of habits in explaining unhealthy snacking behavior is examined. Unhealthy snacking habits are contrasted with other psychological constructs such as conscious goal intentions to eat healthily and the extent to which someone is sensitive to food cues in the environment. It is expected that unhealthy snacking behavior is predominantly predicted by habit strength, emphasizing the need for interventions aimed at changing habitual behaviors, e.g., using implementation intentions.

Chapter 3 is designed to systematically examine the reasons that people report for consuming unhealthy snacks. The reasons for unhealthy snacking identified in this study could subsequently be used to facilitate the specification of relevant cues (possible 'ifs') in the cue-monitoring phase for the cue-monitoring plus planning intervention. This study is

also conducted among a large and representative community sample in order to closely match the experiences of the target population.

To facilitate the identification of the right personally relevant reason for unhealthy snacking to be targeted in one's if-then plan, implementation intention formation is preceded by a cue-monitoring phase in **Chapter 4**. Using a cue-monitoring diary, people report on their critical cues for unhealthy snacking by choosing from a list of possible triggers for this behavior. This chapter provides the first examination of whether a cue-monitoring phase has additional value for implementation intentions' effectiveness.

While if-then plans are characterized by its strong cue-response link targeting one specific situation, complex behaviors such as unhealthy snacking are usually induced in multiple situations. In **Chapter 5** the effects of forming multiple implementation intentions at once is assessed using a behavioral and a laboratory study. While forming multiple plans at once might provide more opportunities to enact one's dietary intention, it is expected to lead to weaker cue-response associations. It is therefore hypothesized that making multiple plans is less effective for reducing unhealthy snacking than making a single strong cue-response association.

Making a single if-then plan does, however, not help people in tackling their unhealthy snacking in various situations and does not take changes in one's personal needs for reducing this behavior into account. To overcome the inflexibility of if-then plans it is tested whether implementation intentions can be taught as a metacognitive strategy in **Chapter 6**. In doing so, participants from a community sample learn how to apply implementation intentions themselves using three steps: planning, monitoring, and evaluating. It is predicted that the metacognitive strategy is most effective in diminishing unhealthy snack consumption over relatively longer time periods (two months) while only cue-monitoring or regular implementation intentions would not create prolonged effects.

Finally, in **Chapter 7** the findings and implications of the empirical chapters are summarized and discussed. It is outlined which psychological factors underlie unhealthy snacking behavior and what reasons are reported for unhealthy snack consumption. We describe whether adding a cue-monitoring strategy benefits implementation intentions' effectiveness, illustrate the effects of forming multiple plans simultaneously, and present the possibilities of teaching implementation intentions as a metacognitive strategy. Lastly, directions and opportunities for future research are described.

2 |

The power of habits: Unhealthy snacking behavior is primarily predicted by habit strength

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Abstract

Although increasing evidence shows the importance of habits in explaining health behavior, many studies still rely solely on predictors that emphasize the role of conscious intentions. The present study was designed to test the importance of habit strength in explaining unhealthy snacking behavior in a large representative community sample (*N* = 1103). To test our hypothesis that habits are crucial when explaining unhealthy snacking behavior, their role was compared to the 'Power of Food', a related construct that addresses sensitivity to food cues in the environment. Moreover, the relation between Power of Food and unhealthy snacking habits was assessed. A prospective design was used to determine the impact of habits in relation to intention, Power of Food and a number of demographic variables. One month after filling out the questionnaire, including measures of habit strength and Power of Food, participants reported their unhealthy snacking behavior by means of a seven day snack diary. Results showed that habit strength was the most important predictor, outperforming all other variables in explaining unhealthy snack intake. The findings demonstrate that snacking habits provide a unique contribution in explaining unhealthy snacking behavior, stressing the importance of addressing habit strength in further research and interventions concerning unhealthy snacking behavior.

Introduction

Many people intend to change their unhealthy behaviors, like their bad habit of consuming high caloric foods. For most of them, however, it seems little is needed (for example, only the smell of fresh baked cookies) to forget about their good intentions and to maintain their old behavior. Nevertheless, many theories in health psychology identify goal-intentions (e.g., "I intend to eat more healthily!") as the key predictor of behavior change (e.g., Ajzen, 1991; Carver & Scheier, 1998), thereby assuming that one's behavior is a result of conscious goals and plans, rather than of situational influences such as the sight or smell of tempting food. In recent years, however, it has been demonstrated convincingly that a large part of our behavior occurs automatically, without conscious processes being involved (e.g., Aarts, Verplanken, & Van Knippenberg, 1998).

Despite compelling evidence for the importance of automaticity in health behavior, many studies still rely solely on conscious predictors and fail to include measures of automaticity, such as habit strength, when aiming to predict changes in health behavior. In the present study we aim to address this gap in the literature by specifically focusing on the role of habits in predicting unhealthy snacking behavior. Examining unhealthy snacking behavior is of particular interest as many people have the intention to eat fewer unhealthy snacks, but often fail to do so (Kamunyika et al., 2000). We propose that habits (Verplanken, 2006) play a particularly large role in unhealthy snacking behavior, which may explain why so many people fail to act upon their good intentions and continue to consume tempting but unhealthy snacks.

Habits and health behavior

Habits develop when a specific action to achieve a particular goal is performed repeatedly under the same situational condition, thereby creating a mental association between the goal and the situation triggering the behavioral response (Aarts & Dijksterhuis, 2000; Orbell & Verplanken, 2010; Ouellette & Wood, 1998). The more frequently such a particular behavior is performed, the more likely that it becomes habitual (Verplanken & Orbell, 2003). Habits are, however, more than just repeated sequences of action (Orbell & Verplanken, 2010). For one, habits are performed in a stable context, as a response to a particular situation or external cue (Ouellette & Wood, 1998). In addition, and arguably most importantly, habits are performed *automatically* (Aarts & Dijksterhuis, 2000; Orbell & Verplanken, 2010; Verplanken & Aarts, 1999; Verplanken & Orbell, 2003). The notion that habits are automatic entails that they are performed efficiently, effortlessly, unconsciously, unintentionally and with little controllability (Aarts, Verplanken, & Van Knippenberg, 1998; Bargh, 1994); and precisely these characteristics make habits hard to change when they become unwanted.

In recent years, the importance of habits in predicting the performance of health behaviors has been acknowledged in studies investigating a variety of behaviors such as

fruit intake (De Bruijn, 2010; De Bruijn, Kremers, De Vet, De Nooijer, Van Mechelen, & Brug, 2007) and exercising (De Bruijn & Rhodes, 2010). Remarkably, however, the role of habit strength has not been investigated frequently in the context of unhealthy eating behaviors such as fat intake or snack consumption. To date, only one study showed the importance of habits in fat intake (De Bruijn, Kroeze, Oenema, & Brug, 2008), and one study demonstrated that habits predicted unhealthy snacking above and beyond constructs derived from the Theory of Planned Behavior (like intention and attitude) (Verplanken, 2006). Importantly, both studies included restricted samples like students (Verplanken, 2006), or participants of a nutrition education intervention (De Bruijn et al., 2008). Despite their importance, the role of habits in unhealthy snacking behavior has as of yet not been examined in a community sample.

The lack of studies investigating the role of habits in predicting unhealthy food intake, particularly in community samples, is in line with the observation that the large majority of interventions that aim to decrease unhealthy food intake do so by educating people about healthy eating and by motivating them to eat more healthily (Korinth, Schiess, & Westenhoefer, 2009). Yet, if the targeted behavior is performed habitually, better knowledge and increased motivation are insufficient to achieve behavior change. In other words, current interventions that focus on traditional predictors of health behavior, such as attitudes and intentions, are unlikely to be effective when unhealthy snacking behavior is largely habitual (Verplanken & Wood, 2006; Wansink, 2010). More insight into the role of habits in unhealthy snacking behavior in a community sample would therefore not only serve to explain why the effects of many existing interventions are rather disappointing (Wansink, 2010), but would also push the field forward with regard to designing more effective interventions in the area of healthy eating and weight management.

In the present study, we seek to gain more insight into the role of habits in predicting unhealthy food intake. Specifically, we aim to investigate whether habits provide an important and unique contribution in explaining unhealthy snacking behavior. To that purpose we will employ the most well-known and frequently used measure of habit strength, the Self-Reported Habit Index (SRHI; Verplanken & Orbell, 2003) which addresses the extent to which a behavior is performed frequently, automatically, and as an expression of one's identity. To investigate the relative importance of unhealthy snacking habits, we will also include another important, and conceptually related predictor of unhealthy food intake - the Power of Food (Lowe et al., 2009).

The Power of Food is a construct that taps into an individual's psychological sensitivity to the food-abundant environment (Lowe et al., 2009). The current widespread availability of highly palatable but unhealthy snacks leads people in constant temptation of consuming food. However, not all people react to this environment in the same way. As the reinforcing value of food varies among individuals (Saelens & Epstein, 1996), some people may be more responsive to food temptations than others (Lowe et al., 2009). This responsiveness is addressed in the Power of Food Scale (PFS). Specifically, the PFS

measures the appetitive drive to consume hedonic foods, induced by the sensitivity to cues in the food environment (Lowe et al., 2009). The Power of Food construct explicitly involves the allure of unhealthy but highly palatable foods, rather than food in general (Lowe et al., 2009). Moreover, the PFS exclusively refers to an environment where people have abundant access to food, and specifically addresses the sensitivity to the hedonic aspects of this food environment (Lowe & Butryn, 2007). The PFS employs questions like: "If I see or smell a food I like, I get a powerful urge to have some", to measure this sensitivity (Lowe et al., 2009). The PFS thus not measures actual intake of unhealthy yet hedonic foods, but rather taps into people's sensitivity to food cues in today's food-abundant environment and may thus serve as a predictor of unhealthy food intake (Lowe et al., 2009). Indeed, recent evidence shows the importance of the Power of Food in predicting unhealthy eating behavior (e.g., Cappelleri et al., 2009; Forman, Hoffman, McGrath, Herbert, Brandsma, & Lowe, 2007).

Although the Power of Food differs substantially from habits as it taps into a pre-condition for consuming unhealthy foods (i.e., the sensitivity to food cues), whereas habits tap into characteristics of the actual behavior (i.e., repetitiveness and automaticity; Verplanken & Orbell, 2003), there is also considerable conceptual overlap between the two constructs. Specifically, in addition to being repetitive and automatic, another characteristic of habits is that they are performed in stable contexts (e.g., Wood & Neal 2007; Wood, Tam, & Guerrero Witt, 2005). Although context stability is not addressed directly by the SRHI as this is a feature of the conditions under which habits are created and performed, rather than of the habitual behavior itself, still, habits develop only in case the behavior is performed repetitively *in a stable context*. In other words, habits are created only when a behavior is frequently triggered by the same food related external or internal cues. The Power of Food, addressing the sensitivity to these food related cues, could thus very well be strongly related to the degree to which the eating behavior is habitual. Assuming that the Power of Food and unhealthy snacking habits have sufficient discriminant validity, it could even be expected that habit strength could potentially mediate the relation between the Power of Food and unhealthy snacking behavior, as it makes sense to assume that those individuals who are more sensitive to food related cues in the environment may be more likely to create strong unhealthy eating habits, which in turn predicts more unhealthy snacking behavior. In the present study, therefore, both the habit to eat unhealthy snacks and the Power of Food are considered as predictors of unhealthy snack intake in order to investigate their (unique) predictive validity in explaining unhealthy snacking behavior as well as their underlying relation.

Present study

The present prospective study was designed to test our hypothesis that habit strength is the most important predictor of unhealthy snacking behavior in a large community sample. The objective of the present study is two-fold. First, we aim to examine

whether habit strength is a unique predictor of unhealthy snacking behavior or whether it is merely another measure to tap into people's sensitivity to food cues, like the Power of Food. It is expected that the concepts of the Power of Food and habits are both predictors of unhealthy snack intake and that they are also closely related, but not to such an extent that their discriminant validity is compromised. Second, we seek to examine how these constructs relate to each other and whether habit strength possibly mediates the relationship between the Power of Food and unhealthy snacking behavior.

Habit strength was also compared to the intention to eat more healthily, as the most commonly included 'traditional' predictor of health behaviors. On the one hand, people are often motivated to eat more healthily, but, on the other hand, it is expected that people are automatically triggered to eat unhealthy snacks and, despite their good intentions, to have little control over their habits. By including these two conflicting forces of habit and intention, the relative importance of automatic behaviors and consciously formulated intentions can be investigated. It is expected that habit strength is the most important predictor of unhealthy snacking behavior, above and beyond constructs like the Power of Food and intention.

Method

Participants

This study draws on data of the LISS (Longitudinal Internet Studies for Social Sciences) panel of CentERdata, a large Internet survey panel which is based on a true probability sample of households drawn from the population register by Statistics Netherlands (De Vos, 2010). Two thousand and twenty one members of the LISS panel were randomly selected and invited to participate in the study. Of these, 1383 agreed to participate (response rate: 68.4%). Participation was defined as filling out an online snack diary for at least four of the seven days (see *Procedure*). A drop-out analysis was conducted to test significant differences in age, education, Body Mass Index (BMI: kg/m^2), perceived health consequences, Power of Food, intention to eat more healthily, and habit strength (see *Questionnaire*) between participants and non-respondents. Analyses showed that participants were older (mean age 51.40 vs. 47.05 years), had a lower intention to eat healthily (M = 3.09 vs. M = 3.22), and a slightly weaker habit to eat unhealthy snacks (M = 2.43 vs. M = 2.63) than non-respondents (all p´s < .05). However, all effect sizes were very small (all $\eta_p^2 \leq .01$).

Participants with a BMI below 18.50 (which may indicate a pathological eating disorder; WHO, 2003b; n = 20), older than 70 years (because BMI scores are no longer reliable for people older than 70 years; Dutch Nutrition Centre, 2010b; n = 124), who reported complete meals instead of snacks (n = 43), and who did not complete the entire questionnaire (n = 2) were excluded from the analyses. This resulted in a sample consisting of 1103 participants (488 men, 615 women, mean age 48.74 years, SD = 14.10, mean BMI 25.72,

SD = 4.51, including normal weight and overweight participants). Of these participants, 34% had a low level of education (elementary school or lower general secondary education), 33% finished a middle education level (intermediate vocational education, higher general secondary education or pre-university education) and 33% held a diploma in higher education (higher vocational education or university). Most participants were married (59%), 28% had never been married, 10% were divorced, and 3% were a widow(er).

Procedure

Participants of the LISS Panel were approached to join a large Internet survey on snacking behavior. Respondents who agreed to participate filled out the survey online. Participants were asked to fill out several questionnaires regarding their eating behavior, which were part of a larger survey. The study was conducted in July 2010. Approximately one month after administering the questionnaires, participants were approached again and requested to keep an online snack diary for seven days, reporting their healthy and unhealthy snacks once a day. After completing the study, participants were debriefed and thanked.

Questionnaire

Demographic variables. Demographic variables were provided by CentERdata, including gender, age, weight, height, education level, and marital status.

Habit Strength. Participants filled out the Self-Report Habit Index (SRHI; Verplanken & Orbell, 2003) which was adapted to measure the habit to eat unhealthy snacks (Cronbach's α = .95). The SRHI includes 12 items that address behavior repetition, automaticity (lack of control and awareness, efficiency) and expressed identity (e.g., "Eating unhealthy snacks is something I do frequently/ I do automatically/ that's typically 'me'."). Participants rated their answers on 7-point scales from 1 (*totally disagree*) to 7 (*totally agree*).

Intention. The intention to eat more healthily was measured by two items ("I want to/plan to eat more healthily."; r = .79, p < .001), on 5-point scales from 1 (*totally disagree*) to 5 (*totally agree*).

Power of Food. Participants filled out the Power of Food Scale (PFS; Lowe et al., 2009; measuring the psychological sensitivity to today's food-abundant environment with 15 items (e.g., "If I see or smell a food I like, I get a powerful urge to have some."; Cronbach's α = .89). Participants rated their answers on 5-point scales from 1 (*totally disagree*) to 5 (*totally agree*).

Perceived health consequences. To control for possible individual differences in perceived health consequences of unhealthy eating, three items were used ("To what extent do you think eating habits have consequences for heart and vascular diseases/obesity/cancer?"; Cronbach's α = .74) which could be answered on 4-point scales ranging from 1 (*no consequences*) to 4 (*large consequences*).

Snack diary

Participants monitored their snack intake by keeping a seven day online snack diary. This diary, which has been previously used and developed in collaboration with a registered dietician (e.g., Adriaanse, De Ridder, & De Wit, 2009), consisted of one column with 12 options for healthy snacks (e.g., apple) and one column with 13 options for unhealthy snacks (e.g., cookie). For both snack categories, also an option 'other' was provided, where participants could specify what 'other' snack they had consumed during that day. A snack was defined as any food consumed in between the regular meals (breakfast, lunch, and dinner). When participants reported taking a snack, they were additionally asked to specify how much of that snack they had consumed, in appropriate units ('pieces' for fruit or 'handful' for chips). Participants were instructed to fill out the diary every evening when they did not expect to eat anymore for that day, even if they had not consumed any snacks. As the present study focuses on unhealthy snacking behavior, only unhealthy snacks will be taken into account.

Data analyses

Caloric intake from unhealthy snacks was calculated in average amount of kilocalories per day, by multiplying each reported snack with the average amount of calories that snack contains, multiplied by the amount of that snack taken. Averages were derived from the Dutch Nutrition Centre (2010a). Data were analyzed using SPSS software version 16.0 (SPSS Inc., Chicago, IL).

Results

Descriptive statistics and correlations

Mean scores, standard deviations and correlations from all study variables are presented in Table 1. Participants consumed approximately 327 kcal from unhealthy snacks on average per day and reported a moderate sensitivity to food cues, a moderate intention to eat more healthily, high perceived health consequences, and low to moderate unhealthy snacking habits. Having a higher intention to eat more healthily was positively correlated to caloric intake from unhealthy snacks, the Power of Food and habit strength. In addition, the Power of Food and habit strength were highly positively correlated and shared approximately 21% of their variance.

Predicting consumption of unhealthy snacks

A hierarchical multiple regression analysis was conducted to test our hypothesis that habit strength is the most important predictor of unhealthy snacking behavior. The results of this analysis are shown in Table 2. Caloric intake from unhealthy snacks was

Table 1: Bivariate correlations, mean scores, and standard deviations for study variables.

	1	2	3	4	5	6	7	8
1. Daily unhealthy snack intake	-							
2. Gender[a]	-.07*	-						
3. Age	-.02	-.07*	-					
4. BMI	.03	-.02	.21**	-				
5. Perceived health consequences (4-points scale)	.02	-.07*	.00	-.09**	-			
6. Intention (5- points scale)	.10**	.00	-.23**	-.13**	.02	-		
7. Power of Food (5-points scale)	.15**	-.07*	-.20**	.15**	.02	.28**	-	
8. Habit strength (7-points scale)	.23**	-.05	-.23**	.12**	-.12**	.28**	.46**	-
M	326.98	44%	48.74	25.72	3.11	3.11	2.47	2.46
SD	227.50		14.10	4.51	.57	.87	.56	1.30

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

[a] 1 = male, 2 = female

used as the dependent variable. The following variables were entered as predictors: gender, age, BMI, education level, and marital status in step 1; the intention to eat more healthily, perceived health consequences, and Power of Food in step 2; and habit strength in step 3. All three steps were significant. In step 1, only gender significantly predicted caloric intake from unhealthy snacks, showing that men had a higher caloric intake from unhealthy snacks. In step 2, intention to eat more healthily and the Power of Food were additionally significant predictors, indicating that participants with a higher intention to eat more healthily and participants who were more sensitive to the Power of Food had a higher caloric intake from unhealthy snacks. However, when habit strength was added in the final step, only gender and habit strength remained significant predictors, indicating that men and participants with a stronger habit to eat unhealthy snacks had a higher caloric intake from unhealthy snacks. Moreover, the results showed that habit strength was clearly the most important predictor of daily intake of kilocalories from unhealthy snacks.

To test for potential interaction effects from habit strength with the other variables, eight separate regression analyses were conducted, adding an interaction term for habit strength by respectively gender, education level, BMI, marital status, age, perceived health consequences, intention to eat more healthily, and the Power of Food in

Table 2: Standardized regression coefficients and explained variance from hierarchical regression analyses with caloric intake from unhealthy snacks as dependent variable, and gender, age, BMI, marital status, education (step 1), perceived health consequences, intention, Power of Food (step 2), and habit strength (step 3) as independent variables (*N* = 1103).

	Step 1		Step 2			Step 3		
	β	R^2	β	R^2	F-change (*df*)	β	R^2	F-change (*df*)
Gender[a]	.08*	.01	.09**	.04	14.83 (2)	.07*	.06	33.48 (1)
Age	-.05		.00			.03		
BMI	.04		.00			-.01		
Married	.01		.03			.03		
Low education	.03		.02			.02		
Middle education	.01		.01			.01		
Perceived health consequences	.03		.03			.05		
Intention			.07*			.04		
Power of Food			.14**			.06		
Habit strength						.20**		

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

[a] 1 = male, 2 = female

an additional fourth step. Interaction terms were computed by centering each variable and multiplying it by the centered value of habit strength in order to reduce possible multi-collinearity (Aiken & West, 1991). Regression analyses showed that none of the interaction terms caused an improvement of the model (all $\Delta R^2 < .01$). A post-hoc power analysis indicated that this lack of significant interactions was not due to low power as the current sample size ensured sufficient power (> .80) to detect significant effects with an effect size as small as $\eta^2 = .007$.

Mediation analysis

To further explore the relationship between habit strength and Power of Food in predicting consumption of unhealthy snacks, we examined whether habit strength mediates the relation between the PFS and unhealthy snacking behavior according to the steps by Baron and Kenny (1986). Using multiple regression analyses, it was first examined whether the PFS predicted caloric intake from unhealthy snacks. There was indeed a significant effect ($\beta = .15$, $p < .001$). In a second regression analysis, it was found that the PFS was related to habit strength ($\beta = .46$, $p < .001$). A third regression analysis which included the PFS and habit strength as predictors, showed that habit strength indeed predict caloric

intake from unhealthy snacks (β = .20, p < .001). Moreover, results from this third regression analysis indicated that the effect of the PFS predicting caloric intake from unhealthy snacks reduced substantially when controlling for habit strength (β = .06, p = .07).

A Sobel test was subsequently performed to test whether this drop in Beta weight was significant (Sobel, 1982). This analysis was also found significant, p < .001, suggesting that habit strength mediates the relation between the PFS and caloric intake from unhealthy snacks. Notably, no evidence was found for a mediation effect of the PFS on the relation between habit strength and caloric intake from unhealthy snacks, as this relation remained similar after controlling for the PFS (β = .20, p < .001; without controlling: β = .23, p < .001).

Discussion

The present study was designed to examine the role of habit strength in explaining unhealthy snacking behavior, using prospective data from over 1100 participants from a representative community sample. To determine whether habits have unique predictive power that is essential when predicting unhealthy snacking behavior, we also included the Power of Food Scale. This construct is related to habits in that it also emphasizes the importance of environmental cues. However, the Power of Food merely taps into a precondition for consuming unhealthy foods, namely, the sensitivity to food cues, whereas habits address characteristics of the actual behavior (i.e., repetitiveness and automaticity). Before habit strength was included in the analysis, it was found that the Power of Food was a significant predictor of unhealthy snacking behavior, suggesting that it is indeed important in explaining this behavior. However, in line with our hypothesis, when habit strength was added to the analysis, the Power of Food was no longer a significant predictor of snack intake. This result signifies that although habit strength has some conceptual overlap with the Power of Food, it also contains an important unique contribution. In fact, habit strength turned out to be the most important predictor of unhealthy snacking behavior, outperforming all other variables. Moreover, additional analyses showed that unhealthy snacking behavior is predicted by habits regardless of gender, education level, BMI, marital status, age, perceived health consequences, intention, or the Power of Food, indicating that the effect of habits is very robust and, unlike most other variables important in explaining eating behavior, have implications regardless of other characteristics.

As the Power of Food and habit strength were strongly correlated and there were theoretical grounds for suspecting that habit strength could possibly explain part of the relation between the Power of Food and unhealthy snacking behavior, a mediation analysis was conducted. This analysis indeed showed that habit strength mediates the relation between Power of Food and unhealthy snacking behavior, implying that people who are highly sensitive to food cues are more likely to create strong unhealthy snacking habits,

which in turn triggers more unhealthy snacking behavior. Notably, no evidence was found for a mediating effect of the Power of Food on the relation between habit strength and unhealthy snacking behavior. Although these results provide an important and novel first insight into the relation between Power of Food and habit strength on unhealthy food consumption, it is important to note that the present results have to be interpreted with caution, as in our study habit strength and Power of Food were measured at the same time and causality can therefore not be assumed.

The result that unhealthy snacking behavior is primarily predicted by habit strength is in line with previous research by Verplanken (2006). However, our findings also extend this research as the present study was the first to investigate the role of unhealthy snacking habits in a large community sample, suggesting that the importance of habits in unhealthy snacking behavior can be extended to the general population. Moreover, in addition to establishing the direct effect of habits on unhealthy snack intake, the present study was novel in for the first time demonstrating how habits may explain the previously found relation (e.g., Forman et al., 2007) between the Power of Food and unhealthy food intake. The present findings thereby add to the growing body of literature showing the predictive validity of habits in health behavior (i.e., De Bruijn, 2010; De Bruijn, et al., 2007) and emphasize that habits should not be neglected when explaining health behavior.

In the present study, some interesting correlations were found that warrant more attention. For one, it was found that intention to eat more healthily was positively related to habit strength, which may seem surprising. Note however that the present measure of intention assessed the intention to eat *more* healthily and thus captured the motivation to *change* one's eating behavior. It is thus to be expected that people who have a habit to eat unhealthy snacks, and consequently consume more snacks, have a stronger motivation to change their food intake than those people whose eating habits are already relatively healthy. A similar rationale holds for the relation between intention to eat more healthily and unhealthy snack intake, as people who consume many unhealthy snacks are likely to be more motivated to change this behavior than people who already eat few unhealthy snacks.

Previous research examining the role of habits in health behavior has often shown that habits have a moderating effect on the role of intentions in behavior. Specifically, these studies generally find that intentions strongly predict behavior in case of weak habits, but that in case of strong habits, intentions are hardly predictive (e.g., Verplanken & Aarts, 1999; De Bruijn, 2010; Verplanken & Wood, 2006). In the present study, no evidence was found for such an interaction effect. One explanation for this finding may be that in the present study, measures for habit strength and intention comprised two different behaviors, i.e., the habit to eat unhealthy snacks and the intention to eat more healthily. Although eating more healthily encompasses many healthier eating behaviors, and thus also consuming less unhealthy snacks, still this measure is conceptually more broad which might explain the absence of an interaction effect in the present study.

However, as evidence can be found in the literature for both the presence (e.g., De Bruijn, 2010) and the absence (e.g., Verplanken & Faes, 1999) of the moderating role of intention on the relation between habit and behavior, this is an issue that needs further investigation in future research.

The present findings may shed new light on existing interventions that aim to alter unhealthy eating behavior. Considering that habit strength is the most important predictor of unhealthy snack intake, interventions trying to change people's knowledge and intentions are likely to have only minimal effects (Orbell & Verplanken, 2010; Verplanken & Wood, 2006). This does not mean that intentions should not be targeted in interventions, because having a strong motivation is often a prerequisite for interventions that focus specifically on changing habits, such as implementation intentions (Adriaanse, Gollwitzer, De Ridder, De Wit, & Kroese, 2011). However, additional skills or techniques are required in order to act upon this intention and actually change unhealthy snacking behavior. For example, Wansink (2010) has suggested that a technique called "The Power of Three" could help to replace old eating habits with good ones. This entails that for one month, people choose three behaviors they will change each day and are asked at the end of the day which of these changes they have accomplished. In this way, people are more mindful of their behavior, and, if performed consistently, it could result in the replacement of the old behavior with a new, positive habit (Wansink, 2010).

Another promising option is the use of implementation intentions (Gollwitzer, 1999). Increasing evidence shows that implementation intentions are very successful in changing unwanted habits, including the replacement of unhealthy snacking habits with healthy ones (Adriaanse, Gollwitzer et al., 2011). Implementation intentions specify where, when, and how to act to obtain a particular goal (Gollwitzer, 1999). Using just one sentence following the structure of "If situation X arises, then I will perform goal-directed behavior Y" (e.g., in case of having the habit to eat chocolate when bored; "If I am bored and feel like eating a snack, then I will eat an apple"), this tool shows very promising results in changing unhealthy snacking habits (Adriaanse et al., 2009), and, because of its simple format, may be very applicable to be used in interventions targeting unhealthy snacking behaviors.

A few limitations of the present study should be noted. First, one disadvantage of the survey design used in the present study is the interpretability of causality. Based on the findings, no firm conclusions can be drawn on whether snacking habits induce consumption of unhealthy snacks, or vice versa. However, the present study adopted a prospective design, obtaining questionnaires about one month before unhealthy snacking behavior was measured, which may largely preclude this concern. A second limitation is that unhealthy snack consumption was assessed using self-report measures. Although monitoring food intake by means of a diary is vulnerable to incomplete data or under-reporting, it is found to be a high quality outcome measure to asses snack intake (Adriaanse, Vinkers, De Ridder, Hox, & De Wit, 2011) and is regarded as a highly valid

method, most closely resembling actual food intake (De Castro, 2000). Specifically, compared to most studies investigating food intake, the present study could be considered methodologically very strong, as only few studies use (a) prospective designs with a one month time interval, (b) employ a seven day snack diary in (c) over 1100 participants of a community sample.

The present study adds to our understanding of eating behavior, showing that habits play an essential role in explaining unhealthy snacking behavior. It is important to note that the present study is conducted in a large community sample, adding to the generalizability of the findings to the general population. Therefore, we believe that the current findings give new insight into unhealthy snacking behavior and the importance of habits, showing that habits provide a unique contribution in explaining eating behavior by showing that unhealthy snacking behavior is primarily predicted by habit strength.

3 |

It’s my party and I eat if I want to: Reasons for unhealthy snacking

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Abstract

Investigating the reasons that people give for unhealthy snacking behavior is important for developing effective health interventions. Little research, however, has identified reasons that apply to a large audience and most studies do not integrate multiple factors, precluding any conclusions regarding their relative importance. The present study explored reasons for unhealthy snacking among a representative community sample. Participants (*N* = 1544) filled out the newly developed Reasons to Snack inventory assessing an elaborate range of motives at baseline and 1-month follow-up. Exploratory and replication factor analyses identified six categories: opportunity induced eating, coping with negative emotions, enjoying a special occasion, rewarding oneself, social pressure, and gaining energy. The highest mean scores were obtained for enjoying a special occasion and opportunity induced eating. Regression analyses with participant characteristics as independent variables and each category of reasons as dependent variables showed differences for age. For all reasons except to enjoy a special occasion, younger people reported a higher score. Women indicated a higher score than men on coping with negative emotions, enjoying a special occasion, and gaining energy. People who diet to a stronger extent reported a higher score for snacking because of social pressure, to reward oneself, and to cope with negative emotions, with the latter also being related to a higher BMI. Finally, a higher education was associated with enjoying a special occasion. Future health interventions could allocate more attention to diminishing unhealthy snacking with regard to the six identified categories, specifically focusing on enjoying a special occasion and opportunity induced eating.

Introduction

Many people consume a lot of palatable but unhealthy snacks (Forslund, Torgerson, Sjöström, & Lindroos, 2005; Piernas & Popkin, 2010). Unhealthy snacks typically are high in energy density and contain large amounts of ingredients such as sugar and fat. Consequently, unhealthy snacking behavior is a major contributor to the increased prevalence of overweight and obesity (Forslund et al., 2005; Piernas & Popkin, 2010). The need for effective interventions supporting people in limiting their unhealthy snack intake is therefore urgent. However, in order to do so, more knowledge concerning why people snack unhealthily is required, as reasons for this behavior are not straightforward. To illustrate, in contrast to unhealthy snacking, meals typically are well-defined moments induced by clear cues such as 'it is mealtime' or 'feeling hungry' (Cleobury & Tapper, 2014; Tuomisto, Tuomisto, Hetherington, & Lappalainen, 1998). For unhealthy snacking behavior such direct motives seem to be less pronounced and psychological motives presumably play a large role in this behavior (Cleobury & Tapper, 2014). A better understanding of why people snack unhealthily is therefore warranted. The present study explored the psychological motives people provide for consuming unhealthy snacks among a large and representative community sample.

Investigating the reasons people give for unhealthy snacking is important in at least three ways. For one, on a personal level, many health interventions require people to tailor the intervention technique to their personal circumstances. Strategies like action and coping planning (e.g., Adriaanse, De Ridder, & De Wit, 2009; Gollwitzer, 1999), pro-active coping strategies (e.g., Kroese, Adriaanse, Vinkers, Van de Schoot, & De Ridder, 2014), and mental contrasting techniques (e.g., Oettingen, Pak, & Schnetter, 2001) require that participants tailor the strategy to their individual snacking situation to anticipate and identify the triggers for the undesired behavior. In order for these strategies to be effective, it is essential that the personally relevant reason for unhealthy snacking is identified (Adriaanse et al., 2009). In addition, such intervention techniques are effective only if the cues are formulated clearly and specifically (De Vet, Gebhardt, Sinnige, Van Puffelen, Van Lettow, & De Wit, 2011; Hagger & Luzszcynska, 2014). Providing participants in this kind of interventions with an overview of reasons that are applicable to a large audience could facilitate the specification of one's personal trigger for unhealthy snacking and benefit intervention effectiveness. However, in order to do so, more research is needed to identify relevant triggers.

Secondly, on a more general level, it is important to determine the relative importance of different reasons for unhealthy snacking behavior in order to establish priorities for health interventions. So far, limited research has been devoted to provide an integrative overview of reasons for unhealthy snack consumption in a representative community sample in order to determine which motives are relatively most important. Yet, the implications for health interventions might differ depending on the reason that is

targeted (Cleobury & Tapper, 2014). For example, if most people indulge in unhealthy snacking in response to the availability of appetitive foods, rather than as a way to cope with negative affect, a focus on stimulus control is expected to be more effective than interventions aimed at coping with stressful events. Examining the relative frequency of different reasons is therefore required.

Finally, in previous research, different factors have been identified that contribute to the consumption of unhealthy foods, including social pressure and social norms (e.g., Hermans, Larsen, Herman, & Engels, 2008; Stok, De Ridder, De Vet, & De Wit, 2014), coping with negative emotions like stress or sadness (Sproesser, Schupp, & Renner, 2013; Van Strien, Frijters, Bergers, & Defares, 1986), experiencing positive affect (e.g., Evers, Adriaanse, De Ridder, & De Witt Huberts, 2013), eating for external or environmental cues (e.g., Cleobury & Tapper, 2014; Prinsen, De Ridder, & De Vet, 2013), and the availability of tempting foods (e.g., Lowe et al., 2009). Typically, however, these studies were conducted in isolation from one another, focusing exclusively on one or only a few factors, precluding any conclusion about the relative importance of the separate reasons. Similarly, with regard to the assessment of reasons for eating behavior, some instruments are available that tap into a few specific motives. For example, the Three-Factor Eating Questionnaire (Stunkard & Messick, 1985) and the Dutch Eating Behavior Questionnaire (Van Strien et al., 1986) include some items or subscales that could be used to address reasons for unhealthy snacking. Yet, the items in such measures are usually generated by researchers, rather than bottom-up provided by participants themselves, and therefore do not necessarily reflect their inherent motives. In addition, none of these measures was designed to assess a wide range of motives and, consequently, there is a lack of understanding regarding the relative importance.

To date, some studies are available that combined different reasons for eating in general, focusing on the totality of eating behavior (including the consumption of healthy and unhealthy foods, as well as main meals and snacks). Steptoe, Pollard, and Wardle (1995), for example, developed an elaborate questionnaire measuring motives for food choices and showed that food is mostly taken because it is sensory appealing (e.g., it smells or tastes good). Furthermore, Renner and colleagues (Renner, Sproesser, Strohbach, & Schupp, 2012) made an inventory assessing a comprehensive range of motives for eating and showed that liking for the food was the predominant reason for food consumption. Tuomisto and colleagues (1998) found among an obese sample that people most often initiate eating because it is mealtime or because of a regular lifestyle. Finally, Jackson and colleagues (Jackson, Cooper, Mintz, & Albino, 2003) examined four distinct reasons for eating based on a model that applies to alcohol use and showed that motivations for eating are largely comparable, namely, to cope with negative affect, to be social, to comply with other's expectations, and to enhance pleasure. Nevertheless, each of these studies regarded eating behavior in general, examining reasons for both desirable (i.e., healthy) and undesirable (i.e., unhealthy) food consumption, making it difficult to

infer relevant conclusions for behavior change interventions targeting unhealthy snack intake. As especially unhealthy snack consumption (rather than meal consumption or healthy food intake) are potentially problematic (Piernas & Popkin, 2010), more research is needed focusing on unhealthy snacking behavior. To the best of our knowledge, only in one study (Cleobury & Tapper, 2014) among overweight and obese people, the findings were interpreted separately for meals, healthy snacks, and unhealthy snacks. These indeed suggest that different motives influence different types of eating behavior. While reasons for main meals mostly related to hunger or time of the day, and healthy snacks were also mostly consumed because of hunger, unhealthy snacks were most frequently consumed because they looked or smelled very tempting. Moreover, next to the focus on eating behavior in general, the majority of these studies recruited highly educated samples (i.e., Cleobury & Tapper, 2014; Jackson et al., 2003; Renner et al., 2012). When aiming to develop effective health interventions targeting a large audience, it is essential to include a sample which is more comparable to the general population at large.

The present study seeks to fill several voids identified in the previous research highlighted above. More specifically, we aim to explore the main reasons people report for unhealthy snacking using a broad range of motives among a large and representative community sample. Although identifying reasons for unhealthy snacking behavior seems a critical issue, the existing literature does not provide in a systematic examination of such reasons among a representative community sample. The present research aims to fill this gap in three ways. First, a Reasons to Snack inventory was developed to assess the reasons people provide for their unhealthy snacking behavior and it was examined whether distinct categories in reasons for unhealthy snacking can be identified. Second, it was examined which types of reasons are most frequently reported for consuming unhealthy snacks. Finally, it was explored whether differences exist in the reported reasons based on participant characteristics including gender, education, Body Mass Index, age, and dieting.

Method

Participants

This study draws on data of the LISS (Longitudinal Internet Studies for Social Sciences) panel of CentERdata, a large Internet survey panel which is based on a true probability sample of households drawn from the population register by Statistics Netherlands (De Vos, 2010). Initially, 2098 members of the LISS panel were randomly selected and invited to participate in the study. Of these, 1709 completed the first questionnaire (response rate: 82%) and were approached for the second questionnaire. The second questionnaire, 1 month later, was completed by 1547 respondents (74% of total).A drop-out analysis was conducted to examine whether study completion (participants who finished both questionnaires vs. those who completed the first questionnaire only) could be predicted by baseline study variables (see *Questionnaire*), using a logistic

regression analysis. Study completion was used as a dependent variable and gender, age, marital status, education, and BMI (kg/m^2) were entered as predictor variables. The model was found to be significant χ^2 (5, N = 1705) = 62.89, p < .001 (Cox & Snell R^2 = .04; Nagelkerke R^2 = .08). Gender, marital status, and education were not found to be significant (p's > .33). Study completion was predicted by age, p < .001, OR = 1.03 (95% CI = 1.02 – 1.04), and BMI, p < .001, OR = 0.98 (95% CI = 0.98 - 0.99). Study completers were found to be older (M = 51.99, SD = 17.56) and to have a lower BMI (M = 29.28, SD = 16.46) compared to participants who did not complete the study (age: M = 42.93, SD = 16.12; BMI: M = 39.35, SD = 28.90).

Three participants were excluded from the analyses because they indicated unlikely high caloric intake from unhealthy snacks (over 3400 kcal from unhealthy snacks on one single day, corresponding to an intake of more than 8 SD above the mean). This resulted in a final sample consisting of 1544 participants, of whom 45.1% were male, with a mean age of 51.95 years (SD = 17.55, range: 16-90), and a mean BMI of 25.67 (SD = 4.55, range: 16.85-57.80)[1]. Of these participants, 1.8% was underweight (BMI < 18.50), 45.0% had a healthy weight (BMI: 18.50-25.00), 35.5% was overweight (BMI: 25.00-30.00), 12.9% was considered obese (BMI > 30), and for 4.9% information to compute BMI was missing. Furthermore, 34.7% percent had a low level of education (elementary school or lower general secondary education), 34.3% finished a middle education level (intermediate vocational education, higher general secondary education or pre-university education) and 30.8% held a diploma in higher education (higher vocational education or university), 0.2% was missing. Most participants were married (58.5%), 25.4% had never been married, 10.3% was divorced, and 5.8% was a widow(er).

Design and Procedure

The study adopted a prospective within-subjects design, with two measurements separated by 1 month. Participants of the LISS Panel were approached to join a large Internet survey on snacking behavior. Respondents who agreed to participate completed the survey online. Demographic variables (including gender, age, marital status, education, and weight and height used to calculate BMI) were retrieved from the LISS database which is updated each year (4 months before the current data collection). Participants were asked to fill out a baseline measurement which was part of a larger questionnaire[2], including the Reasons to Snack inventory and dieting status. One month later, participants were approached again and requested to fill out the follow-up questionnaire. The follow-up measurement included the Reasons to Snack inventory to examine its stability over time and caloric intake from unhealthy snacks in order to relate reasons for unhealthy snacking to unhealthy snacking behavior. After completing the study, participants were debriefed and thanked.

[1] Excluding underweight (BMI < 18.5) and morbidly obese participants (BMI > 40.0) does not affect the results.
[2] The questionnaire also assessed habit strength, intention to consume fewer unhealthy snacks, and self-concordance (intrinsic and extrinsic motivation) to consume fewer unhealthy snacks. Results regarding these variables are beyond the scope of the present paper but available upon request.

Questionnaire

Reasons to Snack inventory. In order to measure reasons for unhealthy snacking, first, an extensive item pool was derived from reasons that have been identified in previous studies that assessed reasons for unhealthy snacking (including published and unpublished data, total N = 525), resulting in 78 different reasons. Thirteen items were omitted because they consisted of overlapping meanings and 10 items were excluded because they referred to vague cues that are not considered actual specific reasons for snacking (such as 'winter'). The remaining 55 items were supplemented with 18 items retrieved from a study by Jackson and colleagues (2003) that included a range of psychological motivations to eat unhealthily, and five items that were added by the authors in order to suit a broader audience rather than merely a student population (e.g., 'being with colleagues'). This resulted in 78 items. Second, to further specify possible reasons for unhealthy snacking, a preliminary version of this inventory was administered in a pilot study among a community sample recruited via the Dutch Nutrition Centre (N = 365). Participants were asked 'If you take an unhealthy snack, how often is this…', followed by the 78 items (e.g., 'to comfort yourself?') on a 7-point scales from 1 (*never*) to 7 (*always*). An open ended question was also administered to obtain additional reasons. Based on this pilot study, items that were reported infrequently ($M \leq 2$, N = 17) were excluded for the final Reasons to Snack inventory. From the remaining 61 items and the additional answers to the open ended question, items were excluded if that item (1) correlated excessively high with other items, signaling redundancy ($r > .85$; e.g. 'as a way to deal with sad feelings' or 'as a way to cope with negative emotions'), (2) covered overlapping meanings (e.g., 'because it's a special or traditional part of some social occasion or celebration' or 'because it belongs to a festivity'), and (3) did not have a clear meaning (e.g., 'it is psychological'). This resulted in a final questionnaire comprised of 35 items (29 from the preliminary version and six based on responses from the open ended question).

The final Reasons to Snack inventory assesses the reasons people hold to eat unhealthy snacks with 35 items, e.g., 'If you take an unhealthy snack, how often is this…' 'to comfort yourself?' or 'to celebrate a special occasion with friends, family, or your partner?'. The items were presented in random order and answers were rated on 7-point scales from 1 (*never*) to 7 (*always*). An 'unhealthy snack' was defined as all foods consumed between the three main meals (breakfast, lunch, dinner) containing high amounts of unhealthy ingredients like fat and sugar.

Dieting. Whether participants were dieting was administered at baseline with one question, i.e., "Currently, I am following a diet" on a scale from 1 (*totally disagree*) to 7 (*totally agree*).

Caloric intake. Caloric intake was included to examine whether the reasons for unhealthy snacking were related to unhealthy snack consumption, and was administered at follow-up. Participants indicated what kind of snacks they consumed and the amount of that snack taken on the day before the study, using a list of snacks that are commonly

consumed. This list of snacks has been developed with a certified dietician and has been validated in previous studies (e.g., Adriaanse et al., 2009). Also, an option 'other' was provided. Additionally, it was asked how typical yesterday's snack consumption was for their normal eating pattern. Caloric intake from unhealthy snacks was calculated by multiplying each reported snack with the average amount of calories that snack contains, multiplied by the amount of that snack taken. Averages were derived from the Dutch Nutrition Centre (2010a).

Data analyses

Data were analyzed using SPSS software version 20.0. Caloric intake from unhealthy snacks was positively skewed and square root transformation was conducted to improve normal distribution. After transformation, 10 outliers were identified on caloric intake (> 3 SD above the mean). As excluding these outliers did not affect the results, findings for the complete sample will be described.

Results

Descriptive statistics and correlations

Descriptive statistics and correlations of the variables under study are presented in Table 1. On average, participants indicated dieting to a low to moderate extent and consumed 368 kcal (*SD* = 344) from unhealthy snacks on 1 day at the 1-month follow-up, which was perceived as moderately typical for their unhealthy snacking behavior (*M* = 3.25; *SD* = 1.98). Older participants and dieters reported a lower caloric intake. Gender, education, and BMI were not associated with caloric intake.

On average, participants mostly indicated that they consume unhealthy snacks because it is a party or a birthday (*M* = 4.74; *SD* = 1.67), as a way to celebrate a special occasion with friends, family, or a loved one (*M* = 4.44; *SD* = 1.69), and because they really crave tasty food (*M* = 4.31; *SD* = 1.68), see Table 2.

Categories in reasons for unhealthy snacking

Factor analysis. An exploratory factor analysis was conducted to examine whether the reasons for unhealthy snacking can be classified into different categories. The 35 items of the Reasons to Snack inventory were entered and an Oblimin rotation was used as the factors were expected to correlate (Steptoe, et al., 1995). Standardized factor loadings were extracted using the pattern matrix. The factor analysis indicated six components with an Eigenvalue above 1. One item did not load on any factor (i.e., 'Because I was coming home'; factor loadings < .40) and was therefore excluded. All other items loaded on one single factor (factor loadings > .40). The factors and the corresponding items are displayed in Table 2. The first factor concerned *opportunity induced eating* consisting of

Table 1. Correlation, means, and standard deviations of the variables under study.

	1	2 [c]	3	4 [c]	5 [c]	6	7	8	9	10	11	12	13
1. Caloric intake	-												
2. Gender [a, c]	-.01	-											
3. Age	-.07*	-.10**	-										
4. Low education [b, c]	.02	.06*	.21**	-									
5. Middle education [b, c]	.00	.01	-.16**	-.53**	-								
6. BMI	-.02	-.10**	.22**	.12**	-.01	-							
7. Dieting	-.06*	.08**	.04	.01	.00	.30**	-						
8. Special occasion	.16**	.18**	-.08**	-.05	-.03	.01	.05*	-					
9. Opportunity induced	.25**	.04	-.44**	-.10**	.04	-.04	.00	.52**	-				
10. Gaining energy	.09**	.16**	-.34**	-.09**	.02	-.08**	.05	.38**	.46**	-			
11. Reward	.19**	.13**	-.33**	-.06*	.00	-.03	.10**	.41**	.58**	.45**	-		
12. Social pressure	.18**	.09**	-.14**	.00	-.05	.03	.13**	.50**	.46**	.37**	.55**	-	
13. Negative emotions	.17**	.23**	-.29**	-.04	-.01	.13**	.20**	.31**	.45**	.36**	.63**	.54**	-
M	368		51.95			25.67	2.92	4.10	3.51	3.27	2.52	2.33	2.16
SD	344		17.55			4.55	1.92	1.42	1.43	1.60	1.39	1.13	1.39

Note. All measures except caloric intake were assessed at baseline.

[a] 1 = male; 2 = female. [b] Dummy coded. [c] Spearman's rho is displayed.

** Correlation is significant at the .01 level (r > .077; two-tailed). * Correlation is significant at the .05 level (r > .051; two-tailed).

nine items, e.g., 'Because tasty food is nearby'. The second factor concerned *coping with negative emotions*, including six items, e.g., 'To cope with negative feelings'. *To enjoy a special occasion* was the third factor with six items, e.g., 'Because it is a party or birthday celebration'. The fourth factor included seven reasons concerning *to reward oneself*, e.g., 'As a reward because you have worked very hard'. The fifth factor concerned motives *because of social pressure*, consisting of four items, e.g., 'Because you feel like you could not say 'no''. The final factor held a physiological motive, rather than a psychological reason, namely *to gain energy*, including two items, e.g., 'To gain energy'. To create a concise questionnaire and equivalent factors, each psychological category was reduced to a maximum of four items. Items with the highest factor loading were included (in line with Renner et al., 2012), see Table 2.

Table 2. Reasons to Snack inventory. (Items in bold are included in the subscales.)

If you consume an unhealthy snack, how often do you eat…	Loading	Mean	SD
To enjoy a special occasion			
As a way to celebrate a special occasion with friends, family, or a loved one	**.89**	**4.44**	**1.69**
Because it is a party or a birthday	**.88**	**4.74**	**1.67**
Because it's a special or traditional part of some social occasion or celebration	**.70**	**3.50**	**1.89**
Because you are with friends	**.59**	**3.72**	**1.71**
Because you are drinking coffee or tea	.50	3.64	1.81
Because you are having a day off	.43	3.38	1.77
Opportunity induced eating			
Because you are watching television	**.74**	**3.09**	**1.72**
Because you are watching a movie	**.66**	**2.99**	**1.80**
Because the food tastes so good	**.65**	**3.64**	**1.85**
Because you really crave tasty food	**.62**	**4.31**	**1.68**
Because tasty food is close by	.61	3.15	1.78
Because you see or smell tasty food	.56	3.23	1.75
Because you are relaxing	.55	3.30	1.70
Because you really could not resist the temptation of the food	.52	3.08	1.77
Because you are enjoying the moment	.42	3.56	1.78
To gain energy			
Because you really need to eat something, otherwise you would faint	**.87**	**3.34**	**1.86**
To gain energy	**.77**	**3.19**	**1.77**
To reward oneself			
As a reward because you have worked very hard	**.64**	**2.60**	**1.65**
As a reward for having done something that you're proud of or feel good about	**.64**	**2.46**	**1.59**
Because you deserve it	**.63**	**2.67**	**1.66**
Because you finished a project	**.61**	**2.35**	**1.50**
Because you worked hard	.58	2.74	1.65
Because you are having a nice day	.53	2.77	1.60
Because you feel good or are in a good mood	.47	2.84	1.64
Because of social pressure			
Because you don't want to stand out or be different from others who are eating	**.75**	**1.92**	**1.27**
To please your mother or someone else who wants you to eat	**.72**	**2.13**	**1.41**
Because you feel like you could not say 'no'	**.68**	**2.29**	**1.48**
Because the food was offered to you and you feel like you could not refuse it	**.68**	**2.99**	**1.65**

Table 2. Reasons to Snack inventory (continued).

If you consume an unhealthy snack, how often do you eat…	Loading	Mean	SD
To cope with negative emotions			
As a way to deal with sad feelings	**-.92**	**2.18**	**1.55**
As a way to comfort yourself	**-.89**	**2.13**	**1.52**
To deal with disappointment	**-.89**	**2.07**	**1.46**
Because you feel tense	**-.88**	**2.28**	**1.56**
Because you feel bored	-.52	2.49	1.64
Because you are tired	-.48	2.16	1.43

Stability and consistency. To examine whether the different categories in reasons for unhealthy snacking were stable over time a replication factor analysis (Osborne & Fitzpatrick, 2012) was conducted using the Reasons to Snack inventory assessed at follow-up (1 month later). Similar to the original exploratory factor analysis, the 35 items were entered using an Oblimin rotation employing the pattern matrix to extract standardized factor loadings. The analysis showed a similar structure with the same six factors. Again, the same item did not load on any factor (factor loadings < .40). In addition, except for one item (i.e., 'Because you are drinking coffee or tea'; factor loadings < .40), all items loaded on the same single factor (factor loadings > .40). The analyses thus showed good stability.

In addition, the correlations between the four-item subscales of the Reasons to Snack inventory at the first and second wave were assessed. The results showed significant correlations between all subscales ranging from $r = .60$ to $r = .77$, all $p < .001$, indicating good test-retest reliability. The internal consistency of the psychological subscales were examined by addressing Cronbach's alphas, which ranged from $\alpha = .78$ to $\alpha = .93$, indicating good internal reliability for all subscales. The subscale regarding gaining energy (consisting of two items) had a satisfactory internal correlation, $r = .55$, $p < .001$.

Relative importance of types of reasons

The mean scores for the categories in reasons for unhealthy snacking are presented in Figure 1. A repeated measures ANOVA was conducted to examine differences between the reported frequencies of the reasons, using the six types of reasons as within subject variables. A main effect of reasons was found, $F(5, 7715) = 838.69$, $p < .001$, $\eta_p^2 = .35$. Post hoc analyses with Bonferroni corrections indicated that all reasons differed from each other (all p's < .001). Overall, the highest mean score was observed for the category regarding enjoying a special occasion, followed by opportunity induced eating. Participants also reported consuming unhealthy snacks in order to gain energy and to reward oneself. Social pressure and coping with negative emotions received relatively lower scores. All categories were related to caloric intake from unhealthy snacks, ranging from $r = .09$ to $r = .25$, all p's ≤ .001, indicating that all reasons were relevant but rather weakly related to caloric intake from unhealthy snacks.

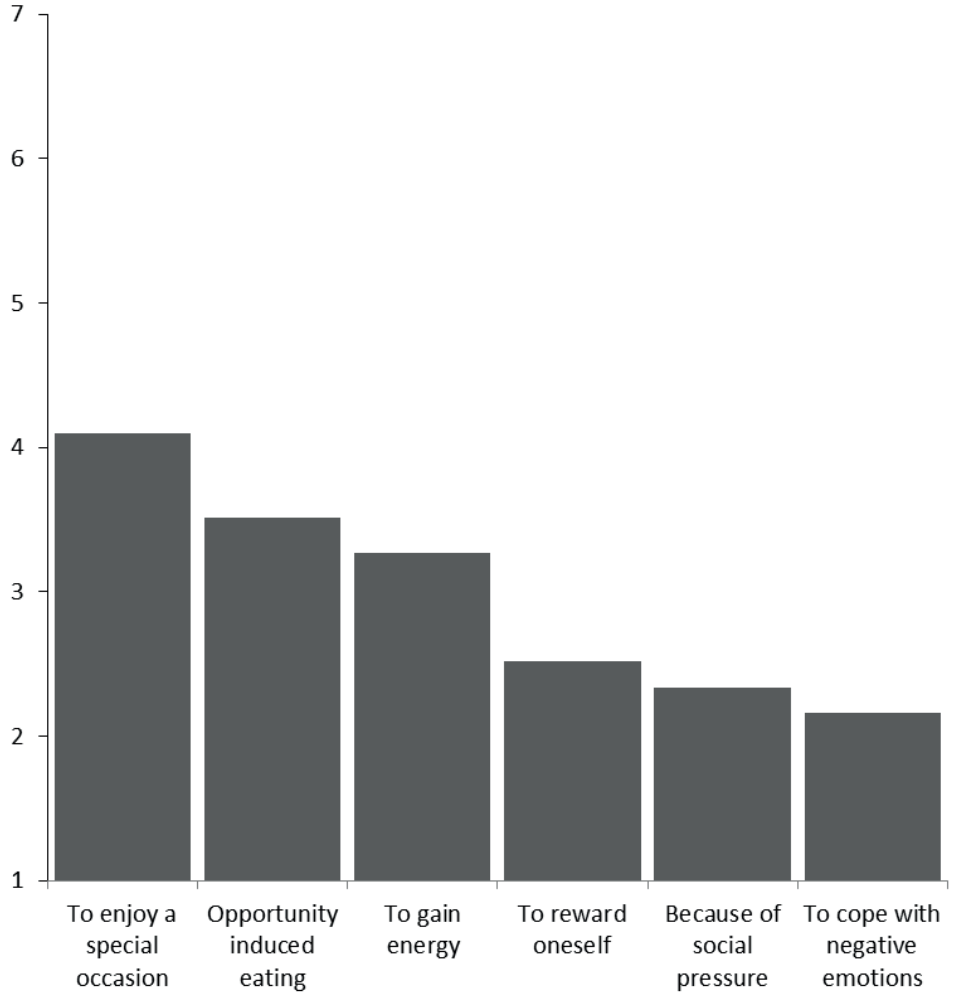

Figure 1. Reason for unhealthy snacking (measured at baseline), means per category (based on the four-item subscales).

Differences based on participant characteristics

To examine the influence of participant characteristics on the reasons for unhealthy snacking, six separate hierarchical regression analyses were conducted with each reason as a dependent variable. The analyses were controlled for caloric intake from unhealthy snacks to ensure that the influence of participant characteristics is not a mere reflection of a higher snack intake in general. Square root transformed caloric intake was entered in each regression analysis in Step 1. In Step 2, the participant characteristics were entered, including gender, age, education level (dummy coded), BMI, and dieting. Because of the large sample size, even very small effects are found statistically significant. Therefore, in line with Cohen's (1988) criteria for effect sizes, the description below is

Table 3. Regression analyses per reason predicted by caloric intake (Step 1) and participant characteristics (Step 2).

	Special occasion			Opportunity induced			Gaining energy		
Step 1	*β*	R^2	*F*	*B*	R^2	*F*	*β*	R^2	*F*
Caloric intake [a]	.18***	.03	51.28	.28***	.08	124.29	.11***	.01	18.15
Step 2	*β*	R^2	Δ *F*	*B*	R^2	Δ *F*	*β*	R^2	Δ *F*
Caloric intake [a]	.19***	.08	12.87***	.27***	.26	60.47***	.11***	.15	40.48***
Gender [b]	.18***			.00			.13***		
Age	-.05			-.43***			-.32***		
Low education [c]	-.11***			-.06*			-.06		
Middle education [c]	-.10**			-.06*			-.07*		
BMI	.01			.06*			-.02		
Dieting	.05			.02			.06*		

	Rewarding oneself			Social pressure			Negative emotions		
Step 1	*β*	R^2	*F*	*β*	R^2	*F*	*β*	R^2	*F*
Caloric intake [a]	.20***	.04	62.87	.19***	.04	53.81	.18***	.03	48.26
Step 2	*β*	R^2	Δ *F*	*β*	R^2	Δ *F*	*β*	R^2	Δ *F*
Caloric intake [a]	.20***	.17	37.84***	.19***	.08	11.86***	.19***	.21	57.47***
Gender [b]	.08**			.06*			.19***		
Age	-.33***			-.14***			-.30***		
Low education [c]	-.05			-.02			-.05		
Middle education [c]	-.08**			-.07*			-.07**		
BMI	.03			.03			.17***		
Dieting	.10***			.13***			.15***		

*** $p < .001$, ** $p < .01$, * $p < .05$, [a] Square root transformed, [b] 1 = male; 2 = female, [c] Dummy coded.

limited to standardized beta scores of $\beta \geq 0.10$ (as β's < 0.10 are considered to reflect small effect sizes, Cohen, 1988). A complete overview of the results can be found in Table 3.

For each reason, caloric intake was found to be a significant contributor, demonstrating that participants who consume more calories from unhealthy snacks have a higher score for each type of reason. In addition, compared to men, women scored higher on the categories enjoying a special occasion, gaining energy, and coping with negative emotions. Younger people reported to a larger extent to snack unhealthily because it is opportunity induced, to gain energy, to reward oneself, because of social pressure, and to cope with negative emotions. Furthermore, people with a higher education reported to a larger degree that enjoying a special occasion is a reason for unhealthy snacking. A higher BMI was associated with consuming unhealthy snacks to cope with negative emotions. Finally, the stronger people perceive themselves as dieters, the more often they indicate rewarding oneself, social pressure, and coping with negative emotions as a reason for unhealthy snacking.

Discussion

The present study assessed the reasons people provide for consuming unhealthy snacks among a large and representative community sample, using the newly developed Reasons to Snack inventory. The present study did not aim to provide an exhaustive overview of all the possible reasons for unhealthy snacking, but rather to indicate the main categories in reasons for unhealthy snacking relevant to a broad audience. From an elaborate range of reasons for unhealthy snacking, six categories emerged, namely, opportunity induced eating, to cope with negative emotions, to enjoy a special occasion, to reward oneself, because of social pressure, and to gain energy. The highest scores were found for consuming unhealthy snacks to enjoy a special occasion, followed by opportunity induced eating. Relatively lower scores were observed for coping with negative emotions and social pressure. Differences in reasons for unhealthy snacking based on participant characteristics were most profound for age. Except for enjoying a special occasion, younger people indicated a higher score for each category. Additionally, women had a higher score than men for half of the reasons, including to cope with negative emotions, to enjoy a special occasion, and to gain energy. Dieting was found to contribute to the consumption of unhealthy snacks to cope with negative emotions, because of social pressure, and to reward oneself. Finally, a higher BMI was related to a higher score in snacking unhealthily to cope with negative emotions, and a higher education to the category regarding enjoying a special occasion.

In line with previous literature (Steptoe et al., 1995), the overall scores were rather low (with a highest mean just above midpoint), suggesting that people oftentimes report that the reason does not extensively affect their unhealthy snacking behavior. To a large

extent, the present study found support for motives that repeatedly appear in the existing literature. Opportunity induced eating, for example, entails hedonic features like craving tasty food and eating because the food tastes good, which are also reported in prior research (Cleobury & Tapper, 2014; Lowe et al., 2009; Renner et al., 2012; Steptoe et al., 1995; Van Strien et al., 1986). Also corresponding to previous research (Renner et al., 2012; Steptoe et al., 1995; Tuomisto et al., 1998), eating for social pressure was found to be a distinct motive, yet, the present study similarly showed that this category received relatively lower scores. In line with previous literature (e.g., Renner et al., 2012; Cleobury & Tapper, 2014) coping with negative emotions was identified as a reason for unhealthy food consumption. Nevertheless, although much research has been devoted to the role of coping with negative emotions on eating behavior (e.g., Van Strien et al., 1986), studies that integrate multiple factors (e.g., Renner et al., 2013), including the present study, found that this factor is reported relatively infrequently. Finally, the present study confirms that next to psychological reasons, physiological motives are important to be included as a separate factor as well (Renner et al., 2012).

In contrast, the reason that was found most important in the current study, namely, to enjoy a special occasion, has received little attention in previous research. Some previous studies included slightly similar concepts such as 'tradition' (Renner et al., 2012) or 'to be social' (Jackson et al., 2003). Nevertheless, while consuming unhealthy foods to enjoy a special occasion intuitively makes sense, remarkably, no studies are known that explicitly addressed such motive. As opposed to previous studies that mostly regarded eating behavior in general, the focus of the current study on unhealthy snacks probably contributed to the identification of this rather novel category. Unhealthy snack consumption, rather than eating behavior in general, is likely particularly associated with enjoying a special occasion, such as being at a party. Similarly, although some studies have included items that relate to the factor 'to reward oneself' (Renner et al., 2012), little research integrating multiple factors for eating has identified this as a distinct motive. Comparably, this factor might be especially relevant for unhealthy snacking rather than overall food consumption. These results stress the importance of adopting a specific focus on unhealthy snacking behavior as, evidently, reasons for eating behavior in general cannot unconditionally be applied to unhealthy snacking.

Regarding the differences in reasons for unhealthy snacking behavior based on participant characteristics, the most pronounced effects were found for age, as most categories appeared more relevant for younger people. In line with this finding, age was also correlated to caloric intake, indicating that younger people in general consume more unhealthy snacks than older people. Additionally, in line with previous research (Cleobury & Tapper, 2014; Renner et al., 2012), it was found that many of the categories were more frequently reported by women than men. Probably, this reflects a general tendency from women to be more preoccupied with eating behavior than men and more inclined to provide a reason for their food consumption (Cleobury & Tapper, 2014; Renner et al.,

2012). Specifically the importance of consuming foods to cope with negative emotions for women rather than men has been described before (e.g., Cleobury & Tapper 2014; Snoek, Van Strien, Janssens, & Engels, 2007; Steptoe et al., 1995). Coping with negative emotions was also found to be more relevant for people with higher BMI as well as for dieters, which might imply that consuming snacks for this reason is rather maladaptive. Yet, it has also been suggested that the self-perceived status of 'emotional eating' merely reflects concerns regarding one's eating behavior, rather than a proper trigger for food consumption (Cleobury & Tapper 2014; Evers, De Ridder, & Adriaanse, 2009) and gender differences in emotional eating are not reflected in actual food intake (Adriaanse, Evers, Verhoeven, & De Ridder, in press).

The reasons identified in the present study demonstrate a remarkable large diversity, showing that a broad range of situations is mentioned as a reason to consume unhealthy snacks. These include opposite factors like experiencing positive affect and sadness, or having worked hard as well as having a day off. It has been suggested that if people are unaware of the triggers for their behavior, which is particularly the case when the behavior is performed automatically (i.e., when people have a habit of consuming unhealthy snacks; Verhoeven, Adriaanse, Evers, & De Ridder, 2012; Verplanken, 2006), people afterwards confabulate a plausible reason to explain their unhealthy behavior (Adriaanse, Weijers, De Ridder, De Witt Huberts, & Evers, 2014). The diversity of reasons in the present study reflect that most situations could serve as such an explanation. Another novel approach regards self-regulation failure (De Witt Huberts, Evers, & De Ridder, 2014) and suggests that before indulging in unhealthy eating, people may consciously take advantage of situations for unhealthy snacking in order to actively make up an explanation that justifies their unhealthy behavior. The present study confirms the broad range of reasons people can give for their unhealthy behavior and fits this perspective in the ease by which explanations can be thought of, as well as the seemingly arbitrary nature of the reasons that –either before or after indulgence- can be applied as an explanation (De Witt Huberts et al., 2014).

Implications

By adopting a specific focus on unhealthy snacking behavior and by including a representative community sample, the present study provides information relevant to health interventions aiming to diminish unhealthy snack consumption relevant to a large audience. Hence, important implications for prevention research and health interventions aiming to change unhealthy food consumption might be drawn from the present study. Future research can benefit from the identified six reasons for unhealthy snacking, for example when using strategies where identification of personal obstacles or triggers is warranted, such as action and coping planning (e.g., Adriaanse et al., 2009; Gollwitzer, 1999) or mental contrasting techniques (e.g., Oettingen, Pak, & Schnetter, 2001). Providing participants with a list comprising the six categories for unhealthy snacking can

facilitate identification of personal triggers and enhance the effectiveness of such strategies. Also, further research should be devoted to examine to role of enjoying a special occasion and on opportunity induced eating, as these categories were found highly relevant for unhealthy snacking, but seem to have been overlooked in research so far.

Similarly, with regard to health interventions, when tailoring to one's personal circumstances is required, intervention developers could aim to include items that represent each of the six categories in order to reflect the main reasons for consuming unhealthy snacks applicable to a large audience. Furthermore, a stronger focus on enjoying a special occasion and on opportunity induced eating may be adopted as participants indicated these categories as relatively most important for unhealthy snacking. This could for instance be done by promoting the availability of healthy alternatives when celebrating an event, and on impulse control to combat opportunity induced eating (Cleobury & Tapper, 2014). Impulse control could, for instance, be achieved by including strategies that override the first impulse to grab an unhealthy snack and instead take an alternative (e.g., implementation intention such as: 'If I see or smell tempting food, then I will eat an apple.'; Adriaanse et al., 2009; Kroese, Adriaanse, Evers, & De Ridder, 2011).

Finally, with regard to clinical settings, professionals can benefit from the six categories that emerged in the current study when identifying problematic situations for unhealthy snacking behavior. For example, by providing people with a diary consisting of reasons for unhealthy snacking based on these six categories could facilitate people in identifying personally relevant obstacles or critical situations. Professionals working with overweight or obese patients as well as dieticians in general additionally could pay specific attention to unhealthy snacking to cope with negative emotions as this category was particularly affected by a higher BMI and dieting status.

Limitations

It is important to also mention the limitations of the present study. Firstly, the present study showed a selective drop-out as non-completers were found to be younger and higher in BMI than completers. Also, it should be noted that BMI was retrieved from the LISS panel database, which was updated four months before the present data collection. This might have caused a potential discrepancy in the included and current BMI. These factors should be kept in mind when interpreting the results. Additionally, regarding dieting status, we did not distinguish between people who diet because of weight-loss purposes or for health or medical related reasons. Future research could establish whether differences exist between different types of dieters by including more elaborate measures of dieting status. Another important limitation is that the reasons for unhealthy snacking were obtained by self-report. Although this method ascertains that possible interventions will closely match the experiences of participants, this does not mean that the generated reasons accurately reflect the actual cause of unhealthy snacking behavior.

In addition, although we did include a measure of unhealthy snack consumption, the relation between the different motives and unhealthy snack consumption cannot be interpreted straightforwardly, especially because we cannot relate the findings to how often people engage in unhealthy snacking. Reporting that a specific reason is more important for consuming unhealthy snacks does not imply that, overall, people will consume more unhealthy snacks, which might also explain the rather low correlations with caloric intake. For example, if people indicate that if they consume an unhealthy snack this is often because they are at a party, but they are in this situation only irregularly, then overall the intake will not increase that much. The other way around, if people consume snacks sometimes because they are watching TV, but they are in this situation every day, this still might affect their snack intake. In addition, the measure for unhealthy snack consumption was also self-reported and comprised only a single day. Although it will be challenging to examine the reasons for unhealthy food consumption in an ecologically valid way without the use of self-report data, future research is needed to address this with more objective measures.

Conclusion

To conclude, the present study generated insight into the reasons people give for consuming unhealthy snacks. Six distinct motivates were identified which are applicable to a broad audience. Enjoying a special occasion and opportunity induced eating were most frequently reported as a reason for taking unhealthy snacks. Especially enjoying a special occasion is a novel motive for unhealthy snacking especially relevant to the consumption of unhealthy snacks. The present results emphasize the importance of targeting these motives in health interventions aimed at diminishing unhealthy food intake.

4

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

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Abstract

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

Introduction

As the prevalence of lifestyle related diseases like obesity, type 2 diabetes, and cancer is increasing rapidly (World Health Organization [WHO], 2003a), many interventions aim to educate people about what constitutes a healthy diet and motivate them to eat more healthily (Korinth, Schiess, & Westenhoefer, 2009). Still, unhealthy food consumption, like unhealthy snacking, continues to increase (Piernas & Popkin, 2010). One explanation for this failure to refrain from eating unhealthy foods is the finding that this behavior is largely habitual (Van 't Riet, Sijtsema, Dagevos, & De Bruijn, 2011; Verhoeven, Adriaanse, Evers, & De Ridder, 2012; Verplanken, 2006). Consequently, educating and motivating people to eat more healthily is essential but likely insufficient to promote behavior change (Verplanken & Wood, 2006).

Habits are viewed as the process in which a specific context automatically generates a particular behavior (Gardner, 2014). When a behavioral action with the aim to achieve a particular goal is performed repeatedly in a stable context or in the presence of a specific cue, a mental association is created between this cue and the response. As a result, the impulse to engage in the behavioral response is induced automatically upon encountering the particular cue. This entails that the habitual behavior is performed efficiently, unintentionally, outside of awareness, and with little controllability (Aarts & Dijksterhuis 2000; Bargh, 1994). Hence, opposing such automatic impulses is inherently difficult, even when someone adopts a strong intention to do so, for example when he or she intends to eat more healthily (Webb & Sheeran, 2006).

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

vant (Hill, Wyatt, Reed, & Peters, 2003). These substantial effects and its simple format make implementation intentions a promising tool for health interventions targeting unhealthy snacking (Hagger & Luszczynska, 2014).

Although applying implementation intentions to change one's routines seems relatively simple, research indicates that formulating effective plans targeting counter-intentional behaviors may not be straightforward as this requires substantial insight into one's behavior (Adriaanse et al., 2009; Hagger & Luszczynska, 2014). Specifically, when trying to change existing unwanted habits, typically, implementation intentions specify the trigger of the habitual behavior in the 'if'-part of the plan, while indicating an alternative response in the 'then'-part (Adriaanse et al., 2009). For example, when aiming to change the unhealthy habit of eating chocolate when watching television, the following implementation intention could be formulated: 'If I am watching television, then I will eat an apple!'. The critical cue (watching television) formerly inducing the unwanted habit (eating chocolate) will become associated with a more desirable response (eating an apple), while inhibiting the association with the unwanted response simultaneously. As a result, the cognitive advantage of the habitual response is eliminated, providing people the opportunity to act upon their intention to eat more healthily again (Adriaanse, Gollwitzer, De Ridder, De Wit, & Kroese 2011). Specifying the right *personally relevant critical cue* that is inducing the unwanted response is thus essential for effective implementation intentions (Adriaanse et al., 2009).

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

Unfortunately, people generally have poor introspection into the reasons for their own behavior (Nisbett & Wilson, 1977). In particular when people are in a 'cold' reflective state, as they usually are when making plans, people often underestimate the effect of visceral states, like hunger or emotions, on their behavior (Loewenstein, 1996), making the specification of relevant cues rather difficult (Adriaanse et al., 2010). Moreover, in case of habitual behaviors, introspection into cues triggering the habitual response is likely

to be even more problematic as habitual behaviors are inherently automatic and executed with little awareness (Bargh, 1994). Identifying cues that habitually trigger unhealthy snacking is thus a demanding challenge. However, as accurate cue specification is a necessary precondition for formulating effective plans, the complications associated with the identification of critical cues is a serious limitation to the effectiveness of implementation intentions. Indeed, research has indicated that people often experience difficulties in formulating specific implementation intentions of good quality when targeting complex behaviors (De Vet, Gebhardt, Sinnige, Van Puffelen, Van Lettow, & De Wit, 2011; De Vet, Oenema, & Brug, 2011). Correspondingly, it has been suggested that implementation intentions are more effective when formation is facilitated by a trained professional rather than left to the target users themselves (e.g., Hagger & Luszczynska, 2014).

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

Different types of monitoring exist (e.g., Burke, Wang, & Sevick, 2011; Webb, Chang, & Benn, 2013). Typically, monitoring is used to examine one's goal striving progress (Carver & Scheier, 1998), e.g., by monitoring weight or blood glucose. Monitoring may also be performed at a behavioral level. For instance, eating behavior can be monitored by reporting the type and amount of food consumed (Burke et al., 2011). Such monitoring strategies are central in weight loss interventions and dietician's practices, and research has consistently showed its effectiveness when targeting weight loss (for a systematic review, see Burke et al., 2011). Yet, for the purpose of aiding the formation of effective implementation intentions, a novel type of monitoring was deemed more relevant; *cue-monitoring*. With cue-monitoring we refer to closely observing unhealthy snack intake in relation to specific situational and motivational circumstances, thereby reflecting upon the critical cues triggering the unwanted responses. It was expected that cue-monitoring would enhance insight into one's personal triggers for their unhealthy snacking behavior. Moreover, it was hypothesized that adding a cue-monitoring component prior to the formulation of if-then plans would help people to feel more capable to change one's behavior in their unhealthy snacking situation and, most importantly, to enhance implementation intention effectiveness in reducing unhealthy snacking.

Method

Participants

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

Design

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

Procedure

Upon recruitment, participants were first asked to sign an informed consent form and to fill out the baseline questionnaire (T0) assessing demographic variables, intention, and habit strength. Participants were then alternately assigned to one of the four conditions and received a monitoring diary corresponding to their condition (detailed below under Manipulations) as well as instructions on how to use it. In case multiple participants joined the study at once, they were provided with the same monitoring diary to preclude any suspicion as there was an evident difference in diary thickness between conditions. Participants monitored their unhealthy snacking behavior for one week. After this week (T1), participants returned the diary and completed a planning exercise in accordance with their condition (see Manipulations), which was introduced as an exercise that could help them to change their unhealthy snacking behavior. Immediately after the planning exercise, participants completed the first follow-up questionnaire assessing the same variables as in the baseline questionnaire as well as insight gained from monitoring their snacking behavior and monitoring diary adherence. Then, all participants received a snack diary to register their unhealthy snack consumption for seven days. After this week (T2), participants handed in the snack diary and filled out the final follow-up questionnaire assessing the same variables as in the baseline questionnaire as well as snack diary adherence. After filling out the T2 questionnaire, participants were reimbursed, thanked, and debriefed.

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

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

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Age T0	-													
2. BMI T0	.26**	-												
3. BMI T1	.26**	.93**	-											
4. BMI T2	.27**	.94**	.98**	-										
5. Intention T0	-.04	.18*	.21**	.21**	-									
6. Intention T1	.00	.14†	.18*	.17*	.60**	-								
7. Intention T2	.12	.29**	.31**	.31**	.54**	.67**	-							
8. SRHI T0	-.03	.07	.19	.11	-.01	.04	.13	-						
9. SRHI T1	-.00	.01	.07	.06	.05	.11	.12	.71**	-					
10. SRHI T2	.06	-.09	-.01	-.02	-.11	-.05	.02	.70**	.76**	-				
11. Insight into cues T1	.02	.06	.10	.08	.12	.29**	.18*	.12	.20*	.07	-			
12. Capability to change T1	-.06	.07	.05	.06	.16*	.24**	.14†	.05	.01	-.05	.56**	-		
13. Daily caloric intake T2	-.16*	-.06	-.02	.00	-.08	-.09	-.08	.20*	.26**	.28**	-.03	-.04	-	
14. Daily snacking frequency T2	-.14†	-.13	-.06	-.07	.01	-.09	-.05	.24**	.23**	.22**	-.01	-.04	.63**	-
Mean	20.86	22.20	22.22	22.15	4.84	5.19	4.98	3.66	3.90	3.79	4.24	4.27	345.80	1.67
SD	2.93	2.64	2.57	2.51	1.48	1.47	1.51	1.05	1.10	1.08	0.96	1.23	225.15	0.80

** Correlation is significant at the .01 level (2-tailed).

* Correlation is significant at the .05 level (2-tailed).

† Correlation is marginally significant at the .10 level (2-tailed).

Manipulations

Monitoring manipulation

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

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

Control. Similar to the cue-monitoring diary, the control diary started with instructions on how to use the diary and the definition of unhealthy snacking. However, in this diary, participants only filled out the subjective question 'How many unhealthy snacks did you eat today' on 7-point scales from 1 (*very little*) to 7 (*a lot*) at the end of the day. This question was repeated for each day in one week. The control diary was employed to ascertain that possible effects are not due to merely reflecting on one's snack consumption (rather than reflecting on *reasons* for snacking).

Planning manipulation

Implementation intention. In the implementation intention condition, participants were informed that forming a specific if-then plan would help them to eat fewer unhealthy snacks and received elaborate step-by-step instructions to formulate a plan.

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

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

Measures

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

T0 Questionnaire

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

Intention. To control for intention as this is an important prerequisite for implementation intention effectiveness and to determine that this would not change due to the manipulations, intention to eat fewer unhealthy snacks was assessed using 3 items (i.e., 'I want/plan/intend to eat fewer unhealthy snacks'), Cronbach's $\alpha = .89$. Participants rated their answers on 7-point scales from 1 (*totally disagree*) to 7 (*totally agree*).

Habit strength. Habit strength was included as an alternative dependent variable. Participants were asked to fill out the 12-item Self-Report Habit Index (SRHI; Verplanken &

Orbell, 2003) adapted to assess the habit to eat unhealthy snacks (e.g., 'Eating unhealthy snacks is something I do automatically'), Cronbach's α = .88. Participants rated their answers on 7-point scales from 1 (*totally disagree*) to 7 (*totally agree*).

T1 Questionnaire

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

Insight into cues for unhealthy snacking. Insight into cues for unhealthy snacking was measured with 6 items, (e.g., 'It is now very clear to me what my trigger is for taking an unhealthy snack'), Cronbach's α = .79. Answers were rated on a 7-point scale from 1 (*completely disagree*) to 7 (*completely agree*).

Capability to change unhealthy snacking. Capability to change unhealthy snacking was assessed using 5 items (e.g., 'I feel like I now know where to begin with changing my snacking behavior' and 'Eating unhealthy snacks is something I can change with the plan I have made'), Cronbach's α = .89. Answers were rated on a 7-point scale ranging from 1 (*completely disagree*) to 7 (*completely agree*).

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

T2 Questionnaire

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

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

Snacking behavior

Snacking behavior was measured with a seven day snack diary (cf. Adriaanse et al., 2009; Verhoeven et al., 2012) in which participants filled out a snacking scheme for each snacking occasion. Two dependent variables derived from this snack diary: *Snacking frequency* represents the number of the filled out snacking schemes on average per day. *Caloric intake* from unhealthy snacks was calculated by multiplying the number of each reported snack by the number of calories in an average portion of that snack, averaged per day. In each snacking scheme, people marked the type of snack they consumed from a list of 14 commonly consumed snacks (e.g., cookie or crisps). For each of the selected snacks, they were additionally asked to report the number of portions they consumed in appropriate units (e.g., 'pieces' for cookie and 'handful' for crisps). Participants were instructed to fill out the snack diary after snack consumption and could report up to six snacking occasions per day. Participants were instructed that if they consumed multiple snacks in one snacking situation (i.e., within 30 minutes), they could fill it out in the same snacking scheme. Also in this diary, a snack was defined as any unhealthy food consumed in between the regular meals containing a high amount of unhealthy ingredients. The

number of calories per snack was derived from the calorie checker from the Dutch Nutrition Centre (2010a).

Results

Drop-out analysis and randomization check

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

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

Descriptive statistics

Participants reported to be motivated to eat fewer unhealthy snacks, to have a moderately strong habit to eat unhealthy snacks, and to eat on average 346 kilocalories from unhealthy snacks over 1.67 snacking occasions per day (for comparable amounts of daily caloric intake, see Adriaanse et al., 2010; Sullivan & Rothman, 2008; Verhoeven et al., 2012). See also Table 1. Participants reported high monitoring diary adherence (M = 6.12, SD = 0.61) and snack diary adherence (M = 6.04, SD = 0.66).

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

Control analyses

To examine whether the manipulations did not differentially affect participants' goal-intention, a repeated measures ANOVA was conducted with Time as a within subjects variable, Monitoring and Planning as between subjects variables, and intention (T0; T1; T2) as a dependent variable. Importantly, no main effects of Monitoring or Planning and no interaction effects were found, all p's > .10. However, a main effect of Time was

observed, $F(2, 314) = 5.84$, $p = .003$, $\eta_p^2 = .04$. Simple effects analyses indicated that, compared to baseline (T0) all participants increased their intention after the monitoring phase (T1), $F(1, 160) = 11.23$, $p = .001$, $\eta_p^2 = .07$, and decreased their intention at the final follow-up after having filled out the snack diary (T2), $F(1, 160) = 4.95$, $p < .03$, $\eta_p^2 = 03$. See Table 1 for means and standard deviations.

Main analyses

Snacking frequency. First, the effects of Monitoring and Planning on snacking frequency were examined, using an ANOVA with Monitoring and Planning as independent variables and snacking frequency (measured at T2) as a dependent variable. The analyses revealed no main effect of Planning ($p = .71$), nor an interaction effect of Monitoring by Planning ($p = .96$). However, a significant main effect of Monitoring was found, $F(1, 157) = 7.97$, $p = .005$, $\eta_p^2 = .05$, indicating that participants in the cue-monitoring condition reported significantly fewer unhealthy snacking situations per day ($M = 1.49$, $SD = 0.75$) compared to participants in the control condition ($M = 1.84$, $SD = 0.82$).

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

Insight into cues. An ANOVA was conducted with Monitoring and Planning as independent variables and insight into cues (measured at T1 after the monitoring phase) as a dependent variable. The analyses indicated no main effect of Monitoring, $p = .25$, or Planning, $p = .19$. A marginally significant interaction effect of Monitoring by Planning was observed, $F(1, 157) = 3.34$, $p = .07$, $\eta_p^2 = .02$. Simple main effect analyses were conducted to examine the interaction effect. Within the implementation intention conditions, no additional effect of Monitoring was found ($p = .62$), indicating no differences between participants in the planning conditions with or without cue-monitoring. Yet, within the goal intention conditions, a main effect of Monitoring was observed, $F(1, 79) = 4.07$, $p = .05$, $\eta_p^2 = .05$. Within the goal intention conditions, the cue-monitoring diary condition reported more insight into cues ($M = 4.38$, $SD = 0.88$) than the control diary condition ($M = 3.93$, $SD = 1.08$). Additionally, if we examine the interaction effect within the cue-monitoring conditions, no effect was found for Planning ($p = .70$), showing no differences in insight into cues between cue-monitoring with or without planning. Within the control diary conditions, however, a main effect of Planning was observed, $F(1, 80) = 4.36$, $p = .04$, $\eta_p^2 = .05$. Within the control diary conditions, participants who formulated an implementation intention showed greater insight into cues ($M = 4.40$, $SD = 0.95$) compared to the goal intention condition ($M = 3.93$, $SD = 1.08$). Findings indicating that keeping a cue-

monitoring diary, conducting the planning exercise, or both, enhanced insight into cues for snacking.

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

Habit strength. A repeated measures ANOVA with Monitoring and Planning as between-subjects variables, Time as a within-subjects variable, and habit strength (T0; T1; T2) as a dependent variable indicated a main effect of Time, $F(2, 310) = 7.08$, p = .001, η_p^2 = .04, qualified by an interaction effect of Time by Monitoring, $F(2, 310) = 4.63$, p = .01, η_p^2 = .03 (other main or interaction effects were absent, $p > .12$). Simple effect analyses indicated a main effect of Time between T0 (baseline) and T1 (after the monitoring phase), $F(1, 157) = 13.61$, $p < .001$, η_p^2 = .08, qualified by a Time by Monitoring interaction effect, $F(1, 157) = 6.52$, p = .01, η_p^2 = .04. While the control diary conditions remained stable from T0 to T1 (p = .48, M = 3.77, SD = 1.07), in the cue-monitoring diary conditions, habit strength increased, $F(1, 77) = 28.10$, $p < .001$, η_p^2 = .27, from on average 3.59 (SD = 1.04) to 3.99 (SD = 1.12). Between T1 and T2 (follow-up), no interaction effect (p = .99) but a marginally significant main effect of Time was observed, $F(1, 159) = 3.50$, p = .06, η_p^2 = .02, suggesting that all conditions slightly reduced their habit strength, see Table 1. An ANOVA indicated that, similar to baseline (see randomization check), this did not result in differences between conditions at T2 (all $p > .22$).

Discussion

In the present study we examined whether cue-monitoring, a novel way to gain insight into triggers for unhealthy snacking, enhances the effectiveness of implementation

intentions when fighting unhealthy snacking behavior. Contrary to the expectations, the results showed no main effect of planning, nor an interaction effect of planning with monitoring. However, a main effect of cue-monitoring was found: people who had kept a cue-monitoring diary had a lower snacking frequency and a slightly lower caloric intake from unhealthy snacks compared to people who had kept a control diary. The findings suggest that cue-monitoring may be a helpful tool in changing unhealthy snacking behavior.

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

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

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

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

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

Using cue-monitoring as a strategy to reduce unhealthy snacking has several advantages compared to other behavior change techniques. Filling out a cue-monitoring diary is a strategy that people can easily do themselves, without depending on professional super-

vision or commercial weight loss programs (Luszczynska, Sobczyk, & Abraham, 2007). Moreover, cue-monitoring is a tool that to a large extent could overcome the problem of poor insight (Loewenstein, 1996; Nisbett & Wilson, 1977) when aiming to gain more knowledge about such habitual behaviors. In the present study, participants in the cue-monitoring conditions were instructed to fill out their diary during or immediately after their snacking occasion (i.e., within an hour), thereby limiting the effects of poor retrospection and making people aware of their situation while they are in a 'hot' state. Additionally, cue-monitoring is easy to use, accessible, and can be implemented cost-effectively in large scale health interventions.

Some limitations of the present study should also be noted. Firstly, the effects were examined over a limited time period and more research is needed to address long-term effects. Secondly, the current sample size might have been insufficient to detect differences with a small effect size. With the current sample, a power of .80 was achieved to detect effects with small to medium magnitude (holding an effect size of $\eta^2 = 0.46$). Hence, smaller effects could have been overlooked and future research is needed to preclude this possibility. Additionally, we assessed unhealthy snacking behavior by means of a snack diary and such self-report measures may be vulnerable to inaccurate or incomplete data. Nevertheless, snack diaries are viewed as a high-quality and sophisticated measure of eating behavior (Adriaanse, Vinkers et al., 2011; De Castro, 2000). Fourthly, the effect sizes found in the present study were rather small. It should be noted, however, that all participants were highly motivated to change their unhealthy snacking behavior and the effects in the present study were obtained on top of the effects that might have been induced by the strict control conditions, e.g., reflecting upon one's snacking behavior and explicitly adopting a strong goal intention. Finally, the results can, as of yet, not be generalized to common populations as only students were included who received a monetary incentive or course credit. Future research should examine the effects of cue-monitoring and planning in community samples as well, if possible without such extrinsic rewards.

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

5

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

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Abstract

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

Introduction

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

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

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

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

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

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

Moreover, when looking at other research that might provide useful insight in the potential effects of multiple implementation intentions, the intuitive appeal of making multiple plans is tempered even further. It has, for example, been suggested that the effects of multiple implementation intentions may be 'diluted', which entails that each implementation intention will be less beneficial compared to when they are formulated in

isolation (Webb, 2006). One of the proposed reasons for this dilution is that weaker cue-response associations, i.e., the link between the critical cue ('if'-part of the implementation intention) and the alternative response ('then'-part) for the alternative behavior may be established (Webb, 2006). In line with this suggestion, research in cognitive psychology shows a similar phenomenon known as the 'fan effect' (e.g., Anderson & Reder, 1999), which describes the interference of associated information and shows that information is less accessible as the amount to be remembered increases. The above outlined literature suggests that multiple plans may lead to weakened associations between the critical cue and the desired alternative response. It remains unclear, however, whether such reduced effects would also occur for the situation described in the present paper: when formulating multiple implementation intentions each addressing a different critical cue, rather than making multiple plans for the same critical cue (when interference of plans is very likely; Gollwitzer, 2006; Vinkers, Adriaanse, Kroese, & De Ridder, in press).

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

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

The present study

In the present study, we aim to investigate the effects of making multiple implementation intentions, examining behavioral (Study 1) as well as cognitive (Study 2) implications. Moreover, in the second study we explore the underlying processes by examining whether problems occur due to formulating multiple implementation intentions or acting upon multiple plans. In order to examine this most stringently, optimizing the possible effectiveness of multiple plans, participants in this condition were explicitly instructed to formulate implementation intentions serving the same goal, while specifying different cues and alternative responses. Specifying similar critical cues or alternative responses would increase the potential for interference or dilution effects (Gollwitzer, 2006; Webb, 2006). Therefore, making multiple yet non-competing plans increases the chance that multiple plans will be effective.

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

Based on the suggested 'dilution' effect (Webb, 2006) and the 'fan' effect (Anderson & Reder, 1999) described above, we expect in the first study that multiple implementation intentions will be less effective in changing undesired habitual behaviors compared to making a single plan. In addition, in the second study, we expect that the formulation of multiple plans will create weaker cognitive associations between the critical cue and the alternative response compared to a single plan, implying that the habitual unhealthy snack will still be more accessible. In order to examine the underlying processes an additional condition is adopted in which participants formulate multiple plans for an unrelated domain (e.g., academic achievement) next to the snacking plan. Two competing hypotheses were formulated. For one, and similar to making multiple related plans, it could be expected that when additional unrelated plans are formulated, reduced mental associations for each implementation intention are established with the healthy alternative. This would indicate that the problems arise in the formulating phase of the planning process. Alternatively, it could be that not making multiple plans *per se* but rather the

interference of information in the content of the multiple plans causes problems when acting upon these plans. In the latter case, probably no adverse effects will be demonstrated when additional plans are formulated for an unrelated domain. As the information is less likely to cause interference, the related implementation intention might be just as effective.

Study 1

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

Method

Participants

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

Design

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

Procedure

At baseline, participants were requested to fill out a questionnaire measuring intention, habit strength, and demographic variables (i.e., age, weight, and height). Then, participants monitored their unhealthy snacking behavior and their snacking situations using a 'cue-monitoring diary' for three days. This monitoring phase was included to ensure that people were optimally prepared to identify three different snacking situations that could be specified as critical cues in the implementation intentions. Next, an appointment was made with each participant to come to the lab and hand in their cue-monitoring diary. Participants were asked to fill out several questionnaires and were then randomly assigned to one of the three conditions. Depending on their condition, participants were given instructions to formulate either one or three implementation inten-

tion(s), or, in the control condition, to list up to ten favorite healthy snacks (cf. Adriaanse et al., 2009). After these instructions, participants received a 'registering diary', in which they could indicate the amount and type of snacks they had consumed for another period of three days, starting on the day after participation in the lab. An appointment was made to return the diary in exchange for their reward. Lastly, participants were debriefed and thanked.

Instructions

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

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

Measures

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

Registering diary. The registering diary was similar to the cue-monitoring diary, except that in this diary only the type and amount of snacks per snacking occasion were

reported. Based on this diary, number of snacking occasions and caloric intake from unhealthy snacks were calculated as the dependent variables.

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

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

Data analyses

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

Results

Descriptive statistics and randomization check

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

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

Main analyses

Number of snacking occasions. An analysis of variance (ANOVA) was conducted with time (baseline vs. follow-up) as a within-subject variable, condition (one implementation intention vs. three implementation intentions vs. control) as a between subject variable and number of snacking occasions as a dependent variable. No main effect of condition was found $F(2, 60) = .32$, $p = .72$. A significant main effect of time was observed, $F(1, 60) = 22.70$, $p < .001$, $\eta_p^2 = .27$, indicating that all participants reported fewer snacking occasions after the experimental manipulation compared to before the manipulation.

However, this main effect was qualified by a significant time by condition interaction effect, $F(2, 60) = 4.56$, $p = .01$, $\eta_p^2 = .13$, indicating that reduction in number of snacking occasions varied between the three conditions (see Figure 1). In order to examine how the three conditions differed, simple main effects of time were calculated within each condition separately.

Simple main effects. A repeated measures ANOVA with time as a within subject variable and number of snacking occasions as a dependent variable was conducted for each condition. A main effect of time was found within both the control condition, $F(1, 21) = 8.56$, $p = .01$, $\eta_p^2 = .29$, and the one implementation intention condition, $F(1, 19) = 17.76$, $p < .001$, $\eta_p^2 = .48$. In the control condition, participants significantly reduced their number of snacking occasions from on average 2.01 snacking occasions at baseline (*SD* = 1.12) to 1.47 at follow-up (*SD* = 0.89). Participants who formulated a single plan reduced their number of snacking occasions from an average of 2.45 snacking occasions at baseline (*SD* = 1.34) to 1.45 snacking occasions at follow-up (*SD* = 0.82). In the three implementation intentions condition, however, no effect of time was observed, $F(1, 20) = .47$, $p = .50$ (baseline: *M* = 1.95, *SD* = 0.84; follow-up: *M* = 1.83, *SD* = 0.74).

Caloric intake. A similar repeated measures ANOVA was conducted with time (baseline vs. follow-up) as a within-subject variable, condition (one implementation intention vs. three implementation intentions vs. control) as a between subject variable, and mean daily caloric intake as a dependent variable. No main effect of condition was found $F(2, 60) = .12$, $p = .89$. The analysis showed a significant main effect of time, $F(1, 60) = 8.77$, $p = .004$, $\eta_p^2 = .13$, indicating that mean daily caloric intake from unhealthy snacks decreased after manipulation compared to baseline consumption. Moreover, the time by condition interaction approached significance, $F(2, 60) = 2.85$ $p = .066$, $\eta_p^2 = .09$, suggesting that reduction in mean daily caloric intake from unhealthy snacks differed between the conditions (Figure 2). Again, in order to examine how the three conditions differed in caloric intake reductions, simple main effects of time were calculated within each condition separately.

Simple main effects. A repeated measures ANOVA with time as a within subject variable and daily caloric intake as a dependent variable was conducted for each condition. A main effect of time was found within both the control condition, $F(1, 21) = 5.52$, $p = .03$, $\eta_p^2 = .21$, and the one implementation intention condition, $F(1 ,19) = 6.96$, $p = .02$, $\eta_p^2 = .27$. In the control condition, participants significantly reduced their caloric intake from unhealthy snacks from on average 416 per day at baseline (*SD* = 325) to 292 at follow-up (*SD* = 259). Participants who formulated one implementation intention reduced their daily caloric intake from unhealthy snacks from 420 on average at baseline (*SD* = 320) to 243 kilocalories at follow-up (*SD* = 180). In the three implementation intentions condition, however, again no effect of time was observed, $F(1, 20) = .04$, $p = .85$ (baseline: *M* = 358, *SD* = 161; follow-up: *M* = 368, *SD* = 197).

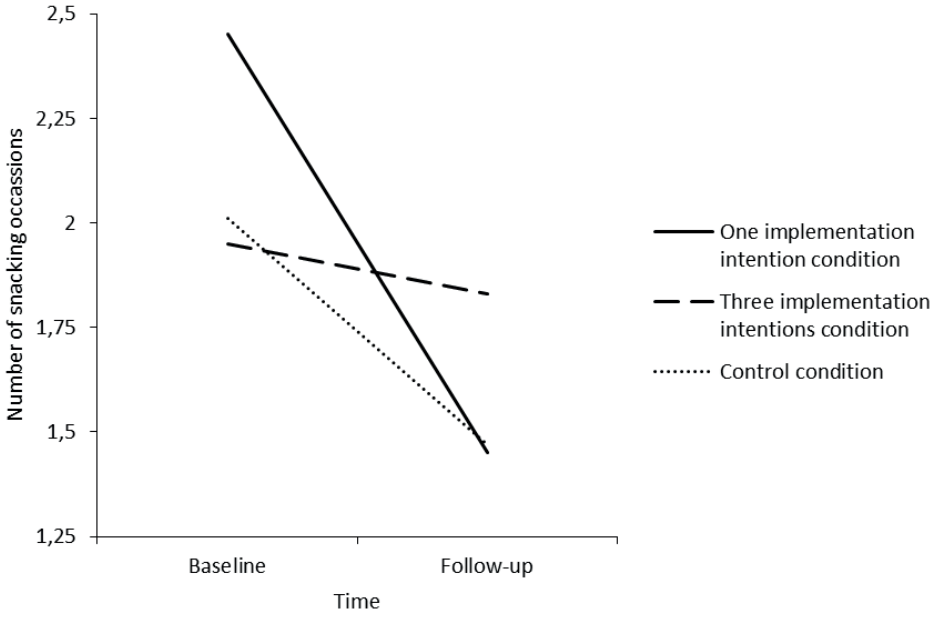

Figure 1: Study 1, Effect of formulating one, three, or zero implementation intentions on the number of snacking occasions.

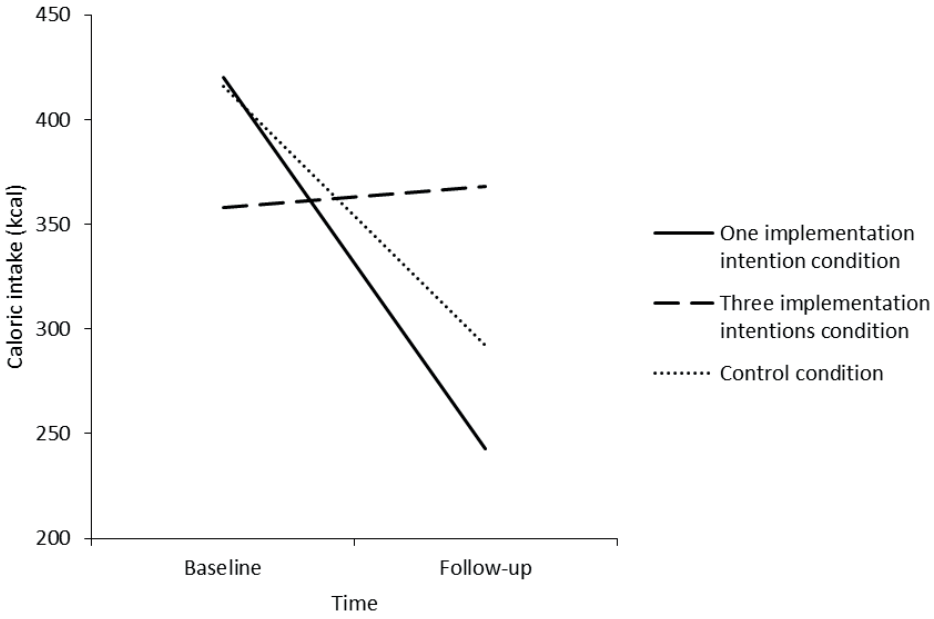

Figure 2: Study 1, Effect of formulating one, three, or zero implementation intentions on caloric intake form unhealthy snacks.

Discussion

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

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

Study 2

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

Method

Participants

One hundred and twenty one students who, upon recruitment, responded affirmatively to the question “Would you like to eat less unhealthy snacks?”, were recruited in exchange for €5 or course credit. Due to technical problems, eleven participants could not be included in the analyses. Participants (n = 17) who were underweight (BMI < 18.5; WHO, 2003b) or did not report their BMI were excluded from the analyses. The final sample consisted of ninety-three participants (50% female, 47% male, 3% not reported) with a mean age of 21.05 years (SD = 3.46) and a mean BMI of 23.41 (SD = 4.80, range: 18.59 - 54.35).

Design

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

Procedure

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

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

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

Means-generation task

In order to generate personally relevant critical cues, habitual snacks and healthy alternatives that could be specified in the implementation intentions and the lexical decision task, a means-generation task was employed (see for details: Adriaanse, Gollwitzer et al., 2011). Participants were requested to think about three different snacking situations and to specify one word for each situation that best reflected their critical cue for taking unhealthy snacks. Participants were explicitly asked to generate three different critical

cues. Then, they were requested to specify for each of the three critical cues what kind of unhealthy snack they often consume in that situation, and to report a healthier alternative for this situation, like taking a healthy snack or engaging in an alternative activity. Participants were requested to specify a different habitual snack and alternative behavior for each situation. To illustrate, when a participant indicated that they consume unhealthy snacks when feeling bored, when watching television, and when being with friends, it was asked "what kind of unhealthy snack do you usually consume in the situation 'bored'/'television'/'friends'?", and were additionally asked to describe "what kind of alternative could you consume or do in the situation 'bored'/'television'/'friends'?". After this, participants were asked to identify two situations in which they find it difficult to adhere to their goal of academic performance. In addition, they were requested to specify a solution for each of the situations.

Implementation intention formulation task

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

Lexical decision task

The lexical decision task, adopted from Adriaanse, Gollwitzer et al. (2011), was presented as a separate study and adjusted to allow for testing the effectiveness of multiple implementation intentions. Participants were told that in each trial of this task a word would be presented shortly, followed by a string of x's, and then a string of letters would appear on the computer screen. They were instructed to indicate as quickly as possible whether this string of letters was a word or non-word by pressing a left or right key. The task consisted of two blocks of 24 trials. Each trial started with a fixation cross (1,000 ms). Then, a word was shortly presented (50 ms). Following this prime, a string of

x's was used as a backward mask (700 ms). Then the target word or non-word that participants were supposed to respond to appeared on screen until a left or right key was pressed.

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

Questionnaires

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

Habit strength. Habit strength was measured similar to Study 1 (Cronbach's α = .93).

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

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

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

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

Data analyses

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

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

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

Results

Descriptive statistics and randomization check

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

Perceived healthiness check

It was tested whether participants specified alternatives that were indeed perceived as healthier than the habitual snack. Alternatives specified by the participants were mostly healthy snacks (e.g., apple) or engagement in an activity (e.g., working out). A repeated measures ANOVA was adopted with type of means (habitual snack vs. alternative) as the within-subject variable, condition (one implementation intention vs. three implementation intentions vs. unrelated implementation intentions vs. control) as the between subject variable, and perceived healthiness as the dependent variable. The results indicated a main effect of type of means for all analyses, showing that the alternative means were perceived as healthier than the corresponding habitual snack, all $F(1, 91) > 73.98$, all $p < .001$. No effects of condition, all $F(1, 91) < 1.42$, all $p > .23$, or

interaction effects between type of means and condition were found, all $F(1, 91) < 2.14$, all $p > .14$, indicating that this did not differ between the conditions.

Main analyses

Habit 1. A 2 (type of means: habitual snack vs. alternative; within subjects) x 2 (condition: one implementation intention vs. three implementation intentions vs. unrelated implementation intentions vs. control; between subjects) repeated measures ANOVA with reaction time to target words as a dependent variable revealed no main effect of type of means, $F(1, 86) = .77$, $p = .38$, or condition, $F(3, 86) = .50$, $p = .68$. However, a marginally significant type of means by condition interaction effect was observed, $F(3, 86) = 2.46$, $p = .068$, $\eta_p^2 = .08$, showing that the effect of type of means differed between the conditions (see Figure 3). In order to examine how the conditions differed, simple main effects of type of means were calculated within each condition separately.

Simple main effects. A repeated measures ANOVA with type of means as a within subject variable and reaction time as a dependent variable was conducted for all four conditions separately. No effect of type of means was revealed for the three implementation intentions condition, $F(1, 24) = .51$, $p = .48$, and the control condition, $F(1, 21) = .98$, $p = .33$. However, in the unrelated implementation intentions condition, a marginally significant effect for type of means was found, $F(1, 19) = 3.41$, $p = .08$, $\eta_p^2 = .15$, suggesting that participants in this condition responded faster to the alternative means compared to the habitual means after seeing their critical cue. Moreover, in the one implementation intention condition, a main effect of type of means was found, $F(1, 22) = 4.13$, $p = .05$, $\eta_p^2 = .16$, indicating that participants that formulated one plan were significantly faster to respond to the alternative, compared to the habitual means.

Habit 2 and 3. A similar repeated measures ANOVA was employed to examine whether the conditions differed in their response latencies to the habitual snack compared to the alternative for the habits for which only the three implementation intentions condition formulated implementation intentions. No main effect of type of means, $F(1, 87) = .35$, $p = .56$, or condition, $F(1, 87) = .18$, $p = .91$, was found. In addition, no type of means by condition interaction-effect was observed, $F(1, 87) = .58$, $p = .63$, indicating that for these habits, none of the conditions had a cognitive advantage for one of the means over the other, regardless of the number of implementation intentions formulated.

Plan commitment and plan motivation

An ANOVA revealed no differences between the conditions in plan commitment, $F(3, 92) = 1.26$, $p = .29$, or plan motivation, $F(3, 92)$, $p = .22$, for the first plan. In addition, within the three implementation intentions condition, a repeated measures ANOVA with habit (habit 1, 2, and 3) as within subject variable showed no differences of plan commitment, $F(2, 23) = .81$, $p = .46$. Therefore, no support was found for these alternative explanations. A similar analysis for plan motivation did show a difference between the

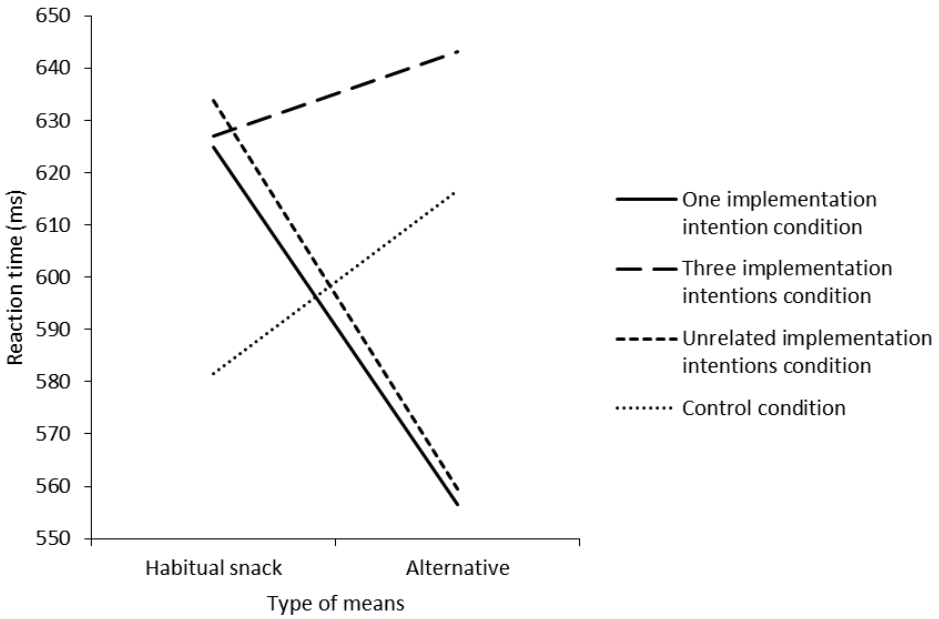

Figure 3: Study 2, Effect of formulating zero, one, three, or one related and two unrelated implementation intention(s) on reaction times to the habitual snack or alternative when primed with corresponding critical snacking situation for plan 1 (variables in Figure not Log transformed).

three plans, $F(2, 23) = 5.07$, $p = .02$, $\eta_p^2 = .31$, indicating that participants were somewhat more intrinsically motivated to act out the first ($M = 6.32$, $SD = .63$) or third ($M = 5.96$, $SD = .63$) plan compared to the second plan ($M = 5.04$, $SD = .62$).

Discussion

In the second study, we examined the cognitive effects of making multiple implementation intentions targeting counter-intentional habits. The present results add to our theoretical framework in two ways. First, we replicated the findings of our first study using a cognitive measure, by showing that making one implementation intention is more effective in changing unhealthy snacking habits than making multiple plans. When formulating a single plan, the alternative means became more accessible upon priming with the critical cue compared to the habitual means. Yet, participants who formulated three implementation intentions did not replace their unhealthy habit. Second, the present findings suggest that the reduced effects of making multiple plans occur due to interference of information when enacting the plans, rather than formulating multiple plans itself. Participants who formulated multiple implementation intentions regarding an unrelated domain also seemed to replace their unwanted habit with a new one, as they displayed marginally

significantly faster responses to the healthy alternative compared to the habitual means after the critical cue prime. Importantly, participants who formulated three implementation intentions also did not outperform the other participants on the second and third habit. Thus, no advantage was established in the three implementation intentions condition for the first plan, as well as for the extra two plans.

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

General discussion

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

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

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

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

Although the large body of evidence showing the effectiveness of implementation intentions in numerous domains is convincing (e.g., Adriaanse, Vinkers et al., 2011; Gollwitzer & Sheeran, 2006; Verplanken & Faes, 1999), the present results show that there are also limits to the use of implementation intentions. For many behaviors targeted in previous studies, especially studies conducted in controlled settings, fuelling a single cue-response link with one implementation intention is sufficient to achieve behavior change. However, when trying to change complex behaviors – as most of the targeted

behaviors are - the behaviors are induced by multiple critical cues and in multiple situations and the usual implementation intentions approach may therefore not be sufficient.

The current findings thus have important implications for research and interventions regarding the effectiveness of implementation intentions. In many behavior change intervention studies participants are stimulated to formulate multiple implementation intentions (e.g., De Vet, Oenema et al., 2009; Jackson et al., 2005; Koestner, Lekes, Powers, & Chicoine, 2002). However, in light of the current findings, this strategy may seriously jeopardize the effectiveness of the plans. Indeed, several of these studies (De Vet et al., 2009; Jackson et al., 2005) did not find beneficial effects of implementation intentions and the present adverse effects of multiple plans may explain these findings. In addition, although in behavior change interventions it is common to ask individuals to make multiple implementation intentions, the present study shows that this might be an ineffective approach.

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

As the present study focused on *changing* unwanted habits, the lower effectiveness of multiple plans may not be generalized to implementation intentions promoting *new* behaviors as well. Adopting new habits is generally easier to achieve then changing old ones (Holland, Aarts, & Langendam, 2004) and the dilution may therefore be weaker. Indeed, recent findings suggest that making multiple plans may in fact be quite promising when targeting the initiation of new habits like fruit and vegetable intake (Wiedemann, Lippke, & Schwarzer, 2011) and physical activity (Wiedemann, Lippke, Reuter et al., 2011). Nonetheless, the study by De Vet, Oenema et al. (2011) showed that multiple plans targeting physical activity is only effective when the specificity of plans is protected. Moreover, as these studies merely provide correlational evidence, future research is warranted to examine whether the findings of the present study apply to multiple implementation intentions promoting new behaviors as well.

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

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

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

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Using implementation intentions as a metacognitive strategy to change unhealthy snacking behavior

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Abstract

Implementation intentions effectively change unwanted habits, like unhealthy snacking habits, by establishing strong cue-response associations. These associations, however, may make the plan rather inflexible as they target a very specific situation (cue) and response. It was therefore examined whether implementation intentions can be taught as a metacognitive strategy (MCS), by informing people how to adjust plans to personal needs and changing circumstances for decreasing unhealthy snacking. After filling out a cue-monitoring snack diary, participants from a community sample (N = 78) randomly received one of three planning exercises (forming goal intentions (control), regular implementation intentions, or implementation intentions using MCS). The MCS involved three steps: planning, monitoring, and evaluating. Participants filled out a seven day snack diary and questionnaires after one and two months, which served as dependent variables. Linear growth modeling was used to examine effects on unhealthy snacking over time. No changes were found in the goal intention or regular implementation intention condition (p's > .32). Yet, a significant reduction was found in the MCS condition (p < .001). Furthermore, comparing unhealthy snacking at two month follow-up indicated that the MCS condition had a lower caloric intake than the goal intention condition (p = .02) and regular planning condition (p = .04). The findings suggest that implementation intentions can be taught as a metacognitive strategy. Providing the planning instructions only once resulted in substantial behavior change. Teaching if-then plans as a metacognitive strategy is an effective way to increase implementation intention effectiveness in reducing unhealthy snacking.

Introduction

The concept of implementation intentions was introduced over two decades ago as a tool to facilitate goal attainment (Gollwitzer, 1993). By creating an association between a particular cue and a goal-directed response, implementation intentions (e.g., 'If situation X arises, then I will perform goal directed behavior Y!') have been found to effectively aid the translation of intentions into goal-directed behavior. This is found for increasing health promoting behaviors (e.g., physical activity; Bélanger-Gravel, Godin, & Amireault, 2013) as well as diminishing unhealthy habits (e.g., unhealthy eating; Adriaanse, Vinkers, De Ridder, Hox, & De Wit, 2011). While implementation intentions are largely effective because of the strong cue-response association they establish (Webb & Sheeran, 2007), this also makes them rather inflexible as they target both a single specific situation (cue) and a detailled goal-directed action. If individuals realize that this situation is no (longer a) good opportunity to act, or if the goal-directed response becomes impossible, modification of the plan is required. Unfortunately, when people are instructed to us implementation intentions they are typically not taught how to adjust plans to accommodate changes in individual needs or circumstances. In the present study, it is tested whether implementation intentions to break unhealthy snacking habits can be used as a *metacognitive strategy,* in which people are taught how to adjust their implementation intentions to varying circumstances by themselves when needed.

To change existing habits, if-then plans usually specify the cue eliciting the unwanted behavior and link this to a favorable response, e.g., 'If I am bored and feel like taking a snack, then I will eat an apple!' (Adriaanse, De Ridder, & De Wit, 2009). In this way, the specific cue (boredom) inducing the unwanted habit (e.g., eating chocolate) becomes more strongly associated with a desirable response (apple) while the link between the cue and the unwanted habit is at the same time inhibited. As a result, the cognitive advantage of the habitual behavior in this specific situation is removed, making people more likely to eat the healthy apple (Adriaanse, Gollwitzer, De Ridder, De Wit, & Kroese, 2011).

Although implementation intentions are commended for their positive aspects including their effectiveness, simple format, and low burden for participants (Hagger & Luszczynska, 2014), there is an important limitation when used in applied settings. The highly specific cue-response association that is a key underlying mechanism of their effectiveness (Adriaanse, Gollwitzer, et al., 2011; Webb & Sheeran, 2007), makes if-then plans rather inflexible (Hagger & Luszczynska, 2014). This could be problematic in at least three ways.

Firstly, many unhealthy behaviors that people want to change are performed in response to multiple cues (e.g., unhealthy snacks may be consumed when enjoying a special occasion, experiencing negative emotions, or social pressure; Verhoeven, Adriaanse, De Vet, Fennis, & De Ridder, 2014a). Targeting a single cue is therefore likely to

be insufficient to render a substantial change in one's eating behavior. One solution is to form multiple plans at once targeting various triggers. Yet, this has been found to result in weakened cue-response associations, jeopardizing plan effectiveness (Verhoeven, Adriaanse, De Ridder, De Vet, & Fennis, 2013). Secondly, personally relevant cues triggering the unwanted behavior are likely to change over time. If someone has managed to successfully change behavior because of using an implementation intention in response to one particular cue, other triggers might become more relevant to be targeted. Thirdly, when trying to implement an if-then plan, people may realize that they did not make an optimal plan, because, for example, the described alternative behavior cannot be enacted in response to the specified cue. Although after plan formation people remain equally sensitive to alternative opportunities compared to people who did not formulate implementation intentions (Gollwitzer, 2014), they do not benefit from strategic automaticity if the options are not specified in the plan.

Taken together, the strong cue-response link is both the key to implementation intentions success and a serious limitation in practice as such plans may become rather inflexible. This limitation is a result of how people typically are instructed to use this strategy. Typically, participants are prompted to fill out an if-then plan by simply following instructions. They are not informed how to use the strategy independently, and thus not employing it in a metacognitive way, which would allow them to actively reflect on their plans and adjust the components to align them with their personal needs. Notwithstanding this common practice, the use of implementation intentions has previously been regarded as part of 'metacognitive' processes in the self-regulation of goal pursuit (Achtziger, Martiny, Oettingen, & Gollwitzer, 2012; Gollwitzer & Schaal, 1998), entailing that people may employ implementation intentions as a self-management strategy for goal striving.

In the present study, we aim to teach implementation intentions as a metacognitive strategy. In doing so, a theoretical framework is adopted based on cognitive and educational psychology. The term metacognition was first described by Flavell (1979). Although researchers have employed different conceptualizations, metacognition is broadly defined as a 'higher-order cognition about cognition' (Veenman, Van Hout-Wolters, & Afflerbach, 2006; Woolfolk, Hughes, & Walkup, 2013). To illustrate, Nelson (1996; see also Achtziger et al., 2012) distinguished between two levels: the 'object-level' including cognitions regarding external objects, and the 'meta-level' overlooking the object-level and steering it towards desired goals. Information about the object-level flows to the meta-level by monitoring, while the meta-level affects the object-level via planning and controlling. Most descriptions of metacognition distinguish two such components, i.e., knowledge about cognition (what we know about our cognition) and regulation of cognition (how we use that knowledge to regulate cognition), with the latter entailing three central skills that also apply to Nelson's model (1996): planning, monitoring, and

evaluating (or 'controlling'; Achtziger et al., 2012; Schraw, 1998; Schraw & Moshman, 1995; Woolfolk et al., 2013).

The first skill, planning, involves determining how to achieve the goal, including selecting suitable strategies. Monitoring, then, comprises examining one's goal progress. Finally, evaluating entails judging the process and its outcomes, and deciding whether the strategy is effective or in need of adjustments (Schraw, 1998; Woolfolk et al., 2013). These metacognitive processes can be activated consciously and deliberately, as well as unintentionally and automatically (e.g., Schraw & Moshman, 1995; Veenman et al., 2006).

It has been demonstrated that metacognition can be trained (Flavell, 1979; Schraw, 1998) which has been applied mostly in educational domains relating to cognitive processes, like reading skills (Haller, Child, & Walberg, 1988) or mathematical problem solving (Schneider & Artelt, 2010). Importantly, each of the three skills involved in metacognition are applicable to the process of implementation intention formation (Achtziger et al., 2012; Gollwitzer & Schaal, 1998). Firstly, planning would mean determining when ('If situation X arises...') and how ('Then I will...') to act. Monitoring, refers to reflecting upon the behavior and its triggers to determine whether the plan is effective and still relevant. Lastly, evaluating involves deciding to either repeat the original plan or to formulate a new, more suitable one.

The potential of implementation intentions as a metacognitive strategy is suggested in recent literature (Achtziger et al., 2012; Gollwitzer, 2014) by emphasizing that content-free formats may be used along with detailed explanations how to individualize plans for personal goals. In the present study, the way of adopting a metacognitive strategy acknowledges this benefit and goes a step further by explaining how implementation intentions are used, as people learn when and how to adjust plans to changing contexts or to adjust unsatisfactory or completed plans. We focus on unhealthy snacking as a typical case of an unwanted habit elicited in different contexts (Verhoeven et al., 2014a). Forming implementation intentions to fight existing habits is, however, challenging in itself as the personally relevant critical trigger must be specified (Adriaanse et al., 2009) and many people experience difficulties in identifying specific personal cues to make a plan (De Vet, Gebhardt et al., 2011). We therefore combine implementation intentions with cue-monitoring, a strategy that aids insight into one's triggers for unhealthy snacking (Verhoeven, Adriaanse, De Vet, Fennis, & De Ridder, 2014b).

The present study was thus designed to examine the effects of implementation intentions as a metacognitive strategy (MCS) over a two month period in a community sample targeting unhealthy snacking behavior. These effects are compared to regular implementation intentions and a control condition (goal intention). It is expected that the MCS will be superior in diminishing unhealthy snacking in the long run compared to usual implementation intentions or goal intentions. Possible effects are also examined for healthy snacks, habit strength, and body mass index.

Method

Participants

Seventy nine people who responded to an advertisement on the website from the Dutch Nutrition Centre participated in the study, of which 64 (81%) completed the study (i.e. filled out each snacking behavior measurement with at least 4 out of the 7 days in the snack diary). Separate ANOVA's indicated no differences between study completers and non-completers for age, BMI, intention, habit strength, and caloric intake at baseline (*p*'s > .58). Separate Chi squared analyses indicated that study completers and non-completers did not differ in gender, education, experimental condition (all *p*'s > .15), and dieting status, although the latter approached significance, χ^2 (1) = 3.00, *p* = .08, such that among non-completers, no-one indicated to diet, while 11 completers (6%) reported to diet.

Non-completers were incorporated in the analyses through Full Information Maximum Likelihood (FIML). Previous studies have found that the exclusion of missing cases (i.e., listwise deletion) can lead to biased results (Asendorpf, Van de Schoot, Denissen, & Hutteman, 2014; Harel, Zimmerman, & Dekhtyar, 2008; Myers, 2011). As an alternative, it is recommended to incorporate missing cases by imputing values (Multiple Imputation) or by estimating parameters based on the information available in the dataset (FIML; Enders, 2010; Graham, 2009). Models in Mplus were estimated while using FIML with robust standard errors, which accounts for possible non-normality of the data.

In line with previous studies (Adriaanse et al., 2009; Verhoeven et al., 2014b), participants who were underweight (BMI < 18.5; WHO, 2003b; *n* = 1) were excluded from the analyses. This resulted in a total sample of 78 participants, of whom 71 were female (91%). All participants held the Dutch nationality. Participants had a mean age of 35.24 years (*SD* = 10.59, range: 19 - 61) and a mean BMI of 24.62 (*SD* = 3.91, range: 18.94 – 39.06). None of the participants were classified with an eating disorder but 13% indicated to be currently on a diet. Most participants (58%) finished higher education, 39% completed medium education, 4% finished lower education, and none of the participants completed primary school only. Of the participants, 19 were in the goal intention condition, 30 in the goal intention plus regular implementation intention condition, and 29 participants received the MCS. Correlations between the main variables under study can be found in Table 1.

Design

A 3 Planning exercise (goal intention; goal intention plus regular implementation intention; goal intention plus MCS – between subjects) by 4 Time (baseline; directly following planning exercise; after one month; after two months – within subjects) mixed design was adopted, although the behavioral measures (i.e., snack diaries) were assessed at 3 time points (baseline; after one month; after two months).

Table 1. Correlations between the variables under study.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.
1. Age T0	-																
2. BMI T0	.26*	-															
3. BMI T1	.28*	.99**	-														
4. BMI T2	.30*	.98**	1.00**	-													
5. BMI T3	.22	.98**	1.00**	1.00**	-												
6. Intention T0	-.08	.17	.19	.17	.09	-											
7. Intention T1	-.20	.17	.20	.20	.13	.60**	-										
8. Intention T2	-.02	.22†	.24	.24†	.20	.48**	.54**	-									
9. Intention T3	-.09	.04	.07	.09	-.04	.43**	.38**	.46**	-								
10. SRHI T0	.10	.38**	.44**	.37**	.45**	.52**	.35**	.39**	.18	-							
11. SRHI T1	.19	.34**	.33**	.34*	.40**	.38**	.10	.12	.17	.68**	-						
12. SRHI T2	-.09	.18	.09	.16	.25†	.16	-.03	-.02	.01	.40**	.62**	-					
13. SRHI T3	-.12	.28*	.20	.26†	.33*	.15	-.03	-.04	-.06	.43**	.57**	.80**	-				
14. Unhealthy snacks T0	.13	.38**	.37**	.39**	.46**	.12	.01	.07	-.05	.41**	.40**	.38**	.47**	-			
15. Unhealthy snacks T2	-.02	-.03	-.05	-.07	.06	.02	-.03	.06	-.11	.18	.07	.32*	.33**	.34**	-		
16. Unhealthy snacks T3	-.05	.15	.15	.14	.22	.01	-.13	-.18	-.27*	.13	.03	.25†	.32**	.44**	.53**	-	
17. FV snacks T2	.06	-.04	.00	-.06	-.11	.11	.16	.10	.03	.12	.07	.01	.14	-.06	-.12	-.15	-
18. FV snacks T3	.19	-.04	-.01	-.08	-.10	-.05	.15	.04	-.02	.09	.03	.11	.12	.08	.00	-.05	.76**

** Correlation is significant at the 0.01 level (2-tailed), * Correlation is significant at the 0.05 level (2-tailed), † Correlation is marginally significant at the 0.10 level (2-tailed).

T0 = baseline, T1 = after planning exercise, T2 = one month follow-up, T3 = two month follow-up.

Procedure

An advertisement on the website from the Dutch Nutrition Centre was placed to recruit people who were motivated to eat fewer unhealthy snacks. People who were interested could send an e-mail to the experimenter with their name, e-mail address, and home address. At the start of the study, all participants received an e-mail with a link to the online baseline questionnaire (T0). All participants provided informed consent according to the ethical standards outlined in the APA's Ethical Principles of Psychologists and Code of Conduct. Participants then reported on demographic background, intention to consume fewer unhealthy snacks, unhealthy snack habit strength, and possible eating disorders. Then, a cue-monitoring phase was adopted to promote cue-identification for implementation intention formation. This phase was included in each condition (thus also in the goal intention condition) to allow for detecting the pure effect of the implementation intention strategy, as cue-monitoring in itself also affects unhealthy snacking (Verhoeven et al., 2014b). Participants received a paper cue-monitoring diary by post to monitor their (triggers for) unhealthy snacking. They were asked to keep this diary for six days after filling out the baseline questionnaire. One week after the start, an e-mail was sent with a planning exercise in an attached document. Participants were randomly assigned to one of three planning exercises (goal intention, goal intention + regular implementation intention, goal intention plus MCS). After filling out their plan, participants received the link to the first online follow-up questionnaire (T1) assessing weight, plan motivation, plan commitment, intention, satisfaction with unhealthy snack consumption, and habit strength.

One month after the start of the study, participants were asked to report their unhealthy and healthy snack consumption for seven consecutive days using an online snack diary. A reminder was sent by e-mail every day. After this week, participants received an e-mail with a link to the second online follow-up questionnaire (T2) assessing weight, plan commitment, perceived plan effectiveness, use of intervention components (i.e., the cue-monitoring phase and the planning exercise which referred to either to the goal intention, the implementation intention, or the MCS), intention, satisfaction with unhealthy snack consumption, and habit strength. Two months after the beginning of the study, participants were again requested to report their unhealthy and healthy snack consumption for one week and to fill out the final online follow-up questionnaire (T3) similar to T2. Finally, participants were debriefed by e-mail, thanked for their participation, and received a book about psychology and eating as a reward.

Materials

Cue-monitoring diary

The cue-monitoring diary was adapted from Verhoeven and colleagues (2014b). Participants were asked to report their unhealthy snack intake as well as to reflect upon the snacking situation and the most important reason for taking the snack. More

specifically, for each snacking occasion, participants indicated (a) the type of the consumed snack based on a list of 14 options (e.g., crisps) and the amount of that snack in appropriate units (e.g., handful), (b) characteristics of the snacking situation, that is, day and time of the day, activity (e.g., watching TV), setting (e.g., at home), and company (e.g., alone), and (c) their most important reason for consuming unhealthy snacks based on a list of 22 different reasons (e.g., 'to cope with negative emotions'). For each category, also an option 'other, namely…' was included. At the end of the cue-monitoring phase, participants were asked to write down the most important insights they gained and write this down on five open lines.

Participants were instructed to fill out the diary every time they consumed a snack within 30 minutes after snack consumption and could report up to six snacking occasions per day. A snack was defined as any unhealthy food consumed in between the regular meals (breakfast, lunch, and dinner). To identify critical cues for unhealthy snacking to support implementation intention formation, only triggers for unhealthy snacking behavior were reflected upon. Healthy snacks were therefore not included in the cue-monitoring diary. Using this diary, baseline unhealthy snack consumption was calculated.

Planning exercise

Goal intention. Participants in the goal intention condition received instructions to formulate their goal intention to eat fewer unhealthy snacks, to write down this intention, and to repeat this intention a couple of times to themselves.

Regular implementation intention. Participants in the goal intention plus regular implementation intention condition (hereafter referred to as regular implementation intention condition) also received the instruction to repeat their goal intention. In addition they received elaborate instructions to formulate an if-then plan in four steps. First, thinking about their cue-monitoring week, participants identified their most important trigger for unhealthy snacking and described it in one sentence ('If…'). Second, they wrote down a healthy alternative response in one sentence ('Then…'). Examples of healthy alternatives were provided, such as eating something healthily or engaging in an activity like calling a friend. After this, the two parts were combined into a complete if-then plan. Finally, participants were asked to repeat their implementation intention and write it down once more (see Knauper, Roseman, Johnson, & Krantz, 2009).

Implementation intentions as a metacognitive strategy (MCS). In the goal intention plus MCS condition (hereafter referred to as MCS condition), participants first repeated their goal intention and formed an implementation intention similar to the regular implementation intention condition. They then received instructions about when and how if-then plans could be adjusted to changing circumstances:

"You just received instructions on how to formulate an 'if-then plan'. With these, you formulated an if-then plan for your own personal snacking

situation. This plan will help you to deal with this situation when you encounter it.

The coming month you are asked to employ this plan and to reduce your unhealthy snacking behavior. It is, however, possible that your personal snacking situations change over time. It is also possible that as soon as you changed your snacking habit in one situation, you would like to break the next snacking habit. For example: You now made a plan to eat something healthily when watching television. Perhaps at a certain point you have changed your snacking behavior in this situation but now you mostly consume unhealthy snacks when you are at a party. In this case, you can make a new plan for that situation.

It is therefore important that you yourself learn how to formulate good if-then plans, so that you can adapt your if-then plan to changing circumstances. To continue changing your snacking behavior and to optimally benefit from this tool, you are asked this month to go through three steps: (1) planning*, (2),* monitoring*, and (3)* evaluating*."*

These steps were then explained to participants. Firstly, for planning, the four steps of formulating regular if-then plans were shortly outlined again (if, then, if-then, repeat). Secondly, monitoring was explained as follows:

"The second step is to give a moment's thought to your snacking behavior. For the study, you are asked to do this weekly. Ask yourself how you are doing with your snacking behavior. Was the plan helpful? Does performing the wanted behavior in your snacking situation now require less effort? Is your most important snacking situation still the same or does this differ? Look back at the most important insights you gained from the Snack diary [i.e., cue-monitoring diary]; has it changed? You received a digital copy of the Snack diary. You can print this diary and use it to monitor your snacking behavior again to gain new insights."

Thirdly, evaluating was described as follows:

"The final step is to evaluate your plan. In doing so, you are going to decide whether your plan is still applicable or that it is perhaps time for a new plan. Ask yourself the following questions: Am I satisfied with my plan? Is my plan still relevant? Do I need a new plan?"

Finally, participants were informed that after following these steps, they could return to the first step, planning, and decide whether to keep the old plan or form a new one. They were explicitly instructed to use only one plan at a time, and they were encouraged to use this strategy as much as they like. They were also informed that they would not be reminded of doing so as they had to employ the strategy independently. Lastly, a schematic overview of the three steps was provided.

Measures

Baseline Questionnaire (T0)

Demographic variables. Age, height, and weight were assessed with open format questions. One of multiple options could be indicated for gender (i.e., 'male' or 'female'), education level ('primary school', 'lower education', 'medium education', or 'higher education'), nationality ('Dutch' or 'other, namely…'), and whether they currently followed a diet ('no' or 'yes, namely…').

Intention. Intention to eat fewer unhealthy snack was assessed with 3 items ('I plan/want/am motivated to eat fewer unhealthy snacks'), Cronbach's α = .89. Answers were rated on 7-point scales from 1 (*completely disagree*) to 7 (*completely agree*).

Habit strength. Habit strength was measured with the Self-Reported Habit Index (Verplanken & Orbell, 2003), assessing unhealthy snacking habits using 12 items (e.g., 'Eating unhealthy snacks is something I do automatically'), Cronbach's α = .88. Answers were rated on 7-point scales from 1 (*completely disagree*) to 7 (*completely agree*).

Eating disorders. Classification of having an eating disorder was assessed with the Eating Disorder Diagnostic Scale (Stice, Telch & Rizvi, 2000), a brief self-report scale for diagnosing anorexia nervosa, bulimia nervosa, and binge-eating disorder, using 25 items.

Questionnaire following planning exercise (T1)

This questionnaire was assessed directly after the planning exercise, which was preceded by the cue-monitoring phase. Weight, intention (Cronbach's α = .83), and habit strength (Cronbach's α = .92) were measured similar to T0.

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

Plan commitment. Plan commitment was measured with two items (e.g., 'Acting out this plan was important to me.'), on 7-point scales from 1 (*completely disagree*) to 7 (*completely agree*), r = .61, p < .001.

Satisfaction with unhealthy snack consumption. Satisfaction with snack consumption was examined with the item 'I am satisfied with the amount of unhealthy snacks I eat' on a 7-point scales from 1 (*completely disagree*) to 7 (*completely agree*).

Questionnaire at one month follow-up (T2)

Weight, plan commitment (r = .70, p < .001), intention (Cronbach's α = .80), satisfaction with unhealthy snack consumption, and habit strength (Cronbach's α = .91) were measured similarly to T0/T1.

Perceived plan effectiveness. Perceived plan effectiveness was assessed with 2 items (e.g., 'This plan helped me to eat fewer unhealthy snacks.'), on 7-point scales from 1 (*completely disagree*) to 7 (*completely agree*), $r = .64$, $p < .001$.

Use of intervention components. For both components of the intervention (cue-monitoring phase and planning exercise, with the latter referring to the goal intention, the regular implementation intention, or the MCS, depending on condition), participants were asked to what extent it had contributed to consuming fewer unhealthy snacks, and how often participants had used that component in the past month, both on 7-point scales from 1 (*not at all, never*) to 7 (*very much, very often*). In addition, regarding the planning component, participants were asked to indicate how many new plans they formulated in the last month, next to the plan they formulated during the exercise.

Questionnaire at two months follow-up (T3)

Weight, plan commitment ($r = .78$, $p < .001$), perceived plan effectiveness ($r = .72$, $p < .001$), use of intervention components, intention (Cronbach's $\alpha = .82$), satisfaction with unhealthy snack consumption, and habit strength (Cronbach's $\alpha = .91$) were measured similar to T0/T1/T2.

Snack consumption (T2 and T3)

Caloric intake from unhealthy snacks at baseline was calculated from the entries in the cue-monitoring diary (see *Cue-monitoring diary*). At T2 and T3, a separate snack diary was administered to obtain data on healthy and unhealthy snack consumption (so note, that on T0 only unhealthy snacks were assessed). Participants filled out an online snack diary (based on Adriaanse et al., 2009; Verhoeven et al., 2014b) for seven days. Participants received a daily e-mail and were requested to fill out the snack diary at the end of the day when they did not expect to eat anymore, or the next day. The snack diary comprised of a list of 3 entries for fruits, 3 entries for vegetables, 10 pre-defined options for not-unhealthy snacks (such as non-fat yoghurt), 14 pre-defined options for unhealthy snacks, and 5 entries for 'other'. Participants were explained that snacks were defined as any food consumed in between the three main meals (breakfast, lunch, and dinner) and were asked to indicate which snacks they consumed and how much of that snack they had eaten in suitable units (e.g., 'pieces' for apples, and 'hands' for crisps). Unhealthy snack consumption was calculated in kilocalories by multiplying the quantity of the snack taken by the number of calories it contains (Dutch Nutrition Centre, 2010a). Unhealthy snacks included the snacks that contain large amounts of unhealthy ingredients such as sugar, fat, or salt, based upon the guidelines from the Dutch Nutrition Centre. For healthy snacks, fruit and vegetables were included calculated in portions. Snack foods that do not belong to either category were not included.

Data analyses

Analyses regarding the descriptive statistics, randomization check, and additional variables were conducted using SPSS 22.0. The remaining analyses were conducted in

Mplus to account for drop-outs and possible non-normality of the data. To examine whether outcome measures changed over the course of the study (i.e., from T0 to T3), we estimated growth models with intercepts (i.e., the starting point at T0) and slopes (i.e., the change from one measurement wave to the next). To examine whether the experimental condition predicts the change in the dependent variables, separate slopes for each condition were estimated and slope differences between conditions were tested.

Results

Randomization check and additional variables

Separate Chi square analyses indicated no differences between conditions for education or dieting status (p's > .94). Separate ANOVA's indicated also no differences for age, BMI, intention, or caloric intake at baseline between conditions (all p's > .23), although the effect for habit strength approached significance, $F(2, 75) = 2.58$, $p = .08$, $\eta_p^2 = .06$. Post-hoc analyses with Bonferroni correction indicated that the goal intention condition tended to show a weaker snacking habit ($M = 4.26$, $SD = 1.14$) than the regular implementation intention condition ($M = 4.88$, $SD = 0.92$, $p = .09$). No differences were found between the goal intention and the MCS condition ($M = 4.53$, $SD = 0.85$, $p = .99$) or the MCS condition and the regular implementation intention condition ($p = .50$). However, conducting the main analyses while controlling for baseline habit strength did not affect the results. It should be mentioned that there were no men in the MCS condition, while there were men in the goal intention ($n = 4$) and regular implementation intention condition ($n = 3$). However, conducting the main analyses with only women included did not affect the results.

Effects between conditions on additional variables were examined for alternative explanations of the possible results. No effects were found for the additional variables, indicating that satisfaction with unhealthy snack consumption, perceived plan effectiveness, plan commitment, plan motivation, number of plans, and use of strategy components were not differentially affected by the planning exercise ($p > .20$).

Using growth modeling in Mplus, it was found that intention decreased significantly over time, $b = - 0.09$, $SE = 0.03$, $t = - 2.56$, $p = .01$. Yet, no differences in the decrease were found between conditions (p's > .21), thus ruling out condition-dependent changes in intention as an alternative explanation of the results.

Main analyses

Unhealthy snack consumption. Growth modeling was used to examine the effects of planning exercise on unhealthy snacking behavior over time. As unhealthy snacking intake was measured in three waves (T0, T2, T3), both linear and quadratic relations for the time effect were estimated. Estimating the development of unhealthy snacking over time as a quadratic relation did not improve model fit indices (i.e., RMSEA, CFI), therefore, the linear time effect is described. At baseline, participants consumed on average 396.95

kcal from unhealthy snacks (*SD* = 209.67). Across conditions, unhealthy snacking decreased by 43.84 kcal (*SE* = 15.84, *t* = -2.77, *p* = .006) per measurement. For this decrease, no difference was found between the goal intention and regular implementation intention condition (*p* = .57). Yet, the MCS condition more strongly reduced caloric intake from unhealthy snacks compared to the goal intention, *t* = -2.38, *p* = .02, and regular implementation intention condition, *t* = - 2.49, *p* = .01. Over time, no effect was observed for the goal intention condition, *b* = -1.41, *SE* = 33.22, *t* = -0.04, *p* = .97, or the regular implementation intention condition, *b* = -24.05, *SE* = 23.96, *t* = - 1.00, *p* = .32. After receiving the MCS, unhealthy snacking reduced with 94.70 daily kilocalories per measurement, *SE* = 19.14, *t* = - 4.95, *p* < .001. This is shown in Figure 1.

The effects of planning exercise were also examined per measurement wave while controlling for baseline caloric intake. After one month (T2), no difference was found between the goal intention and regular implementation intention condition, *b* = - 71.40, *SE* = 60.67, *t* = 1.18, *p* = .24. Also, no difference was observed between the MCS and the goal intention condition, *b* = - 36.47, *SE* = 55.97, *t* = 0.65, *p* = .52. The MCS condition had a lower caloric intake than the regular implementation intention condition, *b* = - 107.86, *SE* = 52.52, *t* = -2.05, *p* = .04. After two months (T3), again no difference was found between the goal intention and regular implementation intention condition, *b* = 82.64, *SE* = 90.94, *t* = 0.91, *p* = .36. Yet, the MCS condition had a lower caloric intake than the goal intention condition, *b* = - 201.89, *SE* = 85.85, *t* = -2.35, *p* = .02, and the regular implementation intention condition, *b* = - 119.19, *SE* = 57.87, *t* = -2.06, *p* = .04. See Table 2.

Secondary measures

Healthy snack consumption. Healthy snack consumption was assessed after one (T2) and two (T3) months to test possible effects on fruit and vegetable consumption. At T2, no difference was found between the MCS condition and the regular implementation intention condition, *b* = 0.23, *SE* = 0.18, *t* = 1.26, *p* = .21. The regular implementation intention condition consumed more healthy snacks compared to the goal intention condition, *b* = 0.35, *SE* = 0.15, *t* = 2.34, *p* = .02. Also, the MCS condition consumed more healthy snacks than the goal intention condition, *b* = 0.58, *SE* = 0.17, *t* = 3.42, *p* = .001. Similarly, at T3, no difference was observed between the MCS and regular implementation intention condition, *b* = 0.21, *SE* = 0.21, *t* = 1.00, *p* = .32. Yet, the regular implementation intention condition consumed more healthy snacks than the goal intention condition, *b* = 0.34, *SE* = 0.15, *t* = 2.25, *p* = .02. The MCS condition also consumed more healthy snacks compared to the goal intention condition, *b* = 0.54, *SE* = 0.17, *t* = 3.27, *p* = .001 (Table 2).

Habit strength and BMI. Linear growth analyses showed a significant decrease over time for both habit strength, *b* = - 0.20, *SE* = 0.04, *t* = - 4.67, *p* < .001, and BMI, *b* = - 0.12, *SE* = 0.04, *t* = - 3.33, *p* < .001. No differences in the decline were found between conditions for habit strength (*p*'s > .51) or BMI (*p*'s > .18). The means are shown in Table 2.

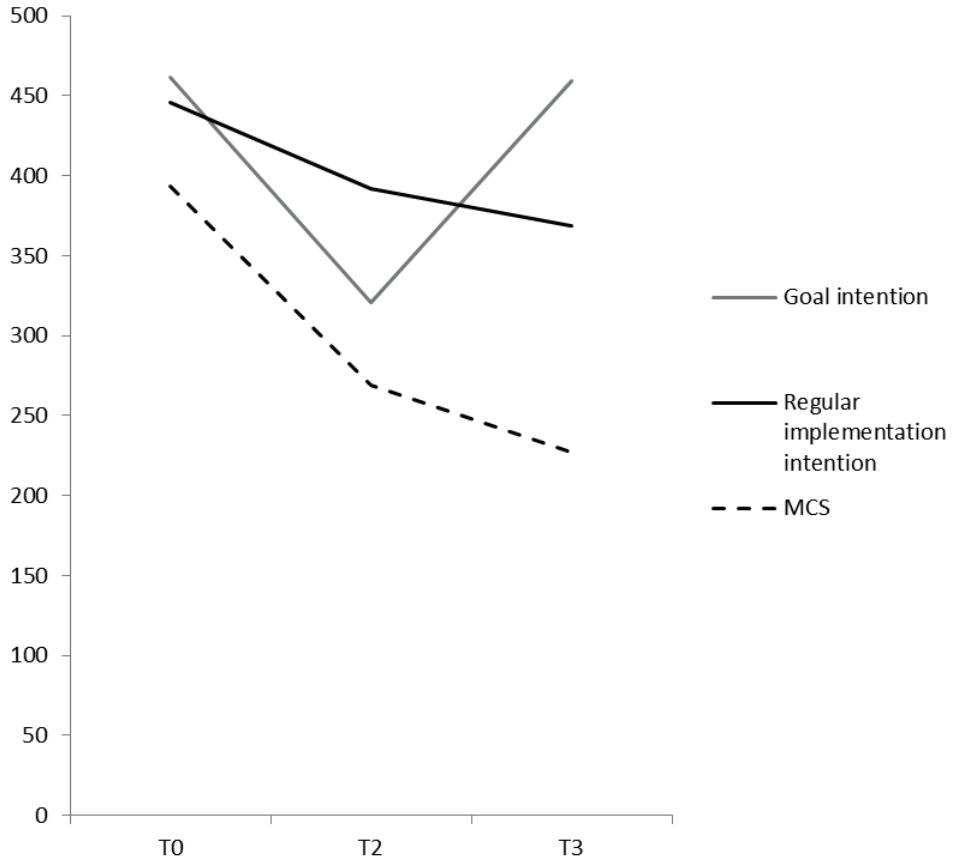

Figure 1. Unhealthy snacks (in kcal) per measurement and experimental condition.
Note. Figure 1 displays means obtained with SPSS, while the analyses are based on FIML to account for missings.

Table 2. Means and standards deviations of the dependent variables per measurement and experimental condition.

	Goal intention			Regular implementation intention			MCS		
	M	SD	N	M	SD	N	M	SD	N
Unhealthy snacks (in kcal) [a]									
T2	315.37	195.33	18	386.78	195.38	29	278.91	195.86	26
T3	445.10	243.35	15	362.40	243.11	28	243.21	243.87	24
FV snacks (in portions)									
T2	0.57	0.43	18	0.92	0.63	29	1.15	0.72	26
T3	0.52	0.25	15	0.86	0.73	28	1.06	0.77	24
SRHI									
T0	4.26	1.14	19	4.88	0.92	30	4.53	0.85	29
T1	4.52	1.21	19	4.84	1.13	24	4.56	1.14	24
T2	3.54	1.56	15	4.20	0.89	28	3.97	1.06	21
T3	3.64	1.13	16	4.18	0.97	27	4.07	1.21	24
BMI									
T0	24.37	3.62	19	24.90	3.96	30	24.49	4.17	29
T1	24.33	3.78	18	25.25	4.06	23	23.71	4.38	23
T2	24.99	4.15	12	24.84	4.04	22	24.32	4.27	21
T3	24.15	4.07	13	24.72	3.85	23	23.41	3.29	18

[a.] Estimated means controlled for baseline caloric intake.

Note. Table 2 displays means and SD's obtained with SPSS, while the analyses are based on FIML to account for missings.

Discussion

The present study examined whether implementation intentions can be taught as a metacognitive strategy aimed at changing unhealthy snacking habits. After a cue-monitoring phase, participants received a planning exercise to form a goal intention, a goal intention plus a regular implementation intention, or a goal intention supplemented with instructions on using implementation intentions in a metacognitive way. All instructions were digitally provided only once. No changes in unhealthy snacking behavior were observed after forming a goal intention or a regular implementation intention. Yet, it was found that people who employed implementation intentions as a metacognitive strategy decreased their caloric intake over time, resulting after two months in an average reduction of 190 kilocalories per day. Additionally, although there was no explicit focus on healthy snack consumption, fruit and vegetable intake was higher in both implementation intention conditions compared to forming a goal intention only, which is possibly a positive side-effect of specifying healthy snack alternatives in the if-then plan.

In the present study, no effects were obtained for regular implementation intentions. Formulating an if-then plan provides the opportunity to tackle a single snacking situation, while participants were confronted with many snacking situations during the cue-monitoring phase. This finding fits our rationale outlined in the introduction that although evidence regarding implementation intention success is abundant (Gollwitzer & Sheeran, 2006; Adriaanse, Vinkers et al., 2011), the effects of implementation intentions in every day goal pursuit can be limited by its inflexibility. The present findings display the difficult translation of lab results to more applied contexts but also demonstrates that implementation intentions as a metacognitive strategy can counter such limitations.

Interestingly, after one month, while the metacognitive strategy was more effective compared to regular implementation intentions, it was not more effective than the goal intention formation. This suggests that cue-monitoring without plan formation may have affected unhealthy snacking to some extent. The effect of cue-monitoring on the short term (one week) has been demonstrated previously (Verhoeven et al., 2014b), suggesting that cue-monitoring may initially be helpful in changing unhealthy snacking behavior. Nonetheless, after two months, merely formulating a goal intention was no longer effective. This demonstrates that a supplementary strategy is needed to develop new habits to promote behavior change maintenance. These findings thus underline once more the importance of taking into account the effects over relatively longer time periods.

Extending previous research suggesting that implementation intentions can be used in a personalized manner (Luszczynska, Sobczyk, & Abraham, 2007; Duckworth, Kirby, Gollwitzer, & Oettingen, 2013), in the present study participants were taught how to employ and adjust implementation intentions for personal goal striving. Importantly, the present study explicitly demonstrated the effects of the metacognitive strategy compared to a control condition (i.e., goal intention formation) and to planning instructions

without a metacognitive component. The promising use of implementation intentions as a metacognitive strategy is an important step forward in implementation intention research and its applicability to practical settings. Additionally, it is generally acknowledged that people have a hard time forming high quality implementation intentions for changing existing habits as they have to specify the right personally relevant critical cue, link this to a goal directed response, adopt an if-then format, and be specific and precise (De Vet, Gebhardt et al., 2011; Hagger & Luszczynska, 2014). It has therefore been suggested that experimenter-guided plan formation rather than user-defined plans could be more beneficial (Hagger & Luszczynska, 2014). Although such a recommendation makes sense, this would substantially limit the appeal of implementation intentions as a self-regulatory strategy. The current elaborate instructions were found to be successful in having people independently formulate if-then plans. Also, while previous studies on implementation intentions have included strategies like boosters (Chapman & Armitage, 2010) which could provide opportunities to adjust personal plans to changing situations, a metacognitive strategy has the additional benefit that participants do not further depend on the intervention after receiving instructions only once. Using the MCS, it is likely that after the duration of a study or intervention, participants continue to benefit from the acquired behavior change technique.

With regard to BMI and unhealthy snack habit strength, a reduction was observed which was not affected by the planning exercise. Perhaps cue-monitoring was sufficient to establish these effects. This is promising for the use of monitoring strategies, but the present study does not provide sufficient information to draw strict conclusions. The included sample was highly motivated to change their unhealthy snacking behavior. The reduction in snack habit strength and BMI could reflect the efforts to adopt a healthier diet or to lose weight, independent of the current intervention. Future research is needed to test the effects of (cue-) monitoring and planning strategies regarding BMI and habit strength.

Limitations of the present study should also be noted. Firstly, participants in the goal intention condition had a somewhat lower habit strength compared to people in the regular implementation intention condition. Yet, controlling for habit strength did not affect the results and possible influences of this dissimilarity therefore seem unlikely. Furthermore, the baseline snack consumption measure derived from the cue-monitoring diary was not completely comparable with the other measures of snacking as this diary focused only on (triggers for) unhealthy snacking. Therefore, next to performing growth modeling analyses including baseline snack consumption as a dependent variable, analyses were also conducted per measurement while only controlling for baseline snack intake, without using baseline caloric intake as a reference for detection of time-effects. Third, although a community sample was included, this sample was relatively highly educated and mostly female. Caution with generalizing the current findings to the population at large is therefore warranted, in particular because using implementation intentions as a

metacognitive strategy might be a demanding task. Finally, we assessed unhealthy snacking behavior with a self-report measure, which may be vulnerable to imprecise data. Although snack diaries are viewed as a relatively high-quality measure of eating behavior (Adriaanse, Vinkers et al., 2011) and examination of snacking behavior in applied settings without using self-report is near to impossible, future research is needed to verify the current effects with more objective assessments.

To conclude, the present study demonstrates the encouraging effects of using implementation intentions as a metacognitive strategy. By providing the instructions just once, a substantial decrease in caloric intake from unhealthy snacks was obtained up to two months after the planning exercise. Employing implementation intentions in a metacognitive way provides a solution for the serious limitations of the inflexibility of this planning tool. The use of self-regulation strategies in a metacognitive way thus shows great promise.

7

Summary and general discussion

Although implementation intentions have been studied extensively and their potential as a behavior change technique has been demonstrated convincingly, there is only limited support for their effectiveness in applied settings. When this strategy is used to facilitate every day goal pursuit, different considerations are pertinent, especially when complex habitual behaviors like unhealthy snacking behavior are targeted. The present dissertation set out to systematically investigate challenges of applying implementation intentions and ways to accommodate them. Strategies that may support the effectiveness of implementation intentions, such as cue-monitoring and metacognition, were employed to facilitate effective planning aimed at unhealthy snacking behavior. In this final chapter, the main findings from previous chapters are summarized, their implications are outlined, and directions for further research are discussed.

Summary of findings

In **Chapter 2,** the need for interventions that address the habitual nature of unhealthy snacking behavior was demonstrated. In a prospective study design among a large and representative community sample, the relative contribution of habit strength was compared to the role of the intention to eat more healthily and the extent to which people are sensitive to food cues in the environment, in order to predict unhealthy snacking behavior one month later. It was shown that habit strength was the most important predictor of unhealthy snack consumption. The findings thereby demonstrate the importance of focusing on the habitual underpinnings when developing interventions aimed at reducing unhealthy snacking behavior, which can be accomplished with the use of implementation intentions.

In **Chapter 3**, the results of a cross-sectional study are reported that investigated the reasons that people report for consuming unhealthy snacks. Insight in these reasons could facilitate the identification of critical individual triggers of unhealthy snacking behavior, which is needed to form effective implementation intentions. Based on an elaborate range of possible reasons for unhealthy snacking, a *Reasons to Snack* inventory was developed. Participants from a representative community sample reported to what extent each reason applied to their own unhealthy snacking behavior. The findings showed that reasons for unhealthy snacking could be classified into six categories; opportunity induced eating, coping with negative emotions, enjoying a special occasion, rewarding oneself, social pressure, and gaining energy. Particularly enjoying a special occasion (e.g., 'Because it is a party or a birthday') proved to be a reason that is highly relevant for unhealthy snacking but is usually overlooked in the eating behavior literature. This knowledge is valuable for tailoring health intervention techniques to individual situations, such as facilitating the identification of personally relevant cues that induce unhealthy snacking, to allow for formulating effective implementation intentions targeting the actual trigger underlying unhealthy snacking behavior.

When implementation intentions are employed to change existing habits, it is essential that the personally relevant critical cue triggering the unwanted habitual behavior is specified in order to create a new cue-response link that truly competes with the old, habitual cue-response association (Adriaanse, De Ridder, & De Wit, 2009). Identifying the most important trigger in retrospect (e.g., during plan formation) is, however, challenging. Automatic behaviors are characterized by a lack of awareness and individuals may therefore not be well aware of the cue that triggered their behavior. In **Chapter 4,** it was examined whether people could benefit from cue-monitoring as an additional self-regulatory strategy prior to formulating implementation intentions to facilitate the identification of critical cues. In doing so, we extended previous research indicating that monitoring is an effective strategy for reducing unhealthy eating behavior (Michie, Abraham, Whittington, McAteer, & Gupta, 2009). In order to aid the identification of relevant cues to formulate implementation intentions that can compete with habitual cue-response links, we proposed a strategy that specifically focuses on monitoring one's critical cues for unhealthy snacking, labeled cue-monitoring. With the use of a cue-monitoring diary, people could report their unhealthy snack consumption and indicate their most important trigger from an overview of possible reasons for each snacking occasion. To examine the effectiveness of the cue-monitoring and implementation intention strategies, participants either kept a 7-day cue-monitoring diary or a control diary, followed by forming an implementation intention or a goal intention. Unhealthy snacking behavior was subsequently measured with a 7-day snack diary. It was hypothesized that keeping a cue-monitoring diary would enhance implementation intention effectiveness. Yet, the expected interaction effect between cue-monitoring and implementation intentions was not found. Rather, only a main effect was observed of monitoring but not of implementation intentions, indicating that cue-monitoring, but not implementation intentions, in itself was effective for reducing unhealthy snacking. These results emphasize the value of using a cue-monitoring strategy when changing unhealthy snacking behavior. Based on previous research, a short term effect of monitoring could be anticipated (e.g., Burke, Wang, & Sevick, 2011; Michie et al., 2009). Yet, in order to establish long term behavior change, the importance of establishing new habits to automatize the desirable behavior is stressed (Verplanken & Wood, 2006), for which implementation intentions might still be required. The effect of cue-monitoring over a longer time period is further addressed in Chapter 6.

Another challenge with aiming to change unhealthy snacking behavior in real life settings is that this behavior is prompted in a variety of situations, reflecting multiple cue-response associations. Ideally, an if-then plan should be formulated to address each of these cue-response associations to render a substantial reduction in unhealthy snack intake. **Chapter 5** was therefore designed to examine the behavioral and cognitive effects of forming multiple implementation intentions, specifying different snacking situations and alternative responses. Although formulating multiple plans may provide people with

more opportunities to enact their dietary intentions, it was expected that the effect of the plans would be diluted (Webb, 2006). This dilution effect would mean that the strength of each of the associations between the cues and responses identified in the implementation intentions is weaker than when only one plan is formed in isolation, leading to less successful goal achievement. Study 1 examined the behavioral effects of making multiple plans. After a cue-monitoring phase of three days, participants formulated zero, one, or three implementation intentions, and additionally filled out a 3-day snack diary to assess unhealthy snacking behavior. First, the findings indicated that this study replicated the effect of cue-monitoring demonstrated in the previous chapter. That is, we found that cue-monitoring both with and without one if-then plan reduced unhealthy snacking. However, making three plans did not result in behavior change. Study 2 was adopted to assess the mental associations after forming zero, one, three relevant plans (all plans regarding unhealthy snacking), or one relevant and two additional plans (one for snacking and two for academic achievement). This latter condition was included to further explore the effects of making multiple plans. On the one hand, it could be expected that the formation of multiple plans in itself resulted in weaker cue-response associations. On the other hand, it could be hypothesized that interference of similar information in the content of the multiple plans targeting the same behavior induces weaker mental associations (also known as the 'fan' effect; Anderson & Reder, 1999). Using a lexical decision task, the mental associations between the critical cue identified in the 'if' part of the plan (e.g., feeling bored) with the habitual response (e.g., eating crisps) and the link between the critical cue and the specified alternative in the 'then' part (e.g., apple) could be compared. It was found that formulating a single implementation intention made the healthy alternative response cognitively more accessible compared to the habitual response, in response to a critical cue-prime. Comparable results were observed after formulating a single plan for the targeted domain (unhealthy snacking) followed by two plans for an unrelated domain. However, when multiple plans targeting unhealthy snacking behavior were formed, no cognitive advantages were observed, which was similar to making no plans at all. Hence, it was concluded that making multiple plans targeting the same behavior (unhealthy snacking) does not promote goal pursuit.

As illustrated in Chapter 5, it is vital for implementation intention success that only one habitual association is targeted at one time by formulating a single plan linking a critical cue to a healthier alternative. Yet, creating a single cue-response link is likely insufficient to establish a considerable change in unhealthy snacking because, for example, unhealthy snacking behaviors are prompted in multiple contexts (i.e., multiple habits exist) or the plan might turn out to be infeasible. **Chapter 6** tested a novel method for using implementation intentions, namely, teaching implementation intentions as a metacognitive strategy in order to overcome the problems associated with the limited number of plans that can be formulated at a time. To this end, a theoretical framework regarding metacognition was employed from educational and cognitive psychology (e.g.,

Flavell, 1979; Woolfolk, Hughes, & Walkup, 2013) in order to teach people from the general population how they could actively use the implementation intention strategy by adjusting their plans to changing needs for goal pursuit. Using implementation intentions as a metacognitive strategy involved three steps, namely, planning (i.e., deciding when and how to act and specifying an if-then plan accordingly), monitoring (i.e., reflecting on the behavior and its triggers to examine the effectiveness and relevance of the current plan), and evaluating (i.e., determining if the plan is in need of modifications). In this way, people are able to target different triggers of their unhealthy snacking behavior, by formulating sequential plans and adjusting their plans to changing needs, without the interference of a skilled experimenter. All participants first kept a cue-monitoring diary for one week. Subsequently, participants were assigned to one of three groups, either receiving instructions to form a goal intention, a regular implementation intention, or implementation intentions as a metacognitive strategy. The behavioral effects were measured up to two months using 7-day snack diaries. It was shown that goal intentions or regular implementation intentions did not reduce unhealthy snacking behavior. In contrast, employing the metacognitive strategy led to a substantial decrease in unhealthy snacking, showing the promising effects of using implementation intentions as a metacognitive strategy.

From the findings described in this dissertation, it can be concluded that it is essential to target the habitual nature of unhealthy snacking behavior if it is aimed to change that behavior, for example with the use of implementation intentions. Applying implementation intentions for changing unhealthy snacking is, however, rather complicated as people need considerable insight into the triggers of their unhealthy snacking behavior in order to truly tackle the underlying habitual association. In addition, typically multiple cue-response associations are present that should all be addressed, but implementation intentions were found ineffective when multiple plans were formulated simultaneously. Therefore, applying implementation intentions to change unhealthy snacking behavior in large scale health behavior change interventions could be facilitated by using plans that are supported by cue-monitoring as an additional strategy preceding plan formation and by adopting a metacognitive framework to teach people to use and amend the implementation intentions themselves. In this way, the aforementioned limitations of employing implementation intentions in real life settings can be addressed and this tool can be used independently (i.e., without professional guidance), making this strategy accessible for the general population at large.

Considerations for practice

The majority of the chapters described in this thesis included community samples in real life settings, which adds to the validity of the findings and its potential for health

behavior change interventions. Hence, based on the findings described above, we can infer important considerations for practice.

Targeting the automatic nature of unhealthy snacking

Many behavior change interventions focus on providing information concerning the importance and the features of a healthy diet. This approach is based on the idea that conscious goal intentions are a key element in behavior change (Ajzen, 1985). In the present dissertation it was demonstrated that unhealthy snacking behavior was foremost predicted by habit strength rather than conscious intentions. This observation is in line with literature demonstrating the importance of habits in unhealthy eating behavior (e.g., Van 't Riet, Sijtsema, Dagevos, & De Bruijn, 2011; Verplanken, 2006). Moreover, this finding provides an explanation why people oftentimes fail to reduce their unhealthy snacking even despite a strong intention, as the mental association between a critical cue and the behavioral response automatically prompts people to consume unhealthy snacks when encountering an unhealthy snacking situation. Although goal intentions are an essential prerequisite for behavior change, the automatic nature of unhealthy snacking demands a different approach for the translation of intentions into action, specifically by targeting the underlying mental cue-response association, for example with implementation intentions.

Implementation intention interventions

In the final empirical chapter of this dissertation (Chapter 6) the effectiveness of using cue-monitoring with implementation intentions as a metacognitive strategy is examined and its possibilities for reducing unhealthy snacking behavior is demonstrated. Although more research is needed to examine the effectiveness of these additional elements in implementation intention interventions, it is suggested that planning could effectively be employed when it is combined with cue-monitoring and metacognitive strategies. Based on the findings in this thesis, a planning strategy is recommended that not only targets the automatic association underlying unhealthy snacking habits (like a typical implementation intention intervention would do) but also includes additional components, such as a cue-monitoring phase. Additionally, it should encourage people to form a single plan at once and adopt implementation intentions as a metacognitive strategy to allow adjustments to changing circumstances. As this strategy can be employed independently by people themselves without the interference of a professional, it is suitable for applications in large scale health interventions.

Nonetheless, the use of cue-monitoring plus planning as a metacognitive strategy requires some caution before wide-scale implementation in practice is considered. For example, if people are not sufficiently encouraged to form a single plan or if regular implementation intention instructions are used rather than the metacognitive strategy, no effects might be established. The cue-monitoring phase confronts people with multiple cues triggering their behavior. If people formulate a single plan targeting one situation

only, it might be perceived as not sufficiently substantial (see also below for a discussion on the interplay between motivational and volitional phases). In that case, people may become less committed to their plan, which is an important requirement for implementation intention success (Achtziger, Bayer, & Gollwitzer, 2012). For similar reasons, caution is also needed when this strategy is used by people who may not benefit from fighting one snacking situation at a time. For example, for people who are obese, making a plan for one snacking situation is expected to be insufficient to render clinically relevant behavior change. In such cases, the initial focus typically is not on small, stable dietary changes as there is a need to lose weight as quickly as possible. Yet, in a later stage when smaller changes are aimed for, implementation intentions may benefit the development of healthy habits in such clinical samples as well.

Limitations

Although the present results inspire important implications and considerations, there are some issues that require further attention, which are described in the next section.

Measures

Measuring unhealthy snacking behavior. The first issue relates to the measurement of unhealthy snacking behavior using the 7-day snack diary. This assessment was chosen because it is regarded as a sophisticated measure of unhealthy snacking (De Castro, 2000), which is more accurate than retrospectively reporting on one's snack intake (such as food frequency questionnaires or 24 hour recalls). Nonetheless, an important concern is that the snack diary used as our main dependent variable is rather similar to one of the key elements of the intervention strategy, namely, the cue-monitoring phase. As cue-monitoring was found to effectively change unhealthy snacking behavior in itself, filling out the snack diary for the snack consumption assessments possibly induced such monitoring effects as well. In addition, concerning the metacognitive strategy, people receiving this instruction are trained to be more aware of their unhealthy snacking behavior. Hence, their reports might be more complete (and thus reflecting a higher snack intake). The studies presented in this dissertation, as well as research on eating behavior in general, would benefit from more objective measures that do not or to a lesser extent require that participants reflect upon their food consumption. Examining eating behavior in real life settings is hard to accomplish without self-reported measures. Recent technological developments, such as digital photography of foods methods entailing that people use their smart phones to capture their food intake (prior and after food consumption), might be less subjective (Martin et al., 2014). Yet, even such strategies still confront people with their food intake and highly depend on the cooperation of participants. In

general, there is a need for developing innovative ways to asses food consumption in applied settings which would certainly benefit research on eating behavior.

Measuring habitual change. Additionally, although behavioral effects were established using cue-monitoring with implementation intentions as a metacognitive strategy, throughout the present thesis no changes in self-reported habit strength were identified. Only the employed lexical decision task (Chapter 5) indicated that forming implementation intentions affected the underlying automatic association. We propose three explanations for this lack of effects. First, one could argue that the lack of effects for habit strength could indicate that habits have not sufficiently been altered and that refraining from consuming unhealthy snacks is still effortful. Breaking existing habitual behaviors is inherently difficult. Considering that creating new habits already costs a considerable amount of time, ranging from approximately 18 to 254 days in order to achieve a high level of automaticity (Lally, Van Jaarsveld, Potts, & Wardle, 2010), it seems likely that breaking existing habits, which is arguably even more difficult, would require a longer period of time.

Alternatively, it is possible that we were unable to demonstrate effects on habits because we employed a self-reported measure of habits (SRHI; Verplanken & Orbell, 2003). The SRHI is currently the most useful and widely adopted tool we have to assess habit strength (Gardner, Abraham, Lally, & de Bruijn, 2012). Nonetheless, using a self-report measure to assess habitual behaviors is debatable. Habitual behaviors are performed automatically, which is characterized by a lack of awareness. Using a self-report measure in which individuals are asked to reflect upon behaviors that they perform automatically seems irrational as people have limited insight into behaviors that they are not aware of. Self-report measures might therefore not accurately capture the extent to which the behavior is performed automatically and possible changes in habit strength might thus remain unobserved.

Additionally, as a result of the cue-monitoring plus planning strategy, participants may have become more aware of the unhealthy snacking behavior and of the cues inducing their behavior, which may actually facilitate more accurate reporting on habits. Consequently, the frame of reference among participants in the current study may have shifted, possibly leading them to report the same scores for habits that have decreased in strength or higher scores for similar levels of habit strength (a phenomenon referred to as 'response shift'; Sprangers & Schwartz, 1999). The finding that the self-reported habit strength increased after keeping a cue-monitoring diary might be considered an illustration of this notion (Chapter 4). This could indicate that the habit strength in general did not reduce. Rather, one of its key features, namely its lack of awareness, might have been weakened as a consequence of keeping a cue-monitoring diary. This is possibly a first step in reducing its automaticity and providing people with an opportunity to alter their behavior. Further research is thus needed to determine the effects of the intervention

strategies on changes in habit strength that take into account longer term effects as well as other ways to measure habit strength.

Manipulations

A second issue concerns the included manipulations for the control conditions. Employing active control conditions is important as the effectiveness of implementation intentions might otherwise be overestimated (Adriaanse, Vinkers et al., 2011). Additionally, it was found that cue-monitoring is an effective strategy in itself, which should be accounted for when examining the effects of implementation intentions. Throughout this thesis, we therefore chose to adopt rather strict control exercises, i.e., by including a cue-monitoring phase followed by goal intention formation or reporting healthy alternatives. As a result, the findings from the implementation intention conditions had to exceed the effects of cue-monitoring in order to be observable (Maas, Hietbrink, Rinck, & Keijsers, 2013; Verhoeven et al., 2014). In addition, this design might induce spontaneous planning as people reflected on their cues for unhealthy snacking and could have used this insight to form plans spontaneously (e.g., Gollwitzer & Brandstätter, 1997). The current findings might therefore be a limited reflection of the actual effects of the cue-monitoring plus planning strategy. In order to truly assess its potential, in future research the strategy should be compared to different types of control conditions.

Not including a cue-monitoring strategy in the control condition, however, might be problematic on a methodological level. An attempt to establish the effects of the cue-monitoring plus planning intervention compared to a control condition without cue-monitoring over a six month period, showed an unexpected reduction in the control condition but not in the intervention group (Verhoeven, Adriaanse, De Vet, Fennis, & De Ridder, 2014c). In that study, participants either received the cue-monitoring plus planning intervention (using the metacognitive strategy) or only repeated their goal intention, and they filled out snack diaries to assess unhealthy snacking behavior. The results showed that the intervention strategy was not more successful in changing unhealthy snacking behavior compared to mere goal intention rehearsal. In contrast, only repeating one's goal intention seemed to reduce unhealthy snacking behavior, with rather unlikely strong effects. Close examination of the results and the adopted design indicated important issues that might explain these findings. As noted, the measurement of unhealthy snacking behavior closely resembles the cue-monitoring phase included in the intervention strategy. As participants receiving the intervention therefore already gained experience with filling out a snack diary and because they were taught to be more aware of their snacking behavior, they might be better able in accurately reporting their snack consumption. Additionally, if participants receive an unsatisfactory exercise (which is likely if they only receive a goal intention exercise), it is possible that they become less involved in the study and less willing to put effort in accurately reporting their snack intake, which

might also result in incomplete snack diary reports. Hence, it is important to carefully consider the impact of including strict or less strict control conditions.

Long term effects

Finally, although we have established effects over two months, research is needed over longer time periods to examine whether the cue-monitoring plus planning strategy is capable of establishing behavior change maintenance. This is also important with regard to capturing potential effects on habitual behavior change, as changing existing habits might take considerable more time then the included two months (Lally , 2010) as well as to weight loss, which is also affected more gradually over time.

Considerations and avenues for future research

Notwithstanding the limitations of the research, the present findings stimulate further considerations that could fuel directions for future research.

The effects of cue-monitoring

In the present research, we supplemented implementation intentions with a cue-monitoring phase to encourage people to reflect upon their reasons for unhealthy snacking *in situ*, to facilitate the identification of critical cues for plan formation. It should be noted that throughout this dissertation, a consistent effect of mere cue-monitoring on behavior in the period shortly following cue-monitoring (after three days; Chapter 5, one week; Chapter 4, and one month; Chapter 6) was observed. Although we aimed to include cue-monitoring as a strategy that would enhance implementation intention effectiveness, and did not expect that cue-monitoring would in itself have such a large effect on reducing unhealthy snacking (exceeding the effects of forming implementation intentions), based on prior research and theories, short-term effects were anticipated to some extent. That is, these findings are in line with research showing the success of monitoring strategies for health behavior change (Michie et al., 2009) and weight loss practices (Burke et al., 2011). Monitoring has a central position in self-control theories (e.g., Carver & Scheier, 1998), It entails the deliberate attention to one's behavior in order to observe its progress in relation to one's goal (Burke et al., 2011; Carver & Scheier, 1998). In this way, monitoring increases individual's awareness of the behavior that is monitored and the circumstances in which the behavior is performed (Burke et al., 2011). Hence, people gain more insight into their unhealthy snacking behavior and perhaps also become more motivated to change this. Yet, while such insights concern important preconditions for behavior change (Ajzen, 1985; 1999), research indicates that this is likely insufficient to induce long term effects. Indeed, the success of cue-monitoring seemed to be only momentary, as this strategy on its own was no longer sufficient in changing behavior after two months (Chapter 6). It has been suggested that it would be more promising to promote sustained

behavior change by focusing on the formation of new desirable habitual behaviors (Verplanken & Wood, 2006). Implementation intentions are thus essential to be included for promoting behavior change maintenance, such as using implementation intentions as a metacognitive strategy.

Simple plans, but not so easy to use

In the current research, only limited support for the effectiveness of implementation intentions on their own was found, which is in contrast with previous research on implementation intentions in general (e.g., Gollwitzer & Sheeran, 2006) and eating behavior more specifically (Adriaanse, Vinkers et al., 2011). The lexical decision task (Chapter 5) indicated that formulating a single relevant plan successfully replaced the cognitive advantage of the old unwanted habitual behavior with a new desirable cue-response association. Yet, in terms of behavioral results, forming regular implementation intentions was equally effective in inducing behavior change to expressing a goal intention (Chapter 4, 6) or listing healthy alternatives (Chapter 5). It should, however, be kept in mind that in most of the present studies (Chapter 5, 6), cue-monitoring preceded plan formation. As cue-monitoring was found effective in itself (chapter 4), potential effects of forming implementation intentions might have been unobserved. Nonetheless, the absence of direct evidence for implementation intentions' effectiveness seems remarkable.

Considering recent literature, this might, however not be that surprising. Implementation intentions have previously been described as simple plans with strong effects (Gollwitzer, 1999). Indeed, the substantial effects on goal achievement as a result of a single if-then sentence (e.g., Gollwitzer & Sheeran, 2006) can be regarded impressive. The use of implementation intentions therefore has gained a lot of attention from both the scientific community and health professionals. As a result, gradually more complex behaviors have been targeted with implementation intentions as compared with original studies that investigated relatively simpler behaviors such as the instigation of one-time actions (like completing a school assignment; Gollwitzer & Brandstätter, 1997). Yet, in doing so, it became increasingly apparent that using these plans is not always straightforward, especially when aiming at complex behavior change (Adriaanse, 2010). For example, when using implementation intentions to break unhealthy snacking habits, a number of boundary conditions emerge, such as that the plan is effective only when a salient and personally relevant motivational cue is targeted (Adriaanse et al., 2009; Hagger & Luszczynska, 2014), if a plausible alternative is specified (rather than a negating format, i.e., '…then I will not eat chocolate'; Adriaanse, Van Oosten, De Ridder, De Wit, & Evers, 2011), and if the enactment of the plan is intrinsically motivated (Koestner, Lekes, Powers, & Chicoine, 2002). Furthermore, the present thesis indicated that applying implementation intentions in real life settings leads to additional complications. While implementation intentions are one of the most recognized and employed tools in psychological research

facilitating behavior change and goal attainment (e.g., Hagger & Luszczynska, 2014), it is thus important to keep in mind that the findings in controlled studies do not guarantee success in more applied fields, as demonstrated in the present thesis by the lack of support for implementation intentions on its own. Reasonably, the translation of such strategies to one of the most challenging settings like in the present research (i.e., in an applied context, among a general population, employed to change existing habits that are recurrently performed, induced in different situations, and subject to changes over time) requires a more elaborate approach, such as the support of innovative strategies like cue-monitoring and by teaching it in a metacognitive way.

Dealing with multiple cues

In the final empirical chapter (Chapter 6) we conclude that using a metacognitive strategy is effective in reducing unhealthy snacking behavior and is likely a good way to cope with multiple varying triggers. Nonetheless, this is only one solution for the problem that making multiple plans is probably ineffective. Other options for tackling multiple cues with implementation intentions are also worthy to explore. One option is to promote sequential planning. This entails that people formulate one plan for one snacking situation first and then later, after the planned behavior has become automatic, a new plan for another snacking situation might be formed. Using sequential intervention sessions, or 'boosters', participants are provided with additional implementation intention instructions to formulate a new plan, providing people the opportunity to adjust the plan to address subsequent triggers (Chapman & Armitage, 2010). It is important to note, however, that this is less appealing than teaching implementation intentions as a metacognitive strategy as people remain dependent on the intervention and its effectiveness is therefore likely restricted to the duration of the intervention.

Another promising option is to use implementation intentions to establish more general temptation–goal associations, rather than specifying a highly specific situation and a detailed alternative response. This could be done by mentally linking a temptation in the if-part of the plan to the activation of one's dieting goal in the then-part, e.g., 'If I see or smell chocolate, then I will follow my goal to diet' (Kroese, Adriaanse, Evers, & De Ridder, 2011; Van Koningsbruggen, Stroebe, Papies, & Aarts, 2011). In this way, the need to identify very specific critical cues and alternatives is circumvented, making the application of implementation intentions perhaps more straightforward. Nonetheless, it could be expected that such plans are not as effective because they establish less specific cue-response associations. The identification of a highly specific cue is considered important in order to enhance the accessibility and detection of the targeted cue (Gollwitzer, 1999; De Vet, Oenema et al., 2011). Thus although identifying more general, inclusive plans would be easier for goal pursuit, its effectiveness in comparison to more narrow yet more specific plans remains to be examined.

Theoretical considerations

Next to the practical applications and avenues for further research that can be derived from the present research, the findings also stimulates considerations in a broader theoretical perspective, which are described below.

The interplay between motivational and volitional phases

A first topic concerns the interaction between motivational and volitional phases. In the model of action phases (Heckhausen & Gollwitzer, 1987), a distinction is made between a motivational phase of goal achievement characterized by committing oneself to a goal, and a volitional phase in which the goal is implemented, typically with the use of implementation intentions. It is generally assumed that the success of implementation intentions in the volitional phase depends on the commitment to one's goal established in the motivational phase. Therefore, a lower goal commitment results in less potential effects of planning strategies (Achtziger et al., 2012; Sheeran, Webb, & Gollwitzer, 2005). Although it has been demonstrated that the motivational phase affects the volitional phase (i.e., a strong goal intention is required for implementation intention effectiveness, Achtziger et al., 2012; Sheeran et al., 2005) and not vice versa (that is, making implementation intentions for a goal does not affect commitment to that goal, Webb & Sheeran, 2008), there might be important exceptions where formulating implementation intentions actually does affect goal commitment. Hence, the interplay between the motivational and volitional action phases might be more complex than generally assumed, and this might be particularly relevant for the research presented in this thesis, as will be explained in the next paragraph.

Oftentimes, people try to achieve goals that are rather difficult to attain, such as reducing their unhealthy snacking behavior. Usually, perceived difficulty of attaining a goal does not lower goal commitment or might even strengthen people's willingness to make an effort (Locke & Latham, 1990; Voorneman, De Ridder, & Adriaanse, 2011). Yet, there are cases when the perceived difficulty leads to reduced goal commitment, most importantly when someone expects that the goal is too difficult to achieve (Feather & Norman, 1982). While formulating implementation intentions usually makes reaching one's goal more feasible, engaging in implementation intention formation might also confront people with the obstacles and difficulties hindering their goal pursuit. In a recent paper considering the pursuit of multiple goals using implementation intentions (Dalton & Spiller, 2012), this line of reasoning is used to explain that when aiming to achieve multiple goals, planning can actually negatively affect goal commitment. As planning puts an emphasis on the difficulties of pursuing multiple goals, this leads to lower expectancies of successful goal achievement, with lowered goal commitment and weaker effects of planning as a result. A similar reasoning might apply to the designs adopted in the present research. During the cue-monitoring phase, people were confronted with the extent of

their unhealthy snack intake and the various situations in which this unwanted behavior is triggered. Normally, being confronted with the perceived difficulty of reaching one's goals would not necessarily negatively affect their goal commitment. Yet, in this case, people were prompted to formulate merely one specific plan for one snacking situation only, while they have just been confronted with the magnitude of their unhealthy snacking and its numerous triggers. Consequently, people might expect that it is unlikely that they will succeed in their goal of reducing their unhealthy snacking behavior, because making one plan for just one situation would not result a meaningful change. This might result in a lower goal commitment and, ironically, less successful goal achievement. Hence, in this case, making the implementation intention might actually negatively affect goal commitment. Thus, we propose that while either engaging in a cue-monitoring phase or forming an implementation intention in isolation would normally not lead to reduced expectations of goal achievement success, being confronted with numerous situations triggering the unwanted response followed by tackling only a single specific situation with one implementation intention might. This could thus be one of the exceptions where not only motivational phases affect the volitional stage, but also vice versa, indicating that the balance between the two action phases is more fragile than usually recognized. A possible solution would be to inform people that while they are addressing one situation first, other triggers will be dealt with in a later stage. In this way, the possible negative consequences are circumvented that might result from planning for only one cue of the many cues that have been identified. Indeed, this is exactly what happens when people were taught how to use implementation intentions themselves as a metacognitive strategy, which was indicated to be effective. It would be interesting to further examine the complex interplay between motivational and volitional action phases in future research.

A toxic dieting environment

A final consideration relates to the public acceptance of the behavior change strategies. Our current food environment has been labeled an 'obesogenic environment' (Swinburn & Egger, 2002) or a 'toxic food environment' (Horgen & Brownell, 2002), as virtually at any place and anytime, people are confronted with the availability of highly palatable but unhealthy foods. Our society could also, however, be regarded as a toxic *dieting* environment. A large amount of dieting strategies is available, dieting seems to have become normative nowadays (Hill, 2002), and many people consider themselves a 'dieter' (De Ridder, Adriaanse, Evers, & Verhoeven, 2014). A search on Amazon reveals that an impressive number of 75.000 hits come up when searching for English books regarding 'weight loss'. Although some of them relate to evidence-based guidelines, most of them are distant from scientific grounds, inducing irrational and sometimes unhealthy practices (Anderson, Konz, & Jenkins, 2000). Many of these diets set unlikely high expectations of excessive weight loss in a minimal amount of time. Similarly, as many consumers set unrealistically high goals for themselves, dieting practices that promise

dramatic weight loss match their goals, making these strategies rather appealing for many consumers (Freedman, King, & Kennedy, 2001).

With such weight loss strategies available that promise vast and fast results, the techniques considered in the present research stand in stark contrast. Most importantly, the use of implementation intentions is characterized by small reductions in caloric intake. Although small but stable changes fostering healthy habits are much more effective in the long run than rigid dieting, it might discourage people if they do not experience direct results, especially when they have been confronted with their unhealthy snacking behavior during the first phase. Having more feasible but less desirable goals is likely to reduce commitment (Voorneman et al., 2011), especially in an environment where quick and easy (but ultimately ineffective) alternatives for weight loss are abundant. Indeed, some participants of the studies presented in this thesis indicated that they did not trust that such a small plan would help them to consume fewer unhealthy snacks and that they therefore planned to enroll in a commercial weight loss program. Thus, despite its strong theoretical grounds, it remains to be observed whether the current planning strategy will be embraced by the public at large, as it requires more patience and offers smaller effects compared to what people expect from weight loss solutions that promise rapid and substantial results.

To conclude

To conclude, inspired by complications with goal pursuit in daily life, the research presented in this dissertation assessed vital issues when applying implementation intentions for reducing unhealthy snacking behavior. The need for health behavior change interventions that address the habitual nature of unhealthy snacking was demonstrated. To this end we applied implementation intentions supported with cue-monitoring and metacognitive strategies. The cue-monitoring phase prior to plan formation was included to facilitate the identification of one's critical cues for unhealthy snacking. This strategy was found successful in inducing short term changes in unhealthy snacking behavior. Yet, the final study indicated that cue-monitoring on its own was insufficient for longer term behavior change. Based on the observation that multiple triggers are present for unhealthy snacking behavior, we also tested whether multiple plans targeting different cues might be effective for reducing unhealthy snacking. We concluded that making multiple plans for unhealthy snacking behavior does not benefit goal pursuit. In order to deal with multiple cues triggering unhealthy snacking and to accommodate changes in personal requirements for achieving one's goal, we employed implementation intentions as a metacognitive strategy. By teaching this tool in a metacognitive way, people were enabled to accommodate changes in personal needs for reducing unhealthy snacking behavior. Because of the combination of controlled experimental studies and the inclusion of community samples, these findings provide us with important new insights on applying implementation intention strategies for everyday goal pursuit.

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Nederlandse Samenvatting

(Dutch Summary)

Ondanks dat mensen vaak sterk gemotiveerd zijn om gezonder te eten (De Ridder, Adriaanse, Evers, & Verhoeven, 2014) ondervinden veel van hen problemen met het omzetten van hun goede intenties in daadwerkelijk gedrag. Dit is zeker het geval wanneer het gaat om het veranderen van bestaand gedrag, zoals het verminderen van snoepen of snacken. In dit proefschrift is de toepassing van een strategie onderzocht die mensen kan helpen om dergelijke doelen te behalen, namelijk 'implementatie intenties', gericht op het veranderen van ongezond snackgedrag. Implementatie intenties zijn gedetailleerde als-dan plannen waarin vooraf wordt gespecificeerd wanneer en hoe een voornemen tot uitvoering wordt gebracht (Gollwitzer, 1999), zoals 'Als ik TV kijk, dan neem ik een appel!'. De werkzaamheid van deze simpele strategie is overtuigend aangetoond in eerdere studies, ondermeer voor het veranderen van ongezond snackgedrag (Adriaanse, Vinkers, De Ridder, Hox, & De Wit, 2011; Gollwitzer & Sheeran, 2006). De effectiviteit van deze tool in een toegepaste context heeft echter beperkt aandacht gekregen. Als deze strategie in de praktijk wordt gebruikt, zoals in grootschalige gezondheidsinterventies, spelen andere problemen en overwegingen een rol dan in gecontroleerde studies. In dit proefschrift is daarom onderzocht hoe de succesvolle toepassing van implementatie intenties gefaciliteerd kan worden voor het veranderen van ongezond snackgedrag. Hierbij zijn verschillende strategieën zoals cue-monitoren en metacognitie gebruikt om de effectiviteit van implementatie intenties in het dagelijks leven te bevorderen.

Ongezond snackgedrag: kleine maar stabiele veranderingen

Wanneer geprobeerd wordt om gezonder te eten, is het met name relevant om de inname van ongezonde tussendoortjes te verminderen. Met ongezonde tussendoortjes of snacks wordt het eten bedoelt dat naast de drie hoofdmaaltijden (ontbijt, lunch, avond-eten) wordt gegeten en die veel energie en hoge concentraties van ongezonde ingrediënten zoals suiker, zout en vet bevatten (Voedingscentrum, 2011). De bijdrage van ongezonde snacks aan de totale energie-inname en aan gewichtstoename is op dit moment groter dan ooit tevoren (e.g., Piernas & Popkin, 2010). Daarnaast wordt geschat dat de toename van gewicht in de meerderheid van de volwassen populatie voorkomen kan worden door veranderingen in de energiebalans van slechts 100 kilocalorieën per dag (Hill, Wyatt, Reed, & Peters, 2003). Ter illustratie, 100 kilocalorieën is te vergelijken met twee handjes chips of twee kleine koekjes. Aangezien het verminderen van ongezond snackgedrag kleine maar stabiele veranderingen behoeft, is het zeer geschikt om aan te pakken met implementatie intenties.

Hardnekkige gewoontes

Ondanks een sterke motivatie vinden veel mensen het moeilijk om hun ongezonde gedrag, zoals snackgedrag, te veranderen. Een mogelijke verklaring hiervoor is dat veel van ons alledaags gedrag bepaald wordt door gewoontes. Gewoontes ontstaan wanneer een gedraging om een bepaald doel te behalen herhaaldelijk wordt uitgevoerd in een

stabiele situatie. Naarmate dit vaker gedaan wordt, ontstaat er een mentale associatie tussen die situatie, of een specifieke uitlokker (of 'cue') hierin, en de gedragsrespons. Dit heeft als gevolg dat enkel het tegenkomen van deze situatie het gedrag automatisch uitgelokt (Aarts & Dijksterhuis, 2000; Ouellette & Wood, 1998; Verplanken & Aarts, 1999). Automatische gedragingen zijn nuttig in het dagelijks leven omdat dit gedrag efficiënt wordt uitgevoerd, zonder dat hier bewustzijn, intenties of controle voor nodig zijn (Bargh, 1994). Het doorbreken van gewoontegedrag is dankzij deze diepgewortelde automatische cue-respons associatie echter een moeizame opgave. Het hebben van een sterke doel-intentie is essentieel (Ajzen, 1985) maar hierdoor onvoldoende om het gedragspatroon te doorbreken. In deze dissertatie is daarom de rol van gewoontes in ongezond snackgedrag nader onderzocht en gebruikt als een uitgangspunt om effectieve gedragsverandering-strategieën te ontwikkelen.

Gewoontes veranderen met implementatie intenties

In tegenstelling tot doelintenties die een wenselijke eindsituatie beschrijven ('Ik wil doel X behalen!'), geven de genoemde implementatie intenties een gedetailleerde beschrijving hoe dergelijke intenties uitgevoerd worden. Implementatie intenties bevatten een ´als-dan´ structuur waarin een relevante cue wordt beschreven in het als-gedeelte en koppelt deze aan een gewenst alternatief in het dan-gedeelte, zoals 'Als situatie Y zich voordoet, dan voer ik doelgericht gedrag Z uit!'. Wanneer implementatie intenties gebruikt worden om bestaande gewoontes te doorbreken, wordt doorgaands de cue die het ongewenste gedrag uitlokt gespecificeerd en gekoppeld aan een alternatieve actie. Zo wordt de mentale associatie tussen de uitlokker en de habituele respons onderdrukt, terwijl er een nieuwe link gecreëerd wordt tussen de uitlokker en een meer gewenste reactie (Adriaanse, Gollwitzer, De Ridder, De Wit, & Kroese, 2011). De werkzaamheid van implementatie intenties is overtuigend aangetoond in eerder onderzoek (Gollwitzer & Sheeran, 2006), waaronder ook voor het verminderen van ongezond snackgedrag (e.g., Adriaanse, Vinkers et al., 2011). Daarnaast lijkt deze strategie erg geschikt voor toepassing in grootschalige gezondheidsinterventies: implementatie intenties hebben een simpele structuur (een enkele als-dan zin), kunnen gemakkelijk verspreid worden onder grote groepen en zijn relatief goedkoop te implementeren (Hagger & Luszscynska, 2014). Onderzoek dat het succes van implementatie intenties aantoont, heeft dit tot dusver voornamelijk gedaan in gecontroleerde labstudies of onder deelnemers uit selecte (studenten) groepen. Indien implementatie intenties worden gebruikt in de dagelijkse praktijk ontstaan er echter andere overwegingen en uitdagingen.

Bijvoorbeeld, ten eerste, wanneer implementatie intenties gebruikt worden om bestaande gewoontes te doorbreken, moet de specifieke uitlokker van het ongewenste gedrag gespecificeerd worden in het als-dan plan. Mensen hebben echter slechts beperkt inzicht in de uitlokkers van hun gedrag, wat zeker geldt wanneer dit gedrag automatisch is. Ten tweede, de meerderheid van implementatie intentie onderzoek betreft de effectiviteit

van een enkel plan, gericht op één cue-respons associatie. Ongezond snackgedrag wordt meestal uitgelokt in verschillende situaties. Het formuleren van slechts één plan is zodoende vermoedelijk onvoldoende en het maken van meerdere plannen behoeft daarom meer aandacht. Tot slot, in de context van het dagelijks leven is de specifieke als-dan associatie die ten grondslag ligt aan de effectiviteit van implementatie intenties ook een nadeel. Zo is het door deze precieze als-dan link niet mogelijk dat meerdere uitlokkers worden beschreven, kan er niet worden omgegaan met eventuele veranderingen in snacksituaties, en kan een plan niet worden aangepast indien dat nodig is (bijvoorbeeld wanneer een alternatief gespecificeerd is die onuitvoerbaar blijkt te zijn). In de huidige dissertatie is zodoende onderzocht hoe implementatie intenties succesvol toegepast kunnen worden in het dagelijkse leven, gericht op het veranderen van ongezond snackgedrag.

Resultaten

In het eerste empirische hoofdstuk, **hoofdstuk 2**, is de rol van gewoontes in ongezond snackgedrag nader onderzocht. Een prospectieve studie was uitgevoerd onder een grote groep deelnemers (*N* = 1103) representatief voor de algemene bevolking. Hierin werd de bijdrage van gewoontesterkte in het voorspellen van ongezond snackgedrag getest. De sterkte van de gewoonte werd vergeleken met andere variabelen zoals de intentie om gezonder te eten en de mate waarin mensen gevoelig zijn voor de aanwezigheid van lekker voedsel. De bevindingen lieten zien dat gewoonte de sterkste voorspeller is van ongezonde snackconsumptie een maand later. Deze voorspeller bleek belangrijker dan bewuste doelintenties of gevoeligheid voor de aanwezigheid van lekker eten. Dit laat zien dat ongezond snackgedrag voornamelijk gewoontegedrag is en dit suggereert dat interventiestrategieën zich moeten richten op de automatische processen die hieraan ten grondslag liggen, wat mogelijk is met implementatie intenties.

In **hoofdstuk 3** zijn de redenen onderzocht die mensen geven voor het eten van ongezonde tussendoortjes. Op basis van een uitgebreide lijst van mogelijke redenen werd de *Redenen om te Snacken* index ontwikkeld. Een grote groep deelnemers van de algemene bevolking (*N* = 1544) werd gevraagd in welke mate elk item voor hen een reden is om ongezonde tussendoortjes te eten. Gevonden werd dat deze redenen in te delen zijn in zes categorieën. De voornaamste aanleiding was het vieren van een speciale gebeurtenis, zoals een verjaardag of feest, gevolgd doordat het past bij de situatie (zoals bij het televisie kijken). Ook werden eten vanwege honger en als beloning (bijvoorbeeld omdat je zo hard gewerkt hebt) genoemd. Tot slot werd aangegeven dat mensen snacken door sociale druk of negatieve emoties (zoals verdrietig zijn). Deze kennis over de redenen voor ongezond snackgedrag kan gebruikt worden om de identificatie van persoonlijke cues gemakkelijker te maken, wat van pas komt bij het formuleren van implementatie intenties.

Wanneer implementatie intenties gebruikt worden om bestaande gewoontes te doorbreken, is het essentieel dat de persoonlijk relevante reden om te snacken beschreven wordt in het als-gedeelte van het plan. Op die manier kan de onderliggende cue-respons associatie worden doorbroken (Adriaanse, De Ridder, & De Wit, 2009). Het achteraf (i.e., tijdens plan formatie) identificeren van deze cue is echter een lastige opgave aangezien mensen beperkt inzicht hebben in de uitlokkers van hun gedrag, zeker wanneer het gaat om automatische gedragingen. In **hoofdstuk 4** werd onderzocht of mensen baat hebben bij de toevoeging van een strategie voorafgaand aan het formuleren van plannen, namelijk 'cue-monitoren'. Deze strategie was ontwikkeld voor het identificeren van uitlokkers van het snackgedrag. Hierbij reflecteren mensen met behulp van een cue-monitoring dagboek op hun snackgedrag en benoemen zij uit een lijst van mogelijke redenen de belangrijkste aanleiding voor hun ongezonde snackinname. Om het effect van cue-monitoren en implementatie intenties te testen, hielden deelnemers in deze studie een zevendaags cue-monitoring dagboek of een controle dagboek bij, gevolgd door het maken van een implementatie intentie of een doelintentie. Ongezond snackgedrag werd vervolgens gemeten met een zevendaags snackdagboek. Ondanks de verwachting dat het bijhouden van een cue-monitoring dagboek het effect van implementatie intenties zou versterken, bleek de strategie op zichzelf effectief te zijn. Cue-monitoring, maar niet het maken van implementatie intenties, leidde tot een vermindering van het snackgedrag op korte termijn. Voor het behalen van langere termijn veranderingen is het echter aan-nemelijk dat implementatie intenties alsnog nodig zijn om nieuw automatisch gedrag te bewerkstelligen. Hierop werd teruggekomen in hoofdstuk 6.

Een andere uitdaging met het verminderen van ongezond snackgedrag in een toegepaste context is dat het gedrag wordt uitgelokt in verschillende situaties, wat duidt op het bestaan van meerdere habituele cue-respons associaties. Idealiter zou een plan voor elk van deze associaties geformuleerd moeten worden. Het onderzoek in **hoofdstuk 5** was daarom ontworpen om de gedragseffecten en cognitieve gevolgen van het maken van meerdere implementatie intenties te testen. Het effect van geen plannen en van één plan werd vergeleken met het maken van drie plannen gericht op drie uitlokkers gekoppeld aan verschillende alternatieven. Enerzijds was het mogelijk dat meerdere plannen leiden tot meer gelegenheid om het gewenste gedrag te vertonen. Anderzijds werd beredeneerd dat het effect van de implementatie intenties zich verspreid over de verschillende plannen. Hierdoor wordt elk plan minder effectief dan wanneer ieder plan afzonderlijk wordt gemaakt (Webb, 2006). In studie 1 werden de gedragseffecten onderzocht van het maken van meerdere plannen. Na het bijhouden van een cue-monitoring dagboek van drie dagen formuleerden deelnemers geen, één of drie implementatie intentie(s), gevolgd door een driedaagse meting van het snackgedrag. De resultaten repliceerde allereerst het cue-monitoring effect uit hoofdstuk 4: cue-monitoring met of zonder een implementatie intentie zorgden voor een vermindering in snackinname. Het maken van drie plannen leidde echter niet tot gedragsverandering. In

studie 2 werden de mentale associaties getest na het maken van geen plannen, één plan, drie plannen (allen gericht op ongezond snackgedrag) en het maken van één relevant plan (gericht op snacken) en twee ongerelateerde plannen (gericht op studeren). Deze laatste conditie was geïncludeerd om de effecten van het maken van meerdere plannen verder te exploreren. Enerzijds kon verwacht worden dat het maken van meerdere plannen op zichzelf leidt tot zwakkere cue-respons associaties. Anderzijds was het mogelijk dat de problemen alleen ontstaan wanneer meerdere plannen voor hetzelfde gedrag worden gemaakt. In het laatste geval is het namelijk mogelijk dat de vergelijkbare informatie in de verschillende plannen met elkaar interfereert en zodoende zorgt voor zwakkere associaties (ook wel het 'uitwaai-effect' genoemd; Anderson & Reder, 1999). Met een lexicale decisietaak werden de mentale links tussen de uitlokker beschreven in het als-gedeelte van het plan (bijvoorbeeld 'verveling') en de habituele respons (zoals 'chips eten') en tussen de uitlokker en de alternatieve reactie in het dan-gedeelte (bijvoorbeeld 'appel') vergeleken. Na het maken van een enkele implementatie intentie was het gezondere alternatief cognitief toegankelijker dan de habituele respons wanneer de uitlokker werd laten zien. Een vergelijkbaar effect werd gevonden na het formuleren van één relevant plan en twee ongerelateerde plannen. Echter, na het maken van meerdere plannen met betrekking tot snackgedrag werden er geen cognitieve voordelen geobserveerd, wat vergelijkbaar was met het maken van geen plannen. Zodoende werd geconcludeerd dat het maken van meerdere plannen die betrekking hebben op hetzelfde gedrag (snackgedrag) niet bijdraagt aan het behalen van de doelen.

De specifieke cue-respons associatie die zo belangrijk blijkt voor het succes van implementatie intenties, zorgt er tegelijkertijd voor dat de plannen relatief inflexibel zijn. In labstudies zorgt dit normaalgesproken niet voor problemen. In het dagelijks leven kan dit echter wel tegen gaan staan. Zo kan er geen rekening worden gehouden met meerdere uitlokkers van het snackgedrag, kunnen mogelijke veranderingen in de snacksituaties niet geaccommodeerd worden en kan een plan niet meer achteraf aangepast worden als bijvoorbeeld blijkt dat het gespecificeerde alternatief niet een goede oplossing is. In **hoofdstuk 6** is daarom een innovatieve methode getest voor het gebruik van implementatie intenties, namelijk als een metacognitieve strategie. Hiertoe werd een theoretisch kader gebruikt vanuit de educatieve en cognitieve psychologie (e.g., Flavell, 1979; Woolfolk, Hughes, & Walkup, 2013) om mensen te leren hoe zij de implementatie intentie tool actief en zelfstandig kunnen toepassen voor hun eigen individuele behoeftes voor het behalen van hun doelen. Implementatie intenties als een metacognitieve strategie bevat drie stappen: plannen (beschrijven hoe en wanneer er een doelgerichte actie wordt uitgevoerd in een als-dan plan), monitoren (reflecteren op het snackgedrag en de bijbehorende uitlokkers) en evalueren (beslissen of er aanpassingen in het plan nodig zijn). Deelnemers van de algemene populatie hielden een cue-monitoring snackdagboek bij voor een week. Hierna kregen zij instructies voor het formuleren van een doelintentie, een implementatie intentie, of voor implementatie intenties als een metacognitieve

strategie. De effecten werden tot twee maanden na het krijgen van de instructies gemeten met een zevendaags snackdagboek. Na één maand bleek dat zowel het formuleren van de doelintentie als de metacognitieve strategie leidden tot een afname in het eten van ongezonde tussendoortjes. Dit liet opnieuw het effect zien van de cue-monitoring strategie. Na twee maanden bleek echter dat alleen de metacognitieve strategie succesvol gedragsverandering had bewerkstelligd. Terwijl er twee maanden na het maken van de doelintentie of implementatie intentie met de originele instructies geen verandering werd geobserveerd, bleken mensen die de metacognitieve strategie hadden ontvangen substantieel minder te snacken dan vóór de oefening en dan hun mededeelnemers.

Tot slot zijn in **hoofdstuk 7** de bevindingen van dit proefschrift samengevat, de limitaties besproken, de implicaties uiteengezet en suggesties voor toekomstig onderzoek beschreven. De eerste belangrijke bevinding is dat gewoontesterkte de voornaamste voorspeller is van ongezond snackgedrag. Interventies om ongezond snackgedrag te verminderen zouden zich zodoende moeten richten op het doorbreken van de onderliggende habituele associatie. Om het snackgedrag te verminderen bleek op korte termijn een cue-monitoring fase voldoende te zijn. Over een langere periode (twee maanden) is de toevoeging van uitgebreide implementatie intentie instructies echter essentieel om gedragsverandering te realiseren. Daarnaast werd aangetoond dat het niet effectief is om meerdere plannen te maken die gericht zijn op ongezond snackgedrag. Zodoende moeten mensen aangemoedigd worden om één plan tegelijkertijd te formuleren. Tot slot is laten zien dat implementatie intenties kunnen worden geleerd als een metacognitieve strategie. Op deze manier kunnen mensen de implementatie intentie tool zelfstandig gebruiken en aanpassen aan veranderende behoeftes voor het behalen van hun persoonlijke doelen. De cue-monitoring plus planning interventie waarbij gebruik wordt gemaakt van de metacognitieve strategie leidde tot een substantiële vermindering van het snackgedrag en blijkt zodoende een veelbelovende strategie om het snackgedrag van mensen uit de doelgroep te veranderen.

Conclusie

Geïnspireerd door uitdagingen met het nastreven van doelen in het dagelijks leven, zijn in dit onderzoek belangrijke complicaties met het toepassen van als-dan plannen onderzocht. Door labstudies met praktische onderzoeken te combineren, zijn nieuwe inzichten geworven die het gebruik van implementatie intenties toegankelijk maken voor de algemene bevolking, zodat mensen geholpen kunnen worden met het doorbreken van hun ongezonde snackgewoontes.

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Curriculum Vitae

Aukje Verhoeven was born on August 30, 1987, in Utrecht, the Netherlands. She graduated from secondary school (pre-university education, Cals College, Nieuwegein) in 2005. After one year of studying Psychobiology at the University of Amsterdam, she decided that it was Psychology that truly interests her. In 2006, she started a Bachelor's program in Psychology at Utrecht University. She did a major in Social Psychology, for which she also followed the honors track, and graduated in 2009. Directly afterwards she did a summer internship at the Centre for Human Sciences in Chapel Hill, North Carolina. In that same year, Aukje started a Master's program in Social Psychology at Utrecht University and graduated in 2010 (cum laude). As part of her Master's education, she completed an internship at the Netherlands Institute for Social research (Sociaal en Cultureel Planbureau) and afterwards worked there on project basis. In October 2010, she started her PhD project at the department of Clinical and Health Psychology at Utrecht University under the supervision of dr. Marieke Adriaanse, prof. Denise de Ridder, dr. Emely de Vet, and prof. Bob Fennis, which resulted in the present dissertation. During this project, she spent two months at the University of Sheffield, UK, to collaborate with prof. Paschal Sheeran and dr. Thomas Webb. From March 2015, Aukje works as a postdoctoral researcher at the Clinical Psychology department at the University of Amsterdam. She continues doing research on implementation intentions, aimed at promoting healthy eating and exercising habits.

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Verhoeven, A. A. C. (November, 2014). Ongezonde eetgewoontes & implementatie intenties. Guest lecture for the Bachelor's program Clinical Psychology at the University of Amsterdam.

Verhoeven, A. A. C., Adriaanse, M. A., De Vet, E., Fennis, B. M., & De Ridder, D. T. D. (May, 2014). Why we snack unhealthily and how to change it. Inter-departmental presentation, department of Cognitive Psychology and department of Clinical and Health Psychology, Utrecht University.

Verhoeven, A. A. C. (December, 2013). Bad habits & implementation intentions. Guest lecture for the Master's program Health and Social Psychology at Maastricht University.

Grants

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