THE ALLURE OF FORBIDDEN FOOD

A GOAL CONFLICT PERSPECTIVE ON DIETING

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A GOAL CONFLICT PERSPECTIVE ON DIETING

De aantrekkingskracht van lekker eten:
een doel-conflict perspectief op lijngedrag

(met een samenvatting in het Nederlands)

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CONTENTS

CHAPTER 1

Introduction and Overview

Body weight is an issue of growing concern in Western societies, as the prevalence of overweight and obesity has increased markedly over the last decades. In many industrialized countries, more than half of the population is now considered too heavy (e.g., Ogden et al., 2006). As overweight and obesity are associated with severe health risks as well as negative social implications, many people try to regulate their weight by dieting. However, although such efforts at weight regulation are often successful initially, most dieters do not maintain their weight loss in the long term, or even regain more weight than they lost in the first place (Jeffery et al., 2000; see Mann et al., 2007, for a review). Apparently, it is very difficult for dieters to resist the temptation of eating attractive, high-calorie foods, even when these interfere with long-term health goals.

A number of theories have been proposed to explain the eating behavior of overweight people and of dieters in order to understand these failures of self-regulation. Most of these theories are based on the assumption that eating behavior is regulated homeostatically in response to signals of hunger and satiety, and that this mechanism is somehow disturbed in individuals with problems in eating regulation, such as overweight people and dieters (e.g., Bruch, 1961; Herman & Polivy, 1984). The boundary model of eating regulation (Herman & Polivy, 1984), for example, suggests that while non-dieters eat in response to cues of hunger and satiety, dieters regulate their eating behavior by means of consciously controlled processes because they are insensitive to such homeostatic cues for eating.

However, human eating behavior is to a large part driven by the hedonic aspects of food, such as its palatability, rather than by purely homeostatic factors (e.g., Pinel, Assanand, & Lehman, 2000). People differ with regard to their sensitivity to these hedonic aspects of food, and this sensitivity has been suggested to play a crucial role in the difficulties of eating regulation and overweight (e.g., Yeomans, Blundell, & Leshem, 2004; Lowe & Butryn, 2007; Lowe & Levine, 2005). Numerous studies have shown that chronic dieters have stronger appetitive responses to attractive food than non-dieters, including cravings, increased salivation, and overeating (e.g., Fedoroff, Polivy, & Herman, 1997; Stirling & Yeomans, 2004). In addition, our living environment confronts us with an abundance of palatable food cues continuously, and it has been suggested that such a “toxic environment” contributes to dieters’ difficulties in weight-regulation

(Wadden, Brownell, & Foster, 2002). Thus, increased sensitivity to palatable food cues could interfere with dieters' attempts at self-regulation.

The present dissertation combines these findings on the hedonic responses to food with recent developments in social psychology to a novel approach to dieters' eating behavior. As recent research in social psychology has shown, much of human behavior is triggered by environmental cues and guided by nonconscious processes, so that we are often not aware of the factors that actually cause our behavior (Bargh, 1990; Aarts, Gollwitzer, & Hassin, 2004). This opens the intriguing possibility that attractive food cues trigger such nonconscious processes in dieters that make it more likely that they will overeat, without them being aware of these influences. The present dissertation examines the role of such nonconscious processes in dieters' self-regulation to understand how the perception of attractive food cues in the environment can interfere with the pursuit of their long-term goal of weight control.

Overview

Chapter 2 of this dissertation lays out a theoretical framework for understanding the self-regulation of chronic dieters. After a review of the literature on dieters' overeating, a goal-conflict theory is introduced that aims to explain the findings on dieters' increased responsiveness to food cues, as well as their ensuing difficulties in eating regulation. This theory proposes that restrained eaters (i.e., chronic dieters) hold two conflicting goals with regard to food, namely the goal of eating palatable food, and the goal of controlling their weight. While the chronically accessible goal of weight control normally dominates restrained eaters' food-related cognitions and behavior, the exposure to attractive food triggers in them a hedonic orientation with regard to food and leads to the inhibition of the mental representation of the dieting goal. As a result of this cognitive response to attractive food cues, actual overeating is more likely to occur.

Chapter 2 presents an overview of empirical studies that support the goal-conflict theory by examining restrained eaters' cognitive processes in the regulation of eating behavior. In addition, the chapter shows how the processes laid out in the goal conflict model can explain earlier findings on the overeating of obese people and restrained eaters. Finally, the chapter discusses the relevance of the findings on restrained

eaters' goal conflict for other instances of goal conflict and considers possibilities for further research in this area.

Chapters 3 – 5 present in more detail the empirical studies that are discussed in Chapter 2. To begin with, Chapter 3 describes two studies which demonstrate that restrained eaters spontaneously activate hedonic thoughts about food when they perceive attractive food cues. Restrained and unrestrained eaters read behavior descriptions involving palatable food, or bland food. Subsequently, the accessibility of hedonic thoughts about food was assessed in an unobtrusive manner. Results showed that restrained eaters activate hedonic thoughts about food when reading behavior descriptions involving food, but only when this food is palatable. Unrestrained eaters do not activate such hedonic thoughts about food. These findings suggest that restrained eaters easily think about food in hedonic terms, which might interfere with the pursuit of their goal of weight control. Specifically, hedonic thoughts about food have been shown to lead to the inhibition of the dieting goal, so that thinking about the hedonic aspects of food makes the pursuit of the dieting goal less likely.

Chapter 4 deals with the effect of attractive food cues on processes of visual attention. Previous studies demonstrated that the exposure to palatable food activates hedonic thoughts in restrained eaters and triggers the inhibition of their dieting goal. It was hypothesized that as a result of these processes, restrained eaters visual attention should be attuned to such stimuli in their environment which match this hedonic orientation. In order to test this hypothesis, restrained and unrestrained eaters were unobtrusively exposed to a number of attractive food items in a word verification task. Subsequently, participants' visual attention to food items was measured in a probe classification task, in which participants had to respond quickly to probe stimuli which appeared either in the location of a food item, or in the location of a non-food control item. To the degree that increased visual attention is allocated to food items, reactions should be faster in those trials in which the probe appears in the same location, rather than in the different location, as the food item. Results confirmed that restrained eaters allocate increased visual attention to attractive food items as a function of their liking of this food. This attentional bias might have important implications for restrained eaters' self-regulation, which are also discussed in Chapter 4.

Chapter 5 considers the question of whether all restrained eaters' efforts at self-regulation are doomed to fail, or whether there are also successful restrained eaters. A related line of research (Fishbach, Friedman, & Kruglanski, 2003) has shown that successful dieters have the tendency to activate, rather than inhibit, their dieting goal when confronted with attractive food temptations. Chapter 5 examines whether such a pattern of self-regulatory success can also be found among restrained eaters. Results of a lexical decision task in which participants were primed with attractive food words show that such primes lead to the activation of the dieting goal in successful restrained eaters, but to the inhibition of this goal in unsuccessful restrained eaters. A second study demonstrates the implications of dieting success for the intention-behavior relationship among restrained eaters. These studies offer converging evidence that successful restrained eaters do exist, and suggest that the accessibility of the dieting goal plays a crucial role in their self-regulation.

The reader should note in advance that all chapters of this dissertation were written in such a way that they can be read independently and in any order. In addition, Chapter 2 presents an overview and a discussion of the empirical findings which are presented in more detail in Chapters 3 – 5. Therefore, there is some overlap between the different parts of the dissertation.

CHAPTER 2

Understanding dieting:
A social cognitive analysis of hedonic processes in self-regulation

The present paper introduces a novel approach to understanding failures of self-regulation in chronic dieters. Traditional approaches to this problem have focused on consciously controlled processes of eating regulation, such as the realization that one has overeaten, or the experience of food cravings. We argue, however, that dieters' problem might rather lie in their sensitivity to the hedonic aspects of food and the resulting inhibition of their dieting goal. We present a goal conflict model that integrates recent findings on hedonic sensitivity in eating regulation with social-psychological research on nonconscious goal pursuit. We show that the perception of attractive food triggers hedonic thoughts about food in chronic dieters and leads to the inhibition of their dieting goal. These processes make subsequent overeating more likely, while bypassing dieters' conscious awareness. We discuss how our model can accommodate earlier research findings in this area, and we consider its implications for dieting behavior and for our attempts at resisting temptations more generally.

This chapter is based on Papies, E.K., Stroebe, W., & Aarts, H. (2008a). Understanding dieting: A social cognitive analysis of hedonic processes in self-regulation. *manuscript under review*

Body weight is an issue of growing concern in Western societies. The prevalence of overweight and obesity has increased markedly over the last decades, and in many industrialized countries, more than half of the population is now considered too heavy (Hedley et al., 2004; Flegal, 2005; Ogden, C. L. et al., 2006; Rennie & Jebb, 2005; Fry & Finlyey, 2005). Such figures are alarming in themselves, but they are especially striking if one considers that obesity has been recognized as a health condition associated with increased risk of cardiovascular diseases, hypertension, some kinds of cancer, diabetes and other health problems (Must et al., 1999; Mokdad et al., 2003). At the same time, overweight and obesity are associated with increased body dissatisfaction (for a review, see Schwartz & Brownell, 2004), and overweight and obese people are the subject of strong bias and discrimination (see Puhl & Brownell, 2001, for an overview; Teachman, Gapinski, Brownell, Rawlins, & Jeyaram, 2003). Thus, overweight and obesity are conditions with severe health consequences as well as negative social implications.

From this, one might infer that most people should be motivated to control their weight to avoid the negative consequences of being too heavy. Indeed, just as the prevalence of overweight and obesity has increased, so has the popularity of weight-loss diets and the number of people trying to regulate their weight by dieting (Kruger, Galuska, Serdula, & Jones, 2004; Mann et al., 2007). Recent data show that 24% of men and 38% of women in the US were trying to lose weight in 1998, most commonly by consuming less calories and eating less fat (Kruger et al., 2004). Another study reports that more than half of the study population were using weight control behaviors at the time of measurement (Neumark-Sztainer et al., 2000). However, although such efforts at weight regulation are often initially successful, most dieters do not maintain their weight loss in the long term (Jeffery et al., 2000; Elfhag & Rossner, 2005; see Mann et al., 2007, for a review). On the contrary, dieters often regain more weight than they initially lost, once the diet program is finished (Mann et al., 2007). In line with such findings, chronic dieters do not manage to actually eat less than non-dieters in either natural or laboratory settings (Stice, Fisher, & Lowe, 2004; Martin et al., 2005; Kruger et al., 2004), and they actually tend to gain weight in the long term (e.g., Klesges, Isbell, & Klesges, 1992; Stice, 1998; Lowe et al., 2006). Apparently, dieters cannot resist the temptations of

attractive, high-calorie food. What makes it so difficult to refrain from eating such foods, even if one knows that they interfere with long-term health goals?

Recently, there is a growing recognition that the abundance and easy availability of attractive, energy-dense foods might contribute significantly to the modern "obesity epidemic" (e.g., Wadden, Brownell, & Foster, 2002; Hill, J. O. & Peters, 1998). Indeed, numerous studies show that dieters are highly responsive to the presence of such attractive foods and experience cravings and lapses of restraint when they are confronted with it (e.g., Fedoroff, Polivy, & Herman, 1997; Stirling & Yeomans, 2004). This suggests the need to study the effect of environmental food cues on the psychological processes governing eating behavior. Viewing eating behavior as the result of the interplay between characteristics of the individual and the environment makes it a truly social psychological research area. At the same time, recent developments in social psychology suggest that much of human behavior is triggered by subtle environmental cues and guided by unconscious mental processes, so that we are often not aware of the factors that cause our behavior (Bargh, 1990; Aarts, Gollwitzer, & Hassin, 2004). This opens the intriguing possibility that attractive food cues trigger in restrained eaters such processes that make it more likely that they will overeat, without them being aware of these influences.

In this article, we will combine these two developments, namely the recognition that environmental food cues might interfere with dieting behavior, and recent research on nonconscious processes underlying behavior, to examine the difficulties that dieters experience in the pursuit of their good intentions. More specifically, we will lay out a goal-conflict theory of dieters' eating behavior that aims to explain the findings on dieters' increased responsiveness to food cues, as well as their ensuing difficulties in eating regulation. We will review a set of studies that support this theory by examining dieters' cognitive processes in the regulation of eating behavior. First, however, we will discuss earlier theories on these issues and examine how these account for difficulties in eating regulation.

Homeostatic theories of obesity

Most earlier theories for understanding the problem of obesity are based on the assumption that eating behavior is regulated homeostatically in response to signals of

hunger and satiety and that this mechanism of homeostatic regulation is disturbed in overweight and obese individuals (Bruch, 1961; Herman & Polivy, 1984; Schachter, 1971; Kaplan & Kaplan, 1957).

Early theories

One of the first psychological approaches to obesity was proposed by Kaplan and Kaplan (1957), who suggested that overeating in overweight individuals occurs because these individuals eat not in response to physiological signals of hunger, but rather in response to conditioned cues for eating (such as lunchtime or dinnertime), or because their eating is a conditioned response to psychological distress. Thus, Kaplan and Kaplan (1957) proposed learning mechanisms to explain why some individuals eat in response to conditioned external cues rather than as a means to reduce their homeostatic hunger. In a related theory, Bruch (1961), too, attributed the development of overweight to the insensitivity to internal cues for hunger. She argued that due to early childhood experiences, some individuals have not learned to distinguish sensations of hunger from other states of arousal, so that they have a tendency to react with eating in response to anxiety or other strong emotions, which increases the chances for developing overweight.

The idea of differential responsiveness to internal and external cues for eating was further developed by Schachter and colleagues (Schachter, Goldman, & Gordon, 1968). They found no evidence that obese participants overeat after a fear manipulation in the laboratory and suggested instead that the eating behavior of obese individuals is strongly affected by "the circumstances of eating" (Schachter, 1968, p. 753). Thus, according to this externality theory, while the eating behavior of normal-weight individuals is triggered by the internal homeostatic cues of hunger, the eating of overweight people is a response to external cues such as the time of day, the sight, smell or taste of food, or other people eating (Schachter, 1968, 1971). A number of innovative studies by Schachter and his colleagues supported this assumption, showing, for example, that the amount of ice cream that overweight individuals ate in a taste test was strongly related to how much they liked it, but not to their level of deprivation (Nisbett, 1968; see also Goldman, Jaffa, & Schachter, 1968). Moreover, obese individuals were more reactive to time cues to determine their eating behavior (Goldman et al., 1968; Schachter & Gross, 1968). Thus, these studies have by and large provided support for the theory that in contrast to normal-weight people, the eating behavior of obese people is more

strongly determined by external cues than by internal cues for eating (see Leon & Roth, 1977; Ruderman, 1986; Rodin, 1980, for overviews; Stroebe, Papies, & Aarts, in press).

The Boundary Model of Eating

Herman and colleagues (Herman & Mack, 1975; Herman & Polivy, 1980) later built on this externality theory when they suggested that it might not be overweight per se, but rather the attempt to reduce one's weight by dieting that makes some individuals overly responsive to external food-related cues and at the same time, less sensitive to internal cues of hunger and satiety. The notion of "restrained eating" (Herman & Mack, 1975) was introduced to describe such individuals who chronically try to restrict their food intake and control their weight by dieting.

The differences between the eating behavior of restrained and unrestrained eaters were explained by Herman and Polivy (1984) in their boundary model of eating. They argue that biological pressures work to maintain consumption above some minimum level (the "hunger boundary") and below some maximum level (the "satiety boundary"); between these boundaries is an area of "biological indifference", where psychological factors have a strong influence on food consumption. Since restrained eaters chronically try to override their hunger for the sake of dieting, they become insensitive to internal cues of hunger and satiety, so that the zone of "biological indifference" is wider in restrained than in unrestrained eaters. At the same time, restrained eaters try to control their eating behavior cognitively by adhering to self-set dieting rules. They impose a so-called diet-boundary on themselves to limit their consumption before they have reached their satiety boundary. Thus, for the regulation of their eating behavior, restrained eaters do not rely on internal homeostatic cues, like unrestrained eaters do, but rather make use of more consciously controlled processes.

Restrained eating can be assessed with the Restraint Scale (Herman & Polivy, 1980), a 10-item self-report questionnaire. The scale consists of 6 items measuring the construct Concern for Dieting (e.g., "Do you often diet?", "Do you have feelings of guilt after overeating?") and 4 items measuring Weight Fluctuations ("What is your maximum weight gain within a week?", "In a typical week, how much does your weight fluctuate?"). Most research on restrained eating has used the aggregate score of both scales, although it has been suggested that restrained eating may not be a unidimensional construct (Gorman & Allison, 1995; Ruderman, 1983), and that the cognitive component

of attempting to diet might best be captured by the Concern for Dieting subscale (van Strien, Breteler, & Ouwens, 2002).

The Disinhibition Effect

The fact that restrained eaters exert conscious cognitive control over their eating behavior makes them more vulnerable to the impact of so-called disinhibitors which temporarily diminish their tendency to restrain their intake. Two kinds of disinhibiting factors have been emphasized, namely the consumption of high-calorie food, and the experience of strong emotions. The classic finding that prompted much research on the disinhibition effect in restrained eaters was reported by Herman and Mack (1975) and deals with the first of these factors, the consumption of high-calorie food. In what was presented as an ice-cream taste test, restrained and unrestrained participants were first asked to consume a "preload" of one or two milkshakes and then offered ice-cream to taste ad libitum. It was found that unrestrained participants regulated their consumption of ice-cream following the intake of the milkshakes, eating less ice-cream when they had also eaten a milkshake, and still less after two milkshakes. The restrained participants, however, behaved differently. While they ate less ice-cream than unrestrained eaters in the no-milkshake condition, they increased their consumption after a preload of one or two milkshakes; this was called "counter-regulation". As an explanation for this curious finding, Herman and Mack (1975) argued that the consumption of the milkshakes made it impossible for restrained eaters to keep to their diet, so that they decided to temporarily forget about their diet altogether and eat as much as they liked – the "what-the-hell" effect (Herman & Polivy, 1984). By violating the self-imposed diet boundary, the preload thus functioned as a disinhibitor for the eating behavior of restrained eaters.

Herman and Mack's original study (1975) inspired a large amount of research to replicate the effect of a preload on the eating behavior of restrained eaters and identify other potential disinhibitors. However, the initial finding that dieters increase their consumption after a preload could not systematically be replicated. The overall picture that emerges from the preload studies is that while unrestrained eaters generally reduce their consumption after a high-calorie preload, the consumption of restrained eaters does not vary systematically as a function of preload (Ruderman & Christensen, 1983; Hibscher & Herman, 1977; Herman, Polivy, & Esses, 1987a; Polivy, 1976; Ouwens, van Strien, & van der Staak, 2003; van Strien, Cleven, & Schippers, 2000; Jansen,

Oosterlaan, Merckelbach, & van den Hout, 1988; Westenhoefer, Broeckmann, Munch, & Pudel, 1994). However, the pattern of counterregulation seems to be especially likely to occur when the preload has a high hedonic value, thus when it is palatable or perceived to be high in calories, or both (Knight & Boland, 1989; Polivy, 1976; Spencer & Fremouw, 1979; Woody, Costanzo, Liefer, & Conger, 1981).

In addition to the fact that the boundary model's central prediction concerning the effect of a preload has received only mixed support, there is also no empirical evidence for the hypothesized "what-the-hell" cognitions underlying this effect (Jansen, Merckelbach, Oosterlaan, Tuiten, & van den Hout, 1988; see also Boon, Stroebe, Schut, & Jansen, 1998). Thus, in those cases where an effect of preload on subsequent consumption has been found, it is not clear what actually makes restrained eaters' overeat. Similar to the preload effects, mixed findings have been reported as to restrained eaters' insensitivity to hunger cues (e.g., Ogden, J. & Wardle, 1990; Herman, Polivy, Lank, & Heatherton, 1987b), and no indication that restrained eaters have a higher satiety boundary (Tepper, 1992).

More consistent effects have been found in studies investigating the effects of stress and strong emotions, which have been proposed by Herman and Polivy (1984) as another potential disinhibiting factor, because they "render the diet boundary irrelevant or at least ineffective" (p. 152), thus making restrained eaters less motivated to keep their diet. Overall, these studies have shown that restrained eaters eat more when depressed, anxious, or stressed than when in a neutral mood, while unrestrained eaters rather decrease their eating in such states (e.g., Baucom & Aiken, 1981; Heatherton, Herman, & Polivy, 1991; Herman et al., 1987b; Mitchell & Epstein, 1996; for a review, see Greeno & Wing, 1994). These effects are explained by Herman and Polivy in terms of "more urgent concerns" (Herman & Polivy, 1984, p. 152) that lead restrained eaters to ignore their diet boundary.

Later studies have investigated the effect of the availability of psychological resources on the regulation of eating behavior and provided a different explanation for dieters' overeating under strong emotions, namely that the emotion-induced overeating might be due not the experience of specific emotions, but rather to the more general effect of limited resources needed for self-regulation. In line with this explanation, several studies have shown that restrained eaters overeat on palatable food when placed

under cognitive load (Bellisle & Dalix, 2001; Boon, Stroebe, Schut, & Ijntema, 2002; Lattimore & Caswell, 2004; Ward & Mann, 2000; see Macht, 2008, for an overview). Boon and colleagues (2002), for example, imposed a cognitive load on half of the participants while they were doing taste test with ice-cream which was presented either as very palatable ("extra creamy"), or as calorie-reduced ("contains 30% less calories"). When the ice-cream was described as "extra creamy", restrained eaters ate the same amount of ice-cream as unrestrained eaters when cognitive load was low, but they consumed much more than unrestrained eaters when cognitive load was high. No such effect was observed for the "calorie-reduced" ice-cream.

These findings confirm that cognitive load impairs restrained eaters' efforts at dieting. However, overeating occurs only when the available food is perceived as hedonic (e.g., "extra creamy"), which suggests that once the dieting efforts are overruled, restrained eaters' eating behavior is guided by the hedonic properties of the food; when the food is not seen as hedonically relevant, restrained eaters do not eat more than unrestrained eaters

Conclusion

Although it seemed to fit well with the original preload studies and has inspired a large number of studies subsequently, the boundary model has limited explanatory power for understanding the problem of dieters' overeating. No consistent evidence has been found for restrained eaters' insensitivity to cues of hunger and satiety, for actual overeating in response to preloads, or for the "what-the-hell-effect" as the proposed mechanism underlying this overeating. While the model's predictions on the effect of strong emotions on eating behavior have largely been supported, these findings might well be due to the availability of psychological resources for self-regulation. When resources are low, the behavior of restrained eaters in the presence of palatable food seems to be guided most by the hedonic aspects of the food, which overrule the impact of the dieting goal. This conclusion is well in line with recent developments in research on dieting behavior, where the role of hedonic aspects of food is receiving increased attention, and researchers have begun to systematically examine the role of pleasure in the regulation of eating behavior.

The Hedonic Value of Food

Scientific and anecdotal evidence suggests that eating is to a large part driven by hedonic responses to food. People are more inclined to eat food that they find palatable (e.g., Pliner & Mann, 2004; Eertmans, Baeyens, & Van den Bergh, 2001; Bobroff & Kissileff, 1986), and terminate eating when the experienced palatability of the food has temporarily diminished (Hetherington & Rolls, 1996; for a review, see Yeomans, 1998). Recently, hedonic processes in eating have also been suggested to play a key role in overeating and obesity. Pinel and colleagues (Pinel, Assanand, & Lehman, 2000) introduced the concept of positive incentive value into the research on overeating, and they argue that the most important factor determining the incentive value of food is its anticipated taste. Thus, eating is to a large part driven not by a homeostatic mechanism to reduce hunger, as was previously assumed, but rather by mechanisms that anticipate the rewarding properties of food (Pinel et al., 2000; Lowe & Butryn, 2007; Finlayson, King, & Blundell, 2008). In support of these arguments, recent neurological evidence suggests that there is a brain system for the hedonic regulation of eating that responds to cues about palatability and is separate from the more homeostatic system that controls eating in response to physiological needs (Yeomans, Blundell, & Leshem, 2004; Lowe & Levine, 2005; Blundell & Finlayson, 2004). Moreover, there is evidence that there are stable individual differences with regard to the sensitivity of the hedonic system for eating regulation (Lowe & Butryn, 2007; Yeomans et al., 2004; Blundell et al., 2005; Finlayson, King, & Blundell, 2007). This implies that some individuals will be more sensitive to cues about the rewarding properties of food than others, and it has been suggested that an increased hedonic sensitivity could be related to difficulties in eating regulation and overweight (Mela, 2006; Yeomans et al., 2004).

Recently, researchers have begun to try to capture these individual differences in hedonic sensitivity and assess their relation to eating behavior. Initially, it seemed plausible to assume that individuals who have difficulties regulating their weight have a more positive evaluation of palatable, high-fat food than others, and therefore eat too much of it. Empirical evidence, however, does not support this straightforward position. Research on the differences between obese and normal weight subjects suggests that these groups do not differ with respect to their “liking” of palatable food (Mela, 2006). One could argue, however, that explicitly asking obese participants for their liking of

palatable, high-fat food items might bias them towards more negative responses due to social desirability concerns. But even when assessed with implicit measures of attitudes, which assess evaluations unobtrusively and thus are said to represent a person's "true attitude", the is no evidence that obese people evaluate palatable food more positively. On the contrary: when measured implicitly, obese people's evaluations of high-fat, palatable food seem to be even more negative than those of normal-weight people (Roefs & Jansen, 2002; Roefs et al., 2005b).

A similar picture emerges concerning restrained and unrestrained eaters' evaluations of high-fat, palatable food. Restrained eaters do not indicate more positive attitudes towards such food than unrestrained eaters when explicit measures are used (Stroebe, Mensink, Aarts, Schut, & Kruglanski, in press; Fedoroff et al., 1997), and comparable results are obtained with indirect measures of evaluations.

In our own study of this issue (Papies, Stroebe, & Aarts, 2008b), we measured restrained and unrestrained eaters' implicit evaluations of food pictures in an affective priming task (Fazio, Jackson, Dunton, & Williams, 1995). Participants were presented with color photographs of palatable (e.g., pizza, ice-cream), neutral (e.g., lettuce, soup), and unpalatable food (e.g., baked beans, blood sausage). After the presentation of a food picture, either a positive or a negative "smiley" symbol appeared on the screen, and participants were asked to categorize this stimulus as quickly and as accurately as possible as positive or negative. If the picture of a palatable food is evaluated positively, it should trigger a positive reaction and therefore facilitate the correct response to a positive smiley (a congruent response) and slow down the response to a negative smiley (an incongruent response). An unpalatable food, on the other hand, should speed up the response to a negative smiley (congruent) and slow down the response to a positive smiley (incongruent). Responses to smileys after neutral food pictures should lie in between. We hypothesized that restrained eaters hold particularly strong positive evaluations of palatable food, so that the effect of the food pictures on their reaction times should be more pronounced than for unrestrained eaters.

Results showed that congruent responses were faster than incongruent responses, with responses after neutral pictures lying in between. This indicates that palatable food was evaluated more positively than unpalatable food. However, contrary to our hypothesis, there were no differences between restrained and unrestrained eaters. Thus,

while restrained eaters displayed a clear preference for palatable food over unpalatable food, this effect was not more pronounced than in unrestrained eaters (see Figure 1); if anything, it was even more pronounced in the unrestrained eaters, although this effect did not reach significance.

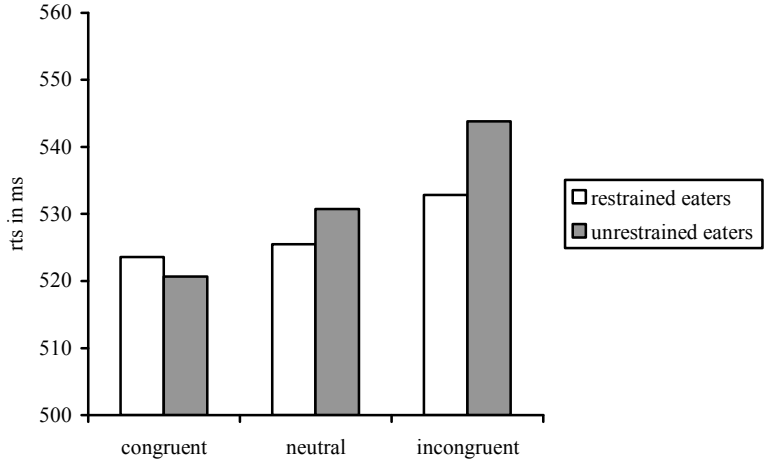

Figure 2.1. Mean response times for categorizing positive and negative smileys after pictures of palatable, neutral and unpalatable food in the affective priming task (adapted from Papies et al., 2008b).

Using other measures of implicit evaluations, Roefs and colleagues obtained similar results (Roefs, Herman, MacLeod, Smulders, & Jansen, 2005a). Taken together, these studies strongly suggest that restrained eaters do not evaluate palatable food more positively than unrestrained eaters. Thus, the crucial difference between restrained and unrestrained eaters does not lie in their basic evaluation of palatable food. Rather, it might be found on a more specific level, namely in the specifically hedonic value attributed to the palatable food.

Food cravings

When considering hedonic processes in the regulation of eating behavior, a potentially useful distinction can be made between the evaluation of a palatable food, and the degree to which its hedonic characteristics elicit the motivation to actually engage in eating it (Mela, 2006; see also Robinson & Berridge, 2000). Thus, the critical issue for eating regulation and overweight might not be the degree to which a person holds a positive evaluation of a certain food, but the degree to which the person actually wants to

eat that food, as this might be a better predictor of behavior (Robinson & Berridge, 2000). The experience of the motivation to eat has mostly been studied by examining the occurrence of food cravings, which are defined as the intense desire to eat a specific food item (Weingarten & Elston, 1990) and are therefore related specifically to the hedonic properties of food. Several questionnaires have been developed to directly assess food cravings (e.g., Cepeda-Benito, Gleaves, Williams, & Erath, 2000), and these have been used to study whether dieters experience more cravings than non-dieters.

While some studies report a clear association between dieting behavior and cravings (e.g., Gendall, Sullivan, Joyce, Fear, & Bulik, 1997; Pelchat, 1997; Nijs, Franken, & Muris, 2007; Polivy, Coleman, & Herman, 2005), other studies find a weak or no such relationship (e.g., Hill, A. J., Weaver, & Blundell, 1991; Rodin, Mancuso, Granger, & Nelbach, 1991; Weingarten & Elston, 1991). Some researchers have proposed cravings to be the mechanism linking a heightened sensitivity to food rewards to overweight. Burton, Smit, and Lightowler (2007) found that experienced food cravings mediate the relationship between a strong responsiveness to external food cues and body mass index. Franken and Muris (2005) predicted in a similar fashion that cravings might be the causal link between reward sensitivity and higher BMI, but they did not find evidence for this mediating role of cravings.

To illustrate the motivational force that cravings for food can exert on the individual, it is interesting to note that the same brain areas are activated when a person experiences cravings for food as in cravings for addictive drugs (Pelchat, Johnson, Chan, Valdez, & Ragland, 2004), and the same neurotransmitter systems are involved (Pelchat, 2002; see also Volkow & Wise, 2005). Thus, there is some evidence that attractive food exerts a strong motivational pull on restrained eaters, which they sometimes experience as explicit food cravings. However, the exact relationship between restrained eating, cravings, and overeating is not yet clear.

We suggest several possible reasons for these mixed findings. First of all, in the craving studies alluded to above, participants were asked to self-report the frequency of experiencing cravings in their daily lives. However, it might be difficult to accurately report one's cravings in retrospect while one is not currently experiencing them (cf. Loewenstein, 1996), which might lead dieters to underestimate how often they experience cravings. In addition to this problem, concerns about the social desirability of

controlling one's food intake might also lead to underreporting of food cravings. This might be especially pronounced in dieters, so that the association of dieting with cravings may appear weaker in such studies than it really is. Finally, we suggest that rather than looking at cravings and motivation to eat as a general phenomenon in dieters, it might be more informative to look at cravings and other appetitive responses to food when one is actually confronted with it. After all, these are the situations in which the hedonic aspects of food are most salient, while at the same time, it is important for dieters to curb their motivation to eat. Therefore, we will now shortly discuss a number of studies that examined restrained eaters' appetitive responses when they were actually confronted with attractive food. These studies suggest that restrained eaters' hedonic responses in such situations might actually play a crucial role in their overeating.

The Hedonic Impact of Food Cues

Several experimental studies have confirmed that the exposure to palatable food cues elicits in restrained eaters stronger appetitive responses than in unrestrained eaters. Compared to unrestrained eaters, restrained eaters have been found to respond with increased salivation to the exposure to attractive food cues (Klajner, Herman, Polivy, & Chhabra, 1981; LeGoff & Spigelman, 1987; Tepper, 1992; Brunstrom, Yates, & Witcomb, 2004). Other studies have shown that imagining liked food triggers increased self-reported food cravings in restrained eater (Harvey, Kemps, & Tiggemann, 2005; Fedoroff et al., 1997), and the exposure to the smell or the sight of palatable food leads to stronger cravings and overeating in restrained compared to unrestrained eaters (Fedoroff et al., 1997; Fedoroff, Polivy, & Herman, 2003; Jansen & Van den Hout, 1991; Rogers & Hill, 1989). Fedoroff and colleagues (2003) showed that restrained eaters' increased cravings were related to increased intake, but only when the food that participants were smelling during the exposure condition was the same food that they sampled during the test phase of the experiment. A related study by Stirling and Yeomans (2004) nicely illustrates the appetitive pull that attractive food exerts on restrained eaters. In this study, participants received a bag of chocolate candies to keep for 24 hours, and the experimenter instructed them not to consume any of it. Restrained eaters reported more difficulties in not eating the chocolate than unrestrained eaters, and they actually secretly ate some of it, while unrestrained eaters had no such difficulties in complying with the instructions (see also Polivy et al., 2005).

These studies show in a variety of ways that restrained eaters react to attractive food cues with increased eating and with other kinds of motivational responses geared towards eating. Even without the prior consumption of a preload, or the experience of stress or strong emotions, restrained eaters were triggered to overeat on high-fat, palatable food. In a sense, the studies suggest that the mere thought or presence of palatable food can act as a disinhibitor of restrained eaters' eating behavior. Speaking in terms of the boundary model (Herman & Polivy, 1984), the diet boundary is rendered ineffective exactly at the moment when it is most needed, namely in the presence of attractive but forbidden food.

These findings raise an interesting possibility concerning the mechanisms underlying restrained eaters' overeating. Based on the findings that restrained eaters react with appetitive responses and overeating to the actual or even imagined presence of attractive food, we propose that a hedonic goal with respect to food and eating might be the driving force behind their eating behavior in these situations. In addition, we argue that the activation of such hedonic responses upon the exposure to food cues might switch off the competing dieting goal in restrained eaters' mind, making it less likely that this goal will influence restrained eaters' behavior. This two-step process might be the psychological mechanism that translates increased sensitivity to the hedonic aspects of food into actual behavior. We integrated these ideas into a goal conflict theory of eating behavior, which we will now discuss in more detail.

The Goal Conflict of Restrained Eaters

The goal conflict theory of restrained eating is grounded in recent research on nonconscious goal pursuit, which examines the processes by which external cues can trigger behavior without the intervention of conscious thought. Indeed, much of our everyday behaviors occur without much conscious thought or intentions (e.g., Bargh, 1990; Ouellette & Wood, 1998), and even the pursuit of goals can occur in such an automatic fashion, in response to environmental cues or the behavior of other people (e.g., Aarts et al., 2004; Custers & Aarts, 2005; Aarts & Dijksterhuis, 2000). Research on nonconscious goal-pursuit is based on the assumption that goals are represented and stored in mind as desired states that can readily be retrieved by external cues (Bargh, 1990).

Several lines of research have examined how behavioral goals can be triggered by environmental cues and guide cognitive and behavioral processes supporting goal pursuit. Custers and Aarts (2005, 2007b) have shown that the exposure to information that renders a desirable state more accessible in mind can motivate an individual to pursue it, for example by increasing behavioral effort at attaining the goal. Moreover, priming goal-relevant information can attune subsequent cognitive processes to facilitate the pursuit of that goal, such as activating means instrumental for reaching that goal (Custers & Aarts, 2007a; Aarts & Dijksterhuis, 2000), perceiving such means as bigger in size (Veltkamp, Aarts, & Custers, in press), and evaluating these means more positively (Ferguson & Bargh, 2004). These processes make it more likely that instrumental means will be selected for the pursuit of a goal, thereby enhancing the chances for goal achievement.

Of particular relevance for our goal conflict theory of restrained eating is the finding that the instigation of a goal can lead to the inhibition of conflicting goals, as these might interfere with the pursuit of the focal goal (Aarts, Custers, & Holland, 2007; see also Shah, Friedman, & Kruglanski, 2002). In a recent study examining this issue, Aarts and colleagues (2007; Experiment 2) unobtrusively primed participants with the goal of studying while measuring the mental accessibility of the goal of socializing by means of a lexical decision task. Results showed that activating the goal of studying outside of awareness led to the inhibition of the goal of socializing, but only when this goal was rendered accessible as the result of a previous priming procedure. Thus, when the goal of studying was instigated, the previously accessible goal of socializing was inhibited, thereby actively decreasing the contribution of the socializing goal in overt action and facilitating the pursuit of the goal of studying. Interestingly, when the goal of socializing had first been co-activated with negatively valenced words in order to make the pursuit of this goal temporarily less desirable, this inhibition effect did not occur. Thus, when the competing goal was made less desirable, it was less likely to interfere with the pursuit of the study goal, thereby rendering its inhibition unnecessary. This study illustrates the functional mechanism of inhibition of potentially conflicting goals, which serves to facilitate the successful pursuit of a focal goal.

Our goal conflict model of restrained eating is built on these findings on the nature of nonconscious goal pursuit. We propose that restrained eaters hold two

conflicting goals with regard to food, namely the goal of eating good food, and the goal of controlling their weight (Stroebe, 2008; Stroebe, Mensink, Aarts, Schut, & Kruglanski, 2008). Both are highly desirable for restrained eaters, but while the first goal is hedonically based and will lead to the consumption of attractive food, the latter is aimed at controlling the intake of such food in order to prevent weight gain. Thus, the goal of eating attractive food is often incompatible with the goal to control one's weight, leading to a potential goal conflict.

The goal conflict model suggests that due to restrained eaters' repeated attempts at weight control, their dieting goal is chronically (thought not necessarily consciously) accessible in mind. As a result, this goal will normally dominate restrained eaters' food-related cognitions and behavior, and will curb the influence of the conflicting goal of eating good food. This changes, however, when restrained eaters are confronted with external cues of palatable food. Because they are highly sensitive to the hedonic properties of food, the perception of palatable food triggers in restrained eaters a hedonic orientation towards food. As the goal of eating the attractive food is then highly accessible, restrained eaters' cognitive processes will be geared towards pursuing this goal, and importantly, conflicting goal representations will be inhibited (Aarts et al., 2007). Thus, when the hedonic goal of enjoying good food is activated by the perception of palatable food, restrained eaters will inhibit the mental representation of the dieting goal. As a result of this two-step process, their subsequent cognitive and behavioral processes will be dominated by the hedonic goal of eating good food rather than by their goal of controlling their body weight. Importantly, both the activation of the hedonic eating goal and the inhibition of the weight control goal can occur outside of conscious awareness (Aarts et al., 2007; see also Danner, Aarts & De Vries, 2007; for a theoretical account and empirical demonstration of the functionality of nonconscious inhibitory processes in goal-directed behavior).

Unrestrained eaters, on the other hand, are less sensitive to the hedonic properties of palatable food and therefore do not activate the hedonic goal of eating good food when confronted with attractive food cues. As a result, the motivational processes directed at the pursuit of this goal that characterize the cognition and behavior of restrained eaters, do not occur in unrestrained eaters.

The goal conflict model provides a novel conceptual framework for understanding restrained eaters' appetitive responses to food and their frequent lapses of restraint (Fedoroff et al., 1997, 2003; Jansen & Van den Hout, 1991). Restrained eaters' reactions towards attractive food are driven by the hedonic goal of eating it rather than by their goal of weight control, which will be reflected in, for example, increased attention for attractive food, as well as increased cravings and overeating. In this sense, our model extends recent findings that point towards a crucial role for hedonic processes in the regulation of eating behavior in general, and in the development of overweight, more specifically (e.g., Yeomans et al., 2004). Moreover, it is grounded in recent social psychological knowledge on the role of nonconscious processes underlying human behavior.

This approach to restrained eating differs crucially from most traditional models of health behavior, which are based on the assumption that individuals' health behavior is guided by conscious processes, such as the forming of conscious intentions based on beliefs (theory of reasoned action, Fishbein & Ajzen, 1975; theory of planned behavior, Ajzen, 1991), or the conscious appraisal of health threats and their possible remedies (health belief model, Janz & Becker, 1984), to mention only a few. In these theories, individuals are assumed to consciously reflect on the goals they want to reach and devise behavioral plans in order to accomplish them. However, there is considerable evidence that we do not have introspective access to much of our mental processes, so that we might not always be conscious of the sources of our thoughts and behavior (e.g., Nisbett & Wilson, 1977; Blackmore, 2003). Thus, a large part of human behavior might not actually originate from such conscious plans and intentions (Wegner, 2002). This is a significant limitation for traditional models that are based on the assumption that health behavior is mainly guided by conscious intent, and poses the challenge to consider nonconscious influences on health behavior.

In order to best examine such nonconscious influences on behavior, social cognition researchers have developed a wide range of implicit measures, which tap cognitive processes rather unobtrusively and are therefore less susceptible to both demand characteristics and socially desirable responding (Fazio & Olson, 2003). This is especially relevant in the domain of health behavior, where participants might be tempted to let their responses reflect their socially desired, rather than they actual behavior. As an

example, research on alcoholism and smoking has shown that implicit measures of cognition tap into different processes than explicit measures, and that they can greatly contribute to our understanding of addiction (e.g., Wiers, Houben, Smulders, Conrod, & Jones, 2006; Swanson, Rudman, & Greenwald, 2001). In the domain of eating and dieting, however, only a rather small number of studies have employed implicit measures, albeit with promising results (e.g. Roefs & Jansen, 2002; Seibt, Häfner, & Deutsch, 2007; De Houwer & De Bruycker, 2007; Ferguson, 2007). Especially among restrained eaters, implicit measures might add greatly to our understanding of self-regulatory failures, since they might be unaware of the effect of food cues, and their responses might be especially sensitive to socially desirable responding.

In the next section, we will describe the findings from a systematic research program that used social cognitive methods to conduct a comprehensive test of the goal conflict model and its predictions concerning restrained eaters' cognitive reactions to food cues. In the studies described here, we used the Concern for Dieting scale of the Restraint Scale (Herman & Polivy, 1980) to identify restrained eaters, rather than the complete scale (van Strien et al., 2002). The Concern for Dieting is especially relevant for our goal conflict model, as it captures the individual's chronic concern with weight loss and the cognitive element of attempts at weight control. In addition, this scale strongly correlates with experienced ambivalence towards food, which might be taken as an indication of a goal conflict in these chronic dieters (Stroebe et al., 2008). These findings led us to focus on Concern for Dieting as a measure of restrained eating in the studies reported here.

Hedonic thoughts about food

A central assumption of the goal conflict model concerns the fact that the exposure to attractive food triggers in restrained eaters the hedonic goal of eating it. In order to test this assumption, we conducted a set of studies in which we unobtrusively measured the spontaneous activation of hedonic thoughts about food in restrained and unrestrained eaters (e.g., Papies, Stroebe, & Aarts, 2007). If the perception of attractive food activates hedonic thoughts in restrained eaters, this might make it more likely that they will actually eat that food (Custers & Aarts, 2005, 2007b; see also Mischel, Cantor, & Feldman, 1996).

In a first study using the probe recognition paradigm, which is borrowed from text comprehension research (McKoon & Ratcliff, 1986), participants read a number of behavior descriptions, some of which mentioned either palatable food (e.g., pizza, apple pie) or neutral food (e.g., rye bread, raisins). After reading a food-related behavior description, participants were presented with single words denoting hedonic enjoyment of food (e.g., tasty, delicious) and were asked to indicate whether this word had been part of the preceding sentence or not. The hedonic words had not been part of the behavior descriptions, but the paradigm is based on the idea that participants' correct responses will be slowed down because hedonic thoughts are rendered accessible by the exposure to palatable food, as the increased accessibility interferes with indicating that the probe word was not part of the preceding sentence. As hypothesized, results showed that restrained eaters took longer to indicate that hedonic food words had not been part of the behavior descriptions, but only when these included palatable food, rather than bland food.

These findings were confirmed in a second study (Papies et al., 2007), in which the activation of hedonic thoughts about food was assessed with a different paradigm that allowed us to measure the activation of hedonic thoughts even earlier in the text comprehension process, namely during the initial encoding of the text (Long, Golding, & Graesser, 1992). Participants read the same behavior descriptions as in the earlier study. After food-related sentences, they were presented with hedonic food words and asked to indicate whether these were existing Dutch words or not (i.e., a lexical decision task). To the degree that reading the behavior descriptions activated hedonic thoughts, these words should be more accessible, reflected in shorter reaction times. The results confirmed our hypothesis that restrained eaters were faster to indicate that hedonic food words were existing Dutch words when they followed behavior descriptions with palatable food compared to bland food, while the palatability of the food items did not affect reaction times of unrestrained eaters. Because the lexical decision task does not require participants to match the probe word with the preceding sentence, it reflects the spontaneous activation of hedonic thoughts during the initial encoding, rather than at retrieval of the behavior description. From these studies, we concluded that the exposure to palatable food activated in restrained eaters hedonic thoughts about food. Importantly, restrained eaters activated these hedonic thoughts without being instructed to do so, and

most likely, they were also not aware of this process; the activation of hedonic thoughts occurred spontaneously (Hassin, Aarts, & Ferguson, 2005).

The findings from these studies provide a first indication that restrained eaters' spontaneously activate a hedonic orientation towards food when they perceive palatable food. These hedonic thoughts might be the cognitive process accompanying the appetitive responses that restrained eaters have been found to display in earlier studies when confronted with attractive food, such as increased cravings and salivation (Fedoroff et al., 1997; LeGoff & Spigelman, 1987). The fact that restrained eaters are easily enticed into thinking about food in terms of its pleasurable, "hot" qualities parallels the work on delay of gratification (Mischel et al., 1996; Mischel, Shoda, & Rodriguez, 1989). This has shown that thinking about stimuli in terms of their "hot", consummatory features makes it more difficult to resist them. Thus, restrained eaters' hedonic thoughts about food might make their overeating on attractive foods more likely. Similarly, the hedonic thoughts can be interpreted as the activation of the mental representation of the goal of eating the food, which would also make this behavior more likely to emerge (Bargh, 1990; Aarts et al., 2004).

However, the activation of hedonic thoughts about food is likely to contribute to overeating also indirectly, namely by inhibiting the mental representation of the conflicting dieting goal. As the hedonic goal of eating good food is often incompatible with the goal of dieting, the activation of hedonic thoughts about food might lead to the inhibition of the conflicting dieting goal in restrained eaters, as outlined above (see Aarts et al., 2007). When the hedonic goal of eating good food is instigated by the perception of attractive food in the environment, the goal of weight control will be inhibited in order to reduce its potential for interference and facilitate the pursuit of the goal of eating good food. This is the central idea of the goal conflict model, which was examined in a second set of experiments.

Inhibition of the dieting goal

Two experiments were conducted to test whether activating hedonic thoughts about food in restrained eaters makes the mental representation of their dieting goal temporarily less accessible (Stroebe et al., 2008). Restrained and unrestrained eaters participated in a lexical decision task that contained, among others, diet-related words (e.g., diet, weight). Participants were instructed to quickly and accurately indicate

whether the presented words were existing Dutch words, and shorter reaction times in this task are presumed to reflect increased accessibility of the concept in question. Shortly before the presentation of the diet-related words, however, participants were either primed with words representing hedonic thoughts about food (e.g., tasty, delicious), or with neutral words (e.g., neither, over). These primes were presented subliminally (i.e., for a duration of 23 ms) in order to prevent conscious processing (Bargh & Chartrand, 2000).

The results of this study showed that restrained eaters who were primed with hedonic food words took longer to recognize the diet-related words than restrained eaters who were primed with neutral words. Reaction times of unrestrained eaters were not influenced by the type of prime. A second study replicated these results and also showed that priming participants with attractive food words (i.e., pizza, cookies) had the same effect as priming hedonic thoughts directly: both kinds of primes inhibited the mental representation of the dieting goal. These studies provide support for the central tenet of the goal conflict model that a hedonic goal with respect to food is incompatible with restrained eaters' dieting goal. Therefore, when palatable food is encountered, restrained eaters automatically inhibit their dieting goal. The perception of palatable food thus disturbs the initial balance between restrained eaters' goal of eating good food and their dieting goal, with the result that the hedonic goal will be more accessible and will impact subsequent cognitive processes and most likely, behavior. In a related series of studies, we aimed to investigate the effects of this on subsequent cognitive processes, specifically, on attentional processes with regard to food.

Hedonically motivated attention for food

The studies on the goal conflict model that were described so far provide us with initial evidence that the exposure to palatable food triggers in restrained eaters a hedonic orientation towards food and leads to the inhibition of their dieting goal. As a result of this, restrained eaters' attention should be more attuned to stimuli in their environment that match this hedonic orientation. We suggest, therefore, that the exposure to palatable food might trigger in restrained eaters an attention bias for palatable food items. Selective attention is generally directed at stimuli which are motivationally relevant for an individual at a given moment (Lang, Bradley, & Cuthbert, 1997), and attentional biases for drug-related cues have been found among, for example, smokers, alcoholics, and

users of heroin or cannabis (e.g., Field, Mogg, & Bradley, 2004; Ehrman et al., 2002; Lubman, Peters, Mogg, Bradley, & Deakin, 2000; Townshend & Duka, 2001). Because they both reflect drug cravings and contribute to their maintenance by keeping the individual focused on drug-related cues, attentional processes have been argued to play a central role in psychological processes underlying addiction (Franken, 2003). We suggest that such an attentional bias might also occur in restrained eaters who have been exposed to attractive food cues and therefore have a hedonic orientation towards food.

We tested our hypothesis in two experiments which first exposed restrained and unrestrained eaters to attractive food items and then measured their visual attention for food (Papies, Stroebe, & Aarts, in press a). Participants first completed a word identification task, which served as the food pre-exposure manipulation and thus for half of the participants contained attractive food items, and for the other half, only food-unrelated words. This manipulation was designed to unobtrusively activate hedonic thoughts in restrained participants and trigger the inhibition of the dieting goal. After this, participants were presented with a modified probe classification task that was designed to measure selective attention for palatable and neutral food words (MacLeod, Mathews, & Tata, 1986). In this task, two words are shortly presented on the computer screen next to each other, for example a food word (e.g., pizza) and an office-related word (e.g., staple). Then, a probe (an arrow symbol) is presented in the location of one of these words, and participants are required to react to the probe by indicating its direction. To the degree that participants have more attention for one of the words, their reactions to the probe are assumed to be faster when it appears in the same location rather than in the opposite location as the attended-to word. This way, participants' reactions to the probes reflect their visual attention for the food words. After the probe classification task, participants provided their hedonic ratings of the food items by indicating how much they liked them on a 9-point scale.

Results showed that restrained eaters had increased selective attention for palatable food words as a function of their liking of this food, but only when they had first been pre-exposed to attractive food items. No such bias occurred for neutral food items or for the unrestrained eaters (Papies et al., in press a). In a second study, we replicated these findings and included an extra condition that was designed to provide extra insight into the mechanism underlying this bias in visual attention. Here, half of the

participants who had been pre-exposed to the attractive food were subliminally primed with diet-related words while their visual attention for food words was assessed. This was done in order to test our hypothesis that restrained eaters' hedonically motivated attention for palatable food is contingent on the inhibition of the dieting goal as a result of the food pre-exposure. If the attentional bias for food disappeared due to the diet prime, this would be indirect evidence in favor of this hypothesized mechanism. This is indeed what was found: restrained eaters who were subtly reminded of their dieting goal after the food pre-exposure had no attentional bias for palatable food (see Figure 2.2).

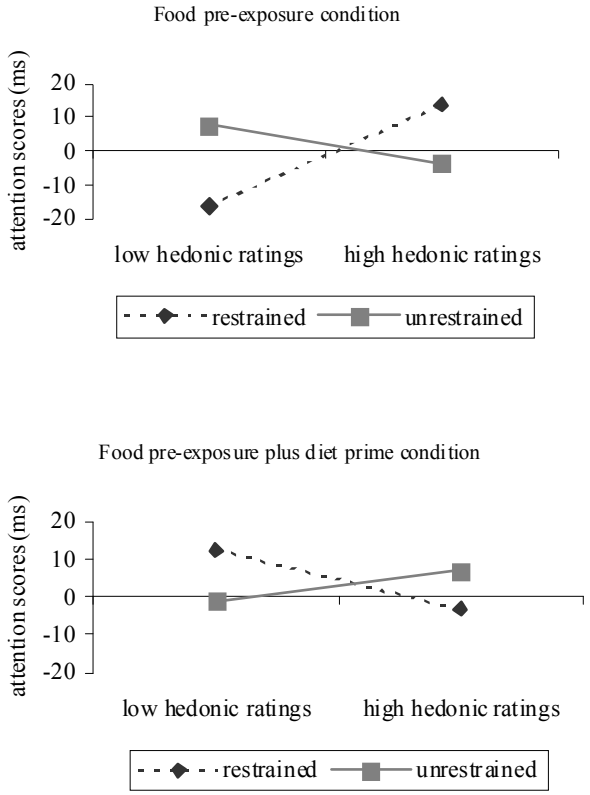

Figure 2. Visual attention scores for palatable food words as a function of restraint scores and hedonic ratings in the food pre-exposure and food pre-exposure plus diet prime conditions (adapted from Papies et al., in press a, Study 2).

These findings on restrained eaters' attentional processes are interesting in several respects. First of all, visual attention is crucial in information processing as is occurs quite "upstream" and thus has a large influence on later processes. Restrained eaters' attentional bias will keep them focused on the attractive food at the cost of competing cues and thereby contribute to the maintenance of hedonic thoughts about food (cf. Franken, 2003). Moreover, attentional biases for rewarding stimuli have been suggested in incentive-sensitization theory (Berridge, 2004; Robinson & Berridge, 2000) to be an indication of increased "wanting", the motivational component of reward that is closely linked to behavior. Restrained eaters' increased selective attention for liked food might thus reflect their increased motivation to obtain this food, and this parallels findings on increased self-reported desire to eat and on the activation of craving-relevant brain areas after the exposure to attractive food (Fedoroff et al., 1997; Pelchat et al., 2004).

Finally, the present findings support the idea of restrained eaters' goal conflict with regard to food, albeit indirectly. Restrained eaters' hedonic orientation was triggered by the exposure to palatable food cues and then directed visual attention towards hedonically relevant cues, but not when the conflicting dieting goal was being re-activated by our priming manipulation. Thus, it was either the hedonic orientation or the weight control motivation that guided restrained eaters' visual attention, and the activation of either one subdued the influence of the other.

Processes of self-regulatory success

The research described so far tries to answer the question what psychological processes drive restrained eaters' eating behavior in the face of attractive food, in order to understand why dieting so often fails in such situations. A rather different approach was taken in a recent series of studies by Fishbach and colleagues (Fishbach, Friedman, & Kruglanski, 2003), who investigated the psychological processes underlying self-regulatory success. In their model of temptation-elicited goal activation, these researchers argue that after repeatedly exercising self-control in tempting situations, the perception of a temptation that might interfere with the pursuit of an overriding goal will automatically activate the mental representation of this goal. Applied to the domain of dieting behavior, their research showed that priming participants with food temptations, such as cake or chocolate, increased the accessibility of the dieting goal, as measured in a lexical decision

task, but only in those participants who considered dieting important and who reported to be successful in their dieting endeavors (Study 4).

At first sight, these findings seem to be inconsistent with the extensive research on dieters' overeating and the psychological processes possibly underlying their self-regulatory failure. However, we should note that the Fishbach et al. studies used a self-constructed measure of "importance of dieting" to identify dieters, whereas the studies on restrained eaters' goal conflict used the Concern for Dieting subscale of the Restrained Eating scale (Herman & Polivy, 1980), which makes the results difficult to compare. Since studies on the goal conflict model reported so far did not include a measure explicitly assessing dieting success, it is possible that there are rather successful and unsuccessful dieters even among restrained eaters, who have sometimes been characterized as rather unsuccessful dieters (e.g., Heatherton, Herman, Polivy, King, & McGree, 1988). Therefore, given the findings of Fishbach and colleagues (2003), we argued that it might be especially interesting to see if we could detect patterns of self-regulatory success even among restrained eaters. We conducted two studies that included both the restraint scale and the measure of self-regulatory success to examine cognitive processes underlying success in chronic dieting behavior, as well as its behavioral consequences.

In a first study (Papies, Stroebe, & Aarts, in press b), we aimed to integrate the findings by Stroebe et al. (2008) who reported that restrained eaters who are primed with food temptations or hedonic food words inhibit the mental representation of their dieting goal, with the findings of Fishbach et al. (2003), who reported activation of the dieting goal after food primes. In a sequential priming task, participants were primed subliminally with palatable food words before the accessibility of diet-related words was assessed by means of lexical decisions. This task also included a baseline condition with random letter strings as "primes", so that the baseline accessibility of the diet words could be assessed for all participants. In addition, we varied the time lag between the onset of the food prime and the target words (the so-called stimulus onset asynchrony, SOA) in order to gain more insight into the process potentially leading to differences between successful and unsuccessful restrained eaters. The activation and the inhibition of related concepts require some amount of processing time, specifically the chain of processing from the perception of palatable food to the activation of hedonic thoughts, to

the resulting activation or inhibition of the dieting goal (cf. Neely, 1977; Simpson & Burgess, 1985). Therefore, we expected the differences between successful and unsuccessful restrained eaters to be especially pronounced at the longer SOA. After the sequential priming task, participants completed the restraint scale, as well as the measure of self-regulatory success introduced by Fishbach et al. (2003).

The results of this study confirmed our hypothesis that self-regulatory success moderates the impact of attractive food primes on the accessibility of the dieting goal in restrained eaters (see Figure 2.3). Compared to the baseline, at which no food prime was presented, the accessibility of the mental representation of the dieting goal was increased in successful restrained eaters, and decreased in unsuccessful restrained eaters, when a food prime was presented. This effect only occurred only at the longest SOA, thus under those conditions where the prime had received most processing before the onset of the target word. In other words, with enough processing time, successful restrained eaters activate their dieting goal when they are confronted with attractive food, while unsuccessful restrained eaters inhibit it.

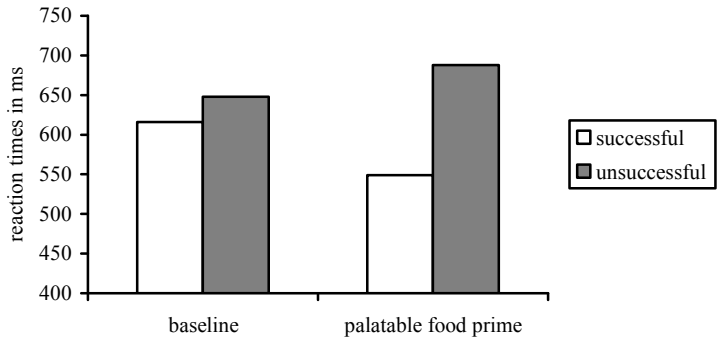

Figure 2.3 Accessibility of diet-related words in restrained eaters in the baseline condition and the palatable food prime condition with an SOA of 540 ms (adapted from Papies et al., in press b, Study 1).

Within our framework of nonconscious goal pursuit, we argue that the resulting differences in accessibility of the dieting goal are likely to influence restrained eaters' behavior in these situations. That is, successful dieters should be able to refrain from eating the attractive food because they are influenced by their dieting goal, whereas the

dieting goal is not available to guide the behavior of unsuccessful restrained eaters, who are therefore more likely to eat the forbidden food.

These behavioral implications of dieting success were investigated in a study that examined the association of restrained eaters' dieting intentions and actual dieting behavior over a 2-week period (Papies et al., in press b, Study 2). Successful and unsuccessful restrained eaters were asked to indicate the degree to which they intended not to eat certain food items over the next two weeks. Two weeks later, they were contacted again and asked to indicate on a self-report measure how often they had actually eaten these items. Results confirmed our hypothesis that self-regulatory success increases the likelihood that restrained eaters act on their intentions. Only for successful restrained eaters, there was a strong correlation between their intentions not to eat certain food items and the frequency of actually eating them. Thus, their intentions strongly predicted their later behavior. For unsuccessful restrained eaters, however, there was no correlation between their intentions and their actual behavior. Self-regulatory success thus functioned as a moderator of the intention-behavior link in restrained eaters.

These two studies offer converging evidence that self-regulatory success is a crucial dimension in restrained eating, as it influences goal accessibility in critical situations, as well as the degree to which goal intentions are enacted over a longer period of time. With regard to the goal conflict model of eating, these studies suggest that the conflicting relationship between the goal of eating good food and the goal of weight control might result in the inhibition of the dieting goal especially in the case of unsuccessful restrained eaters. This raises the interesting question of what the mechanism is that makes one group of restrained eaters successful (see also Aarts, 2007). Research on nonconscious goal pursuit suggests that goals that have repeatedly been pursued in response to certain situational cues can eventually be triggered automatically by the perception of these cues, because strong associations have developed between such cues and the goal representations (Bargh, 1990). Based on this reasoning, we suggest that successful restrained eaters have learned to associate the dieting goal with attractive food cues because they have repeatedly pursued this goal when they were confronted with food temptations (cf. Fishbach et al., 2003). These strengthened associations are reflected in the increased accessibility of the dieting goal after food primes. Thus, while this group of restrained eaters might also have a goal conflict between the goal of eating good food

and the goal of weight control, they have learned to resolve the conflict in favor of the dieting goal, which makes long-term dieting success more likely.

Summary

The aim of the goal conflict model is to explain restrained eaters' failures in eating regulation when they are confronted with attractive food cues. We presented a series of studies that tested hypotheses derived from this model and provided evidence for its central tenets. We showed that restrained eaters spontaneously think about palatable food in hedonic terms, and inhibit the representation of their dieting goal when they are confronted with palatable food. The resulting hedonic orientation towards food was found to guide restrained eaters' visual attention towards palatable food which they liked, but not when the dieting goal was subtly made salient. Together, these sets of studies provided evidence for the conflicting relationship between restrained eaters' goals with respect to food, namely eating good food, and controlling their weight. Another set of studies extended these conclusions by showing that there is a group of restrained eaters who qualify themselves as successful and indeed follow up on their dieting intentions. In line with research by Fishbach and colleagues (2003), we found that these successful restrained eaters activate their dieting goal, instead of inhibiting it, when they perceive food temptations, which makes it more likely that they will refrain from eating it. The empirical studies reported here focused on examining the cognitive processes that might underlie restrained eaters' responses to attractive food and their frequent lapses of restraint. We will now discuss how the model relates to earlier accounts of these phenomena.

The Goal Conflict Model in Context

The goal conflict model was proposed to explain the difficulties that restrained eaters have in controlling their eating when they are confronted with attractive food. We argued that the emphasis on hedonic aspects of food and on nonconscious processes in eating regulation, might add to our understanding beyond traditional approaches to this issue. We will now shortly discuss how the goal conflict model relates to earlier theories and can help us understand some of the unresolved issues in the domain of restrained eating.

Recently, research on the regulation of eating behavior has begun to emphasize the role of hedonic processes. It is increasingly recognized that the hedonic properties of food determine to a large part how much we eat, and that individual differences with respect to the sensitivity to the hedonic properties of food could play a role in difficulties in eating regulation (Mela, 2006; Yeomans et al., 2004; Blundell et al., 2005; Lowe & Butryn, 2007; Lowe & Levine, 2005). Our model builds on this notion and specifies the psychological processes by which this hedonic sensitivity could be translated into behavior. The behavioral implications of hedonic sensitivity have been demonstrated in a number of studies, in which it was found that restrained eaters react with increased salivation, cravings, and overeating to the presence of attractive food cues (Fedoroff et al., 1997, 2003; Harvey et al., 2005; Brunstrom et al., 2004). As our studies have shown, the perception of attractive food cues triggers hedonic thoughts in restrained eaters and leads to the inhibition of the dieting goal, so that an increased motivation to eat the attractive food (e.g., consciously experienced cravings), as well as actual overeating, become more likely.

The goal conflict model might also be helpful in understanding the empirical findings on Schachter's externality theory (1968). Schachter suggested that the eating behavior of obese individuals is more strongly triggered by external cues, like the sight or taste of food, than the eating of normal-weight people. In support of this theory, when offered food which they liked, obese people were found to increase their eating, regardless of their levels of deprivation (Nisbett, 1968; Schachter et al., 1968); they were found to avoid food which they do not like, such as the meals of an unattractive university meal plan (Goldman et al., 1968), and obese Jews reported less difficulties in fasting on a religious holiday when they spent more time in the synagogue, which suggests that they could fast more easily when they were not surrounded by tempting food cues (Goldman et al., 1968). All these studies indicate that obese people are more reactive to the hedonic properties of food, and that the confrontation with palatable food easily triggers them to overeat. These results bear a strong resemblance with the findings on the hedonic sensitivity of restrained eaters, and to the degree that obese people are trying to restrain their eating behavior, both sets of findings could be based on the same processes, namely the activation of hedonic thoughts and the inhibition of the dieting goal. Therefore, contrary to the conclusions drawn by some researchers (e.g., Rodin,

1980), externality theory might actually have explanatory value for explaining instances of overeating, as long as the external food cues are hedonically relevant.

One of the central findings inspired by the boundary model (Herman & Polivy, 1984) is that restrained eaters do not adjust their consumption in a taste test when they have consumed a preload, the so-called disinhibition effect. As was noted above, this effect is especially pronounced when the preload is palatable, or high in calories, which we argue could serve as a proxy for palatability. In these experiments, the preload might function as a palatable food cue that triggers hedonic eating in restrained eaters at the cost of their dieting goal. Thus, the preload findings fit well in the framework of the goal conflict model. In addition, the goal conflict model specifies the process that could underlie these effects and provides empirical evidence for it, which is especially relevant since the hypothesis of the "what-the-hell"-cognitions suggested by Herman and Polivy (1984) has received no empirical support.

Further research on disinhibition phenomena has suggested that the limited availability of resources for self-regulation in restrained eaters makes it more likely that their eating behavior will be guided by the hedonic aspects of the presented food. This conclusion fits well with our model, which assumes that the hedonic aspects of food are especially relevant for restrained eaters. As the pursuit of the dieting goal might be a more controlled process and thus require more cognitive resources than the goal of enjoying good food, the cognitive load might interfere strongly with the pursuit of this goal and lead to overeating when attractive food is presented. This argument is also in line with the reflective-impulsive model by Strack and Deutsch (2004) which proposes that reflective decisions, such as not to eat a certain food in order to diet, require more cognitive capacity than the pursuit of more impulsive goals, such as giving in to food temptations, and are therefore more easily disrupted (cf. Hofmann, Rauch, & Gawronski, 2007).

The goal conflict model can also help us to better understand the mixed findings on the relationship between food cravings and restrained eating. Recall that in this domain, some studies reported that dieters experience food cravings more often than non-dieters, while others report no such association. We argue that food cravings are especially likely to occur when a restrained eater is confronted with palatable food, rather than as a continuous experience, because palatable food cues will trigger a hedonic

orientation towards food and inhibit the dieting goal. In fact, food cravings might be the conscious experience of exactly this state, namely the strong motivation to consume a certain palatable food at the cost of one's dieting goal. In support of this reasoning, we reported the occurrence of nonconscious processes that resemble food cravings in their focus on the attractive aspects of food, namely the activation of hedonic thoughts about food, and the bias in selective attention for preferred food items. Both of these processes were activated by the perception of palatable food items, and we argue that this is the crucial trigger of such hedonic processes in restrained eaters. Thus, researchers might be more likely to find a relation between restraint and explicit measure of cravings when these are assessed during the confrontation with palatable food, or when participants are asked whether they experience cravings in situations where they are confronted with attractive food. The methods used in our studies have the added value of assessing hedonic processes in eating without the conscious awareness of the participants, so that they are less susceptible to demand characteristics than traditional measures of cravings.

In sum, the goal conflict model specifies the psychological processes underlying chronic dieters' responses to food cues and can explain previous findings in this research area, such as externality findings, the disinhibition effect, and experiences of food cravings. The question remains, however, why some individuals are burdened with such a goal conflict with regard to food, whereas others are not. A possible answer might be found in research on individual differences in personality, which shows that individuals reliably differ in their sensitivity to rewarding stimuli, which is grounded in neurobiological structures involving dopamine activity (Gray, 1991). Differences in sensitivity to signals of reward have been suggested to underlie the personality characteristics of extraversion and impulsivity (Depue & Collins, 1999), and indeed, overweight and restrained eating have been found to be associated with impulsivity on a variety of measures (Nederkoorn, Smulders, Havermans, Roefs, & Jansen, 2006; Nederkoorn, Van Eijs, & Jansen, 2004; Nederkoorn, Braet, Van Eijs, Tanghe, & Jansen, 2006). The increased sensitivity to the hedonic aspects of palatable food (e.g., Lowe & Butryn, 2007; Yeomans et al., 2004) might be considered as one specific manifestation of this generally increased sensitivity to reward. We suggest that such neurobiological differences underlying more general personality characteristics could also play a role in

the development of eating restraint and thus in the conflict between the goal of eating good food and the goal of weight control.

In an environment where palatable, hedonically relevant food is easily available, increased sensitivity for rewarding stimuli and for palatable food could lead to the overconsumption of palatable, high-calorie food, and eventually to weight gain. However, our society favors a rather slim physique, so that an individual who has gained some amount of body weight will sooner or later adopt a weight control goal. This way, individuals who are highly sensitive to reward could eventually become restrained eaters, with the associated conflict between the goal of eating good food, which results from the increased hedonic sensitivity, and the goal of weight control, which is the result of repeatedly succumbing to the hedonic aspects of high-calorie, palatable food. The processes outlined in the present paper give an indication of the difficulties for self-regulation once such a goal conflict has developed.

Examining the processes that characterize the goal conflict of restrained eaters is also highly relevant to self-regulatory processes in other domains of goal pursuit. Goals such as saving money, academic success, or a happy marriage often require that we resist attractive temptations such as shopping sprees, socializing with colleagues during working hours, or having extra-marital relationships. When confronted with an attractive temptation that interferes with the pursuit of a long-term goal, focusing on the rewarding properties of the temptation and allocating heightened visual attention to temptation-related cues makes it more likely that one will give in to the temptation (cf. Mischel et al., 1996). On the other hand, when one is able to actively think about the long-term goal that the temptation would interfere with, successful pursuit of this goal is more likely to emerge (cf. Fishbach et al., 2003). Thus, avoiding tempting situations, or actively keeping the long-term goal in mind or devising subtle reminders of one's goals, might prevent that attractive temptations lead us astray from our long-term goals.

Concluding Remarks

The present article discussed a goal conflict model that was designed to delineate the processes involved in restrained eaters' overeating. Specifically, we systematically examined the cognitive processes that might underlie restrained eaters' behavior when they have been confronted with attractive but "forbidden" food. This

innovative approach to the regulation of eating behavior builds on recent research on nonconscious goal pursuit, which is still in its infancy. Therefore, the application of knowledge from this domain to issues of health behavior has only just started, and our work should be seen as an initial exploratory step towards explaining and predicting restrained eaters' behavior from their cognitive responses to food cues. However, our research program conducted a systematic test of hypotheses derived from the goal conflict model. The social cognitive measures used to test our predictions allowed us to tap into restrained eaters' spontaneous reactions to food, in terms of hedonic thoughts, motivated attention, and goal accessibility, and we made a first step towards predicting restrained eaters' goal-directed behavior. Moreover, our findings relate to goal conflict in other domains of behavior and can provide a starting point for examining the interplay between external temptation cues and long-term goals to identify the processes underlying goal conflict more generally.

This way, our research program on the goal conflict of chronic dieters is informative for several domains of self-regulation and can help to generate novel theoretical predictions as well as practical implications to help individuals bolster their long-term goal against the influence of attractive temptations. The next step in research on goal conflict should now be to relate such cognitive responses to temptation cues to actual instances of goal-directed behavior, both inside the laboratory and outside. We believe that the goal conflict model could serve as a useful theoretical framework for this challenging endeavor.

CHAPTER 3

Pleasure In The Mind:
Restrained Eating and Spontaneous Hedonic Thoughts About Food

Two experiments examined the impact of exposure to social food cues on the spontaneous activation of hedonic thoughts about food in restrained and unrestrained eaters. Consistent with hypotheses, it was found that restrained eaters, but not unrestrained eaters, spontaneously activate hedonic food thoughts upon reading behavior descriptions that involved a palatable food item. Moreover, it was shown that the activation of hedonic food thoughts in restrained eaters occurred on-line. These findings are discussed in the context of a motivational account of eating-regulation and the possible role of the spontaneous activation of hedonic thoughts about food in the self-regulation of restrained eaters.

This chapter is based on Papies, E.K., Stroebe, W., & Aarts, H. (2007). Pleasure in the mind: Restrained eating and spontaneous hedonic thoughts about food. *Journal of Experimental Social Psychology, 43*, 810-817

In Western societies, dieting has become a popular means of weight regulation. Recent data indicate that of a large sample of U.S. adults, 24% of men and 38% of women were trying to lose weight (Kruger, Galuska, Serdula, & Jones, 2004). However, it seems that most dieters are not able to follow their diet consistently, as there are only a few able to reduce their body weight in the long term (Jeffery et al., 2000). It has been suggested that a so-called "toxic environment", promoting unhealthy eating and activity patterns, contributes to these difficulties in weight-regulation and to the development of obesity in industrialized societies (Wadden, Brownell, & Foster, 2002; Hill & Peters, 1998). Indeed, in daily life we are surrounded by other people eating and by cues that indicate the availability of all kinds of tasty treats. How do dieters react to the continuous presence of such temptations? We propose that the exposure to palatable food cues makes the pleasurable, hedonic aspects of food particularly accessible in the mind of dieters, and that this process makes the consumption of palatable food more likely. In the present article, two studies are reported which tested whether the activation of spontaneous hedonic thoughts about food is more likely to ensue in dieters than in non-dieters. Moreover, we examine whether not only palatable food itself, but also the perception of other people eating it can act as such a hedonic cue.

The impact of external food cues on chronic dieters

Research on the behavioral and physiological reactions to food cues has shown that dieters respond more strongly to stimuli representing palatable food than non-dieters. Much of this research was inspired by the concept of "restrained eating" (i.e., chronic dieting, Herman & Polivy, 1980) and the counterintuitive finding that restrained eaters have a tendency to overeat after having been induced by the experimenter to consume a prescribed amount of palatable and typically highly calorific food (a so-called "preload"; Herman & Mack, 1975; for an overview, see Ruderman, 1986). Herman and Polivy argued that while unrestrained eaters regulate their eating behavior by responding to internal cues such as hunger and satiety, restrained eaters regulate their food consumption cognitively by adhering to self-set dieting rules (Herman & Polivy, 1984). Once they have violated these rules, for example by consuming an experimental "preload" such as a high-calorie milkshake, they overeat because they feel that their diet is ruined anyway. This motivational explanation of overeating has been termed the "what-the-hell-effect" (Herman & Mack, 1975).

However, later studies indicated that restrained eaters could be induced to overeat not only by the consumption of an actual preload, but also by the mere perception of palatable food. Restrained eaters who were confronted with the smell or sight of palatable food or who had been instructed to imagine a palatable food, ate more after this experimental manipulation than unrestrained eaters. Unrestrained eaters were not influenced by the food cues or even reduced their consumption (Fedoroff, Polivy, & Herman, 1997; Jansen & Van den Hout, 1991; Rogers & Hill, 1989). Moreover, restrained eaters were found to respond with higher levels of salivation to the presence of palatable food (Brunstrom, Yates, & Witcomb, 2004; Tepper, 1992) and to the smell of food (LeGoff & Spigelman, 1987). Finally, olfactory and cognitive food cues were also shown to elicit stronger cravings for the presented food in restrained than in unrestrained eaters (Fedoroff et al., 1997; Fedoroff, Polivy, & Herman, 2003).

The work reviewed above shows that external cues representing palatable food trigger stronger eating-oriented reactions in restrained eaters than in unrestrained eaters, even when no preload has been consumed. These data may suggest that restrained eaters' behavioral reactions are the result of hedonic thoughts about food (e.g., delicious, tasty) that are triggered by the processing of palatable food cues (e.g., pizza). Such hedonic thoughts represent the evaluative meaning of a stimulus in terms of pleasure, which is one of the basic evaluative dimensions that is accessed when people perceive and categorize stimuli in their environment (Tesser & Martin, 1996). Hedonic thoughts about food refer to the pleasure that can be derived from eating the food, and as such, they might be a powerful trigger of actual eating behavior (Epstein, Truesdale, Wojcik, Paluch, & Raynor, 2003). The findings reviewed above suggest that these hedonic thoughts of restrained eaters are triggered spontaneously, that is without the conscious intent of the perceiver, since they potentially interfere with the conscious dieting goal of restrained eaters. In order to test this possible mechanism underlying the overeating of restrained eaters, the present studies examined the spontaneous activation of the hedonic concept in response the processing of palatable food cues.

The work on delay of gratification by Mischel and his colleagues (e.g. Mischel, Shoda, & Rodriguez, 1989; Mischel, Cantor, & Feldman, 1996) lends support to the notion that the difficulties of restrained eaters in resisting palatable food could be due to the way in which they cognitively represent it. Mischel's work has amply demonstrated that a focus on the "hot", consummatory features of food stimuli makes delay of

gratification much more difficult (Mischel et al., 1996). In line with these findings, we suggest that restrained eaters are more likely to access such hedonic representations of palatable food when they are exposed to food cues, and therefore to give in to the temptations of palatable food.

Palatable food itself may not be the sole cue that triggers hedonic mental processes in dieters. Another external cue that has been found to exert strong effects on eating behavior is the presence of other people eating. It is a well-established finding that humans eat more in a group than when alone, and that the presence of another person eating a lot or eating little can similarly facilitate or inhibit our eating behavior (for an overview, see Herman, Roth, & Polivy, 2003). Accordingly, to more fully understand and appreciate the role of food cues in the spontaneous activation of hedonic processes, it is important to examine how the processing of eating behavior and specific food objects interact in the elicitation of hedonic thoughts in unrestrained and restrained eaters.

The present research

We report two experiments designed to investigate whether restrained eaters activate hedonic thoughts when they perceive another person enjoying good food. Previous research has shown that, upon perceiving the behavior of another person, people infer or activate certain psychological characteristics (e.g., traits or goals) implied by, or associated with the behavior (Hassin, Aarts, & Ferguson, 2005; Uleman, Newman, & Moskowitz, 1996), even without explicit instructions or conscious intentions to do so. Although the activation of these characteristics is mainly studied in isolation, recent research shows that it has direct implications for the perceiver's own behavior (Aarts, Gollwitzer, & Hassin, 2004). In the present research, we specifically examined whether restrained eaters activate hedonic thoughts when they perceive someone eating palatable food. As hedonic thoughts refer to the pleasure-related dimension of evaluations, they will make the consumption of palatable foods more likely (Mischel et al., 1996; Aarts et al., 2004). Accordingly, examining the impact of social food cues on the activation of hedonic thoughts about food in restrained eaters may help to better understand the process that leads restrained eaters to abandon their diet and overeat in response to cues such as the sight, smell or taste of palatable food.

Study 3.1

The first study serves as an initial test of our hypothesis that restrained eaters, but not unrestrained eaters, spontaneously think about the hedonic aspects of food when perceiving palatable food or the eating behavior of another person. In this study, we used the probe recognition task (McKoon & Ratcliff, 1986), which assesses the spontaneous activation of certain concepts during text comprehension. In the probe recognition task, participants are presented with a number of behavior descriptions. Each behavior description is immediately followed by a probe word, and participants are asked to respond to the probe word as quickly and accurately as possible by indicating whether it has been part of the preceding sentence or not. On the critical trials, the probe word may be suggested by the preceding sentence without being explicitly mentioned in it. Upon reading the behavior description, the accessibility of the implied concept increases, thereby interfering with the required "no"-answer. The processes assessed by the probe recognition task can be considered spontaneous because participants are not instructed to think about certain concepts when they read the behavior descriptions, rather, they are merely instructed to read the text (McKoon & Ratcliff, 1986).

In the present study, we presented participants with behavior descriptions which involved an actor and a food item. However, these behavior descriptions varied systematically on two dimensions, namely the palatability of the food item mentioned, and whether the actor was actually eating the food. This way, we not only tested for the spontaneous occurrence of hedonic thoughts about food, but we also examined whether such thoughts are activated by the processing of both palatable food words and the eating behavior of another person.

Given the empirical evidence showing that restrained eaters display stronger eating-oriented reactions to palatable food cues than unrestrained eaters, we hypothesized restrained eaters' response latencies to be higher on trials involving palatable food compared to trials with neutral food. Reading about palatable food should activate in restrained eaters hedonic thoughts about food, thereby slowing down the correct "no"-answer to the hedonic food word following the behavior description.

Method

Participants and design. One hundred and seven students (84 women, 23 men) of Utrecht University participated in the study in exchange for course credit or € 4. The experiment had a 2 (food object: palatable vs. neutral) x 2 (actor's behavior: eating vs.

other) design with the last factor as a within participants factor, and with dietary restraint as a continuous variable. Participants were randomly assigned to either the palatable food condition or to the neutral food condition. The experimental sentences contained behavior that explicitly refers to eating, and behavior that does not explicitly refer to eating. Dietary restraint was measured by means of the Concern for Dieting subscale of the Revised Restraint Scale (Herman & Polivy, 1980, see Appendix A). Gender had no effects on the results reported below.

Materials. Participants were presented with 24 experimental trials and 108 filler trials, with each trial consisting of a sentence followed by a probe word. Of the experimental sentences, there were 6 sentences with an eating behavior and palatable food (e.g., "Bill is eating a big piece of apple pie."), 6 sentences with an eating behavior and neutral food ("Bill is eating a big piece of rye bread."), 6 sentences with no eating behavior and palatable food ("Bill is giving away a big piece of apple pie."), and 6 sentences with no eating behavior and neutral food ("Bill is giving away a big piece of rye bread."; see Appendix B). Sentences with and without an eating behavior were on average equally long. All experimental sentences were followed by a hedonic probe word that had not been part of the sentence, such as "tasty", thus requiring a "no"-response (see Appendix B).

Of the 108 filler trials, 12 trials were eating-related sentences followed by a non-food probe that had been part of the sentence, thereby requiring "yes" as the correct response. These sentences were included in order to prevent participants from expecting that all eating-related sentences required "no" as the correct response. The remaining 96 filler trials were unrelated to food or eating. In total, half of all trials required "yes" and half required "no" as the correct answer. All eating-related trials were presented in random order and interspersed between the filler trials in order to conceal from participants the true purpose of the study.

Procedure. Upon arrival at the laboratory, participants were seated in individual cubicles containing a desktop computer. All materials and instructions were presented on the computer. Participants were instructed to read each sentence carefully and to indicate as quickly and as accurately as possible whether the probe word that followed the sentence had been part of the sentence or not. This could be done by pressing the clearly labeled "yes"- or "no"-key on the keyboard of the computer. The probe recognition task began with 5 practice trials in order to familiarize participants with this procedure.

Each trial consisted of a fixation line in the middle of the screen for 1,000 ms, the presentation of the sentence for 2,000 ms, a blank screen for 1,000 ms and another fixation line for 500 ms. Subsequently, the probe word was presented and remained on the screen until the participant had responded by pressing the "yes"-button or the "no"-button.

After completing the probe recognition task, participants were asked to fill out the Revised Restraint Scale (Herman & Polivy, 1980). Finally, they were debriefed, paid, and thanked.

Results

Response latencies. The main dependent variable was the time it took participants to indicate whether the hedonic probe word had been part of the preceding sentence or not. Response latencies of incorrect responses or larger than three standard deviations above the mean were excluded from analyses (2 %, no differences between conditions; see also Hassin et al., 2005).

Response latencies were analyzed in the General Linear Model in a 2 (food object: palatable vs. neutral) x 2 (actor's behavior: eating vs. other) design with dietary restraint as a continuous variable. This analysis revealed the expected though only marginally significant interaction between restraint and food object, $F(1, 103) = 3.52$, $p = .06$, $\eta^2 = .03$. In order to examine this interaction and test our specific hypothesis, the effect of food object was assessed for restrained eaters (one standard deviation above the mean; see Aiken & West, 1991) and for unrestrained eaters (one standard deviation below the mean) separately. These contrast analyses showed that restrained eaters responded more slowly to hedonic food words if they followed sentences that contained palatable rather than neutral food objects (*M*s = 726 and 650 ms, respectively), $F(1, 103) = 5.82$, $p = .02$, $\eta^2 = .05$, while the palatability of the food objects did not influence the reactions of unrestrained eaters (*M*s = 662 and 670 ms, respectively), $F(1, 103) = .06$, *ns*.

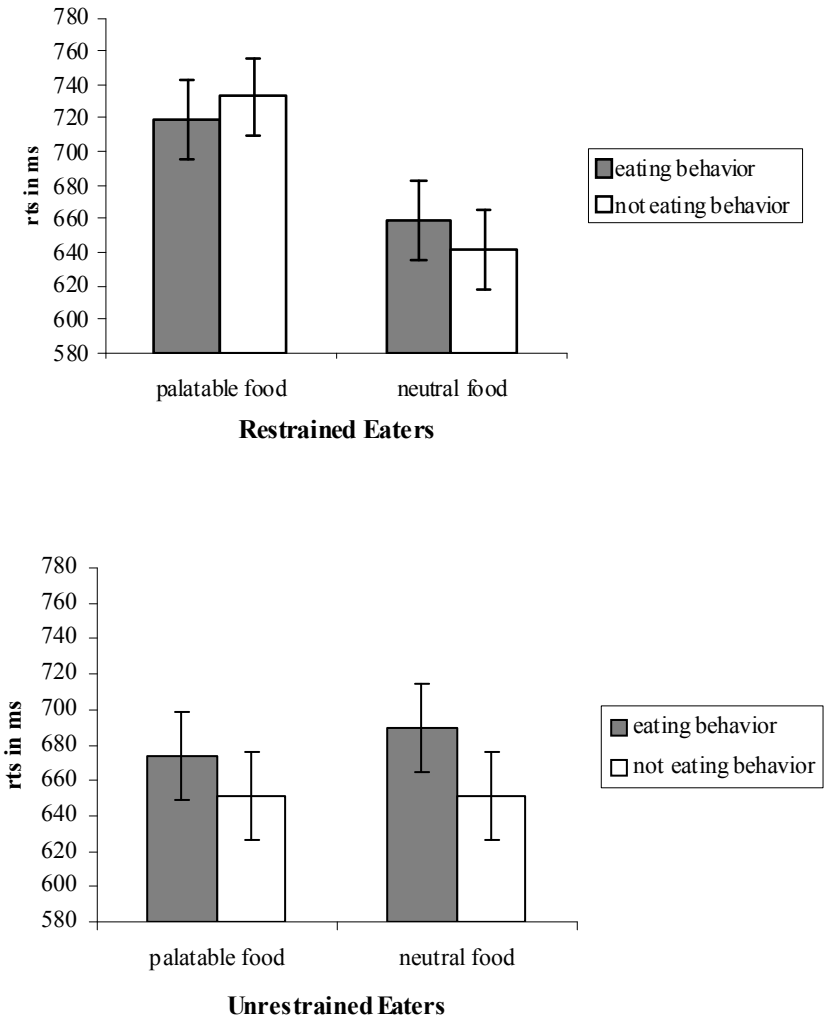

Figure 3. 1. Mean response latencies in the probe recognition task as a function of the palatability of the food object and actor's behavior for restrained eaters (one standard deviation above the mean, see Aiken & West, 1991) and unrestrained eaters (one standard deviation below the mean). Error bars represent one standard error.

The initial analysis also revealed an unexpected main effect of actor's behavior, $F(1, 103) = 4.56$, $p = .04$, $\eta^2 = .04$, such that response latencies were higher when the sentence described an actor's eating behavior, relative to an unrelated behavior. This effect was qualified by a marginally significant actor's behavior x restraint interaction

effect, $F(1, 103) = 3.43$, $p = .07$, $\eta^2 = .03$. Contrast analyses showed that the reactions of unrestrained eaters to hedonic probe words were slowed down when the preceding sentence described an actor's eating behavior rather than a behavior unrelated to eating (*M*s = 681 and 651 ms, respectively), $F(1, 103) = 7.89$, $p < .01$, $\eta^2 = .07$. The reactions of restrained eaters were unaffected by the type of behavior displayed by the actor (*M*s = 689 and 687 ms), $F(1, 103) = .04$, *ns*. These results are displayed in Figure 3.1.

Error rates. Error rates were analyzed in the same design as the response latencies. This analysis revealed only a marginally significant effect of food object, $F(1, 103) = 3.66$, $p = .06$, $\eta^2 = .03$, such that slightly more errors were made in trials with palatable food objects compared to trials with neutral food objects (Ms = 1.4% and 0.3%, respectively). This result suggests that longer response latencies after sentences with palatable food objects cannot be attributed to greater accuracy on such trials.

Discussion

Study 3.1 showed that restrained eaters' reactions to hedonic probe words were slowed down after sentences that contained a palatable food object, irrespective of whether the actor was explicitly said to be eating the food or not. This suggests that behaviors including palatable food items activated hedonic thoughts about food in restrained eaters. For restrained eaters, the palatability of the food is the most salient characteristic of the behavior that they perceive, and reading about palatable food leads to the activation of hedonic thoughts about food.

Study 3.1 also revealed an effect of the actor's behavior on the response latencies of unrestrained eaters, such that they reacted more slowly to hedonic food words when these were preceded by sentences that described an actor's eating behavior, relative to sentences with no eating behavior. This pattern of reaction times was not influenced by the palatability of the food object mentioned in the sentence. Although we did not specifically predict this effect to occur for the unrestrained eaters, this activation of hedonic thoughts in response to eating behavior descriptions can be explained in terms of the logical inferences described by McKoon and Ratcliff (1986). Regardless of the food object being eaten, unrestrained eaters thought of "tasty" as the logical consequence of the actor's eating behavior.

While the pattern of results obtained in Study 3.1 confirmed our hypothesis that restrained eaters activate hedonic thoughts about food in response to the processing of palatable food items, the current findings are not conclusive as to whether these thoughts

indeed occur on-line, i.e., during encoding of the behavior. It has been suggested that the probe recognition paradigm used in Study 3.1 may measure inferences about the text that occur off-line, i.e., at a later stage of information processing (McKoon & Ratcliff, 1986; Hassin et al., 2005; Wigboldus, Dijksterhuis, & Van Knippenberg, 2003; Keenan, Potts, Golding, & Jennings, 1990). The testing procedure requires research participants to compare the probe word with the preceding sentence in order to determine whether the probe had been part of that text. This process could lead them to activate concepts that they may not have activated while first reading the text (Hassin et al., 2005). Therefore, Study 3.2 was set up to replicate the finding that restrained eaters respond to palatable food cues with hedonic thoughts about food with a paradigm that allows for a more stringent test of the hypothesis that these thoughts are indeed activated on-line. In addition, Study 3.2 also included a measure of perceived hunger in order to test the alternative explanation that restrained eaters activate hedonic thoughts about food because they feel more hungry than unrestrained eaters (cf. Cabanac, 1971).

Study 3.2

In order to measure the activation of hedonic thoughts at the initial encoding of behavior information, in Study 3.2 we employed an experimental paradigm that has been used in text comprehension research for probing the on-line status of spontaneous goal inferences (Long, Golding, & Graesser, 1992; Long & Golding, 1993). Specifically, a rapid serial visual presentation procedure (RSVP) was used to present the experimental material, which means that the behavior descriptions appear on the screen one word at a time at a rapid pace. After the final word, a lexical decision target is presented in order to assess directly the accessibility of the concept in question. A short stimulus-onset-asynchrony (SOA) is used to rule out controlled processing. As in Study 3.1, we expected restrained eaters to spontaneously activate hedonic thoughts in response to sentences with palatable food objects. This should be reflected in shorter reaction times in the lexical decision task, due to the increased accessibility of the hedonic words.

Method

Participants and design. Eighty students (65 women, 15 men) of Utrecht University participated in the study in exchange for course credit or € 4. The design of the study was the same as in Study 3.1. Gender had no effect on the results reported below.

Materials. The same experimental sentences and hedonic probe words were used as in Study 3.1, with only slight changes undertaken in order to ensure that the food object was placed on average in the same position within the sentences describing eating behavior and other behavior.

The twelve experimental sentences were presented to participants in random order and interspersed between 60 filler sentences. Filler sentences were constructed the same way as the experimental sentences and followed by either an unrelated word target or a pronounceable non-word target. Among the filler sentences were 12 eating-related sentences followed by a non-word target in order to preclude participants' expectancy that an eating-related sentence would invariably be followed by an existing target word. Of the total of 72 sentences, half were followed by an existing target word, and half were followed by a non-word target.

Procedure. Upon arrival at the laboratory, participants were seated in individual cubicles containing a desktop computer. All materials and instructions were presented on the computer. Participants were instructed to read each sentence carefully and to respond to the target words as quickly and accurately as possible by pressing the clearly labeled "yes"- or "no"-keys.

The lexical decision task began with 10 practice trials. Each trial consisted of a row of asterisks presented in the center of the screen for 1,000 ms, followed by the sentence presented word by word, with each word remaining on the screen for 200 ms and followed by a blank screen for 50 ms. The last word in each sentence was followed by a period, signaling the end of the sentence to the participant. Subsequently, a letter string was presented between four asterisks on each side, signaling to participants that this was the target word requiring a lexical decision. The target remained on the screen until the participant responded. The next trial commenced after an interval of 1,000 ms.

After the lexical decision task, participants were asked to fill in the Restraint Scale. Then, participants' self-reported hunger was recorded by means of a 7-point scale. Finally, participants were debriefed, paid, and thanked.

Results

Response Latencies. The main dependent variable was participants' average response latency for indicating that the hedonic target words were existing Dutch words. Response latencies of incorrect responses (3.5%) or correct responses larger than three

standard deviations above the mean (1.7% of trials, no differences between conditions) were excluded from analyses.

Response latencies were analyzed in the General Linear Model in a 2 (food object: palatable vs. neutral) x 2 (actor's behavior: eating vs. other) design with dietary restraint as a continuous variable. This analysis revealed an interaction between food object and dietary restraint, $F(1, 76) = 8.93$, $p < .01$, $\eta^2 = .11$. Consistent with our hypothesis, contrast analyses showed that restrained eaters (one standard deviation above the mean, see Aiken & West, 1991) responded faster to hedonic food words when the preceding behavior description contained a palatable food object rather than a neutral food object (*M*s = 615 and 701 ms, respectively), $F(1, 76) = 9.26$, $p < .01$, $\eta^2 = .11$. The response latencies of unrestrained eaters (one standard deviation below the mean) did not differ between sentences with palatable and neutral food objects (*M*s = 642 and 608 ms, respectively), $F(1, 76) = 1.43$, *ns* (see Figure 3.2).

Moreover, the two-way interaction between food object and restraint was qualified by an interaction with actor's behavior, $F(1, 76) = 5.91$, $p = .02$, $\eta^2 = .07$. Contrast analyses showed that the difference between response latencies after sentences with palatable food objects and sentences with neutral food objects for restrained eaters was stronger for sentences explicitly referring to eating behavior (*M*s = 607 and 709 ms, respectively), $F(1, 76) = 12.08$, $p < .01$, $\eta^2 = .14$, than for sentences not explicitly referring to eating behavior (*M*s = 624 and 693 ms), $F(1, 76) = 5.13$, $p = .03$, $\eta^2 = .06$.

In sum, restrained eaters responded faster to hedonic food words when the behavior description contained a palatable food object rather than a neutral food object. The effect of the palatability of the food object was enhanced by the social cue of another person eating the food. Unrestrained eaters' responses to hedonic targets were not influenced by the actor's behavior or food objects mentioned in the experimental sentences.

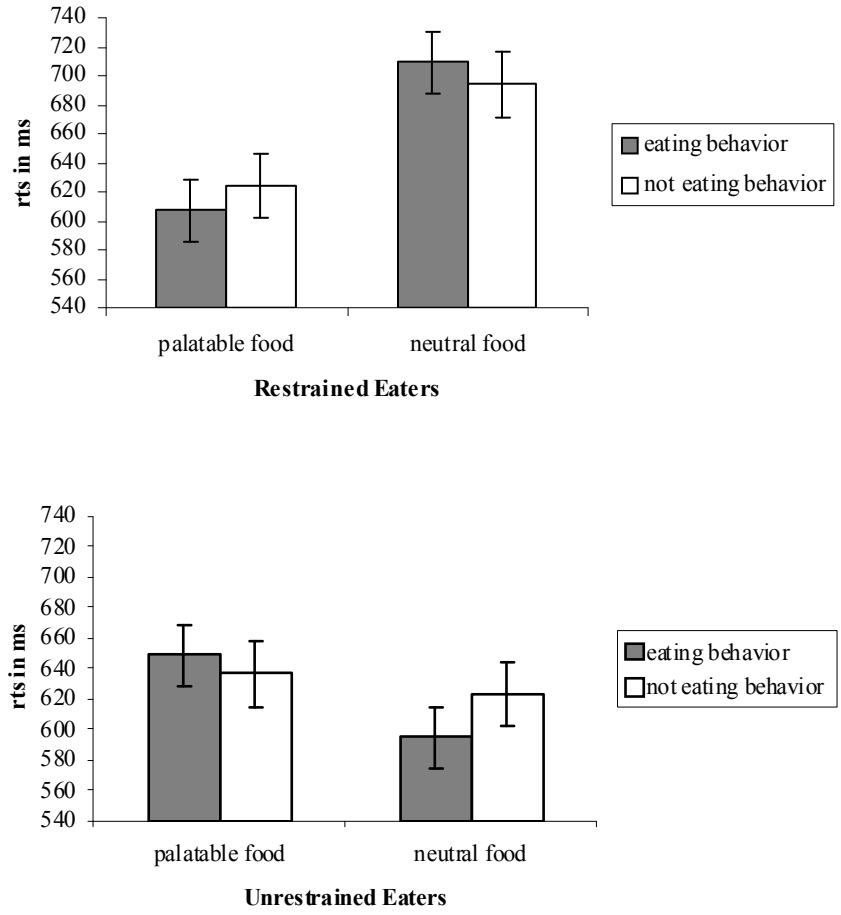

Figure 3.2. Mean response latencies in the lexical decision task as a function of the palatability of the food object and actor's behavior for restrained eaters (one standard deviation above the mean, see Aiken & West, 1991) and unrestrained eaters (one standard deviation below the mean). Error bars represent one standard error.

Error rates. Error rates were analyzed in the same design as the response latencies, which revealed a significant interaction between actor's behavior and food object, $F(1, 76) = 6.57$, $p = .01$, $\eta^2 = .08$. On trials describing eating behavior, less errors were made when the sentence contained a palatable food object relative to a neutral food object (*M*s = 1.2% and 5.7%, respectively), $F(1, 76) = 5.76$, $p = .02$, $\eta^2 = .07$. On not-eating trials, there was no effect of food object, $F(1, 76) = .45$, ns. These effects suggest that the faster responses after eating behavior descriptions with palatable food objects were not made at the cost of accuracy.

Potential effects of hunger. Perceived hunger was not associated with restraint scores, $r = .07$, ns. In order to rule out hunger as a potential confound in our results, we replaced restraint scores with hunger scores in the full factorial model. These analyses revealed no main effects of hunger and no interaction effects with the other factors on response latencies (all $p > .5$) or error rates (all $p > .3$).

Discussion

The results of Study 3.2 replicated our earlier finding showing that restrained eaters activate hedonic thoughts in response to processing behavior descriptions involving palatable food. Importantly, because the paradigm used here allows us to assess the activation of hedonic thoughts at the encoding stage of information processing, these findings show that restrained eaters encode behavioral information that involve palatable food objects in terms of hedonic concepts. When measured on-line, there was no evidence of the activation of hedonic thoughts in unrestrained eaters in response to the behavioral information.

General Discussion

Our research was designed to investigate the spontaneous activation of hedonic thoughts triggered by the processing of food and eating behavior descriptions in restrained eaters. Several earlier studies have shown that chronic dietary restraint can easily be disrupted by the perception of food cues, such as the smell or sight of pizza or the eating behavior of other people. The studies reported here examined whether restrained eaters activate hedonic thoughts in response to such food cues. These hedonic thoughts could be the mechanism that triggers the overeating of restrained eaters.

The results of Study 3.1 showed that restrained eaters think hedonically about food when they read about a behavior that involves palatable food. Study 3.2 replicated these results with a different paradigm, showing that restrained eaters activate hedonic thoughts about food in response to reading about palatable food, especially when it concerns eating behavior. Moreover, this study confirmed our hypothesis that these hedonic thoughts were activated on-line. Although the present studies confronted participants merely with food words and verbal behavior descriptions rather than actual food and eating behavior, the results are instructive about the spontaneous occurrence of hedonic thoughts in restrained eaters.

Our findings suggest that restrained eaters strongly connect palatable food with the pleasure that can be derived from eating it. This specific relation of food with food-specific pleasure can be distinguished from a more general association between palatable food and positive affect. Studies that examined general attitudes towards palatable food with implicit attitude measures could not find systematic differences between restrained eaters' and unrestrained eaters' evaluation of palatable food (Roefs, Herman, MacLeod, Smulders, & Jansen, 2005). On explicit measures, restrained eaters even rate palatable food less positively than unrestrained eaters (Papies, Stroebe, & Aarts, in press a). However, the current studies show that restrained eaters do spontaneously think about the hedonic properties of palatable food. This activation of the food-specific rewarding qualities of food might be a better predictor of actual consummatory behavior than the more general evaluation of food. Thus, our findings point towards an interesting motivational, rather than evaluative account of the eating regulation of restrained eaters.

What are potential consequences of restrained eaters' hedonic thoughts about food? We would argue that these thoughts can interfere with restrained eaters' attempts at dieting in several ways. Earlier studies have shown that the activation of hedonic food thoughts in restrained eaters can inhibit dieting. For example, Stroebe and colleagues (Stroebe, Mensink, Aarts, Schut, & Kruglanski, 2008) showed in a sequential priming task that the subliminal presentation of hedonic thoughts about food decreases the activation of dieting thoughts, but only for restrained eaters. This process has important behavioral implications for restrained eaters, since it makes it less likely that subsequent eating behavior will be guided by the goal of eating restraint.

The present studies may also shed a new light on the results of the classic preload studies that showed that restrained eaters overeat when they have received a preload by the experimenter. In all preload studies reported in the literature, the food that participants were required to eat prior to the taste test was not only high in calories, and thus a violation of their diet, but also very palatable, such as milkshakes or chocolate cake (e.g., Herman & Mack, 1975; Polivy, Herman, Hackett, & Kuleshnyk, 1986). In this sense, the preload could function as a palatable food cue and automatically trigger hedonic thoughts about food in restrained eaters. Restrained eaters will then use the subsequent taste test as an opportunity to pursue the goal of hedonic enjoyment of eating and, most likely, overeat. The same reasoning can be applied to interpret the findings of other studies in which overeating in restrained eaters was induced by means of the smell

of food, the sight of food, or thoughts of palatable food. Therefore, our findings are also in line with the work on delay of gratification (Mischel et al., 1996; Mischel et al., 1989) that has shown that encoding tempting stimuli in terms of their "hot", consummatory features makes it more difficult to resist them.

From the present studies, we may conclude that the abundance of food cues in our environment is likely to be detrimental for the dieting goal of restrained eaters. The processing of palatable food cues makes restrained eaters think about the hedonic pleasure to be gained from it and may trigger restrained eaters to seek this pleasure. The current studies thus identified a possible mechanism that could explain why restrained eaters easily overeat when they are confronted with palatable food.

Appendix A

Concern for Dieting Subscale of the Revised Restraint Scale (Herman & Polivy, 1980). For the present studies, a Dutch translation of this scale was used (Jansen, Oosterlaan, Merckelbach, & van den Hout, 1988).

1. How often are you dieting?
2. Do you have feelings of guilt after overeating?
3. Do you eat sensibly in front of others and splurge alone?
4. Do you give too much time and thought to food?
5. Would a weight fluctuation of 5 lb affect the way you live your life?
6. How conscious are you of what you are eating?

Appendix B

Stimulus Materials used in Study 3.1 (translated from Dutch)

Experimental sentences

Words in parentheses denote food objects presented in the neutral food condition.

1. a) Bill is eating a big piece of apple pie. (rye bread)
   b) Bill is giving away a big piece of apple pie. (rye bread)
2. a) Janice is having a couple of chocolate cookies during the movie. (peeled carrots)
   b) Janice is putting a couple of chocolate cookies into a bag. (peeled carrots)
3. a) Tom sates his appetite with French fries. (Brussels sprouts)
   b) Tom forgets the plate of French fries. (Brussels sprouts)
4. a) Sandra is taking a handful of M&M's from the bowl. (raisins)
   b) Sandra is putting the M&M's in the cupboard. (raisins)
5. a) Lucy tries three kinds of chocolates. (oatmeal)
   b) Lucy sells three kinds of chocolates. (oatmeal)
6. a) Ben is taking a bite of the warm pizza. (kidneys)
   b) Ben is giving away the warm pizza. (kidneys)

Hedonic probe words

delicious, tasty, good, indulging, scrumptious, delectable

CHAPTER 4

The allure of forbidden food: On the role of attention in self-regulation

The aim of the present studies was to examine the impact of food cues on restrained eaters' attention for food. Previous research has shown that restrained eaters spontaneously activate hedonic thoughts in response to palatable food cues, and that such food cues also lead them to inhibit their dieting goal. We argue that as a consequence, restrained eaters' selective attention will automatically be drawn towards hedonically relevant food items. Consistent with our expectations, the results of two studies revealed that restrained eaters, but not unrestrained eaters, displayed an attentional bias for hedonically rated food items when they had been pre-exposed to food cues. However, this attentional bias did not occur when restrained eaters were primed with the concept of dieting, thereby rendering the regulation of eating behavior more successful. These findings are discussed in the context of implicit processes in self-regulation.

This chapter is based on: Papies, E.K., Stroebe, W., Aarts, H. (in press a). The allure of forbidden food: On the role of attention in self-regulation. *Journal of Experimental Social Psychology*.

Much of human self-regulatory behavior requires ignoring the allure of short-term temptations in order to pursue other, long term goals. For example, the attractive idea of going to a party on the night before an exam should be abandoned in favor of a good grade, the successful pursuit of a weight loss diet requires resisting the allure of a delicious chocolate cake, and the goal of saving for a new car should prevent us from spending all our money on an attractive vacation. How do individuals manage to pursue their long-term goals when they are constantly confronted with alternatives that are more attractive in the short run?

Research in the domain of self-regulation has identified a number of cognitive mechanisms and strategies that individuals use to resist short-term temptations in favor of long-term goal pursuit. In his research on delay of gratification, for example, Mischel showed that ignoring the "hot", pleasurable features of a luring temptation increases the chances that one will be able to resist it in favor of a more attractive, larger reward later (for a review, see Mischel, Shoda, & Rodriguez, 1989). More recently, Fishbach and her colleagues (Fishbach, Friedman, & Kruglanski, 2003) demonstrated that encountering an attractive short-term temptation (for example, cake) can activate the overriding, long-term goal (dieting), which increases the chances of successful pursuit of the long-term goal. In their counteractive control theory, Trope and Fishbach (2000, 2005) identified a number of more elaborate strategies that individuals employ to secure long-term outcomes in the face of short-term temptations, such as bolstering the value of the long-term goal or devising penalties for not reaching it. In the present research, we investigate the motivational dynamics of goal pursuit in one specific domain where the ability to resist temptations seems to be especially difficult for many individuals, namely the domain of dieting.

Although dieting is a very popular means of weight control, it is very difficult for most people to maintain a successful weight-loss diet, and only few dieters are able to reduce their body weight in the long term (Jeffery et al., 2000). It has been suggested that a so-called "toxic environment", which promotes unhealthy eating and activity patterns, contributes to these difficulties in weight-regulation and to the development of obesity in Western countries (Wadden, Brownell, & Foster, 2002). In industrialized societies, highly palatable and calorically-dense foods are very visible and easily available, so that dieters are constantly confronted with temptations that threaten their long-term goal of weight control. In the present article, we investigate a mechanism by which such food

temptations interfere with the dieting behavior of chronic dieters. Specifically, we examine whether the exposure to food cues leads chronic dieters automatically to direct selective attention towards attractive food items, making it more difficult for them to resist this temptation.

Restrained eating and the allure of palatable food

Earlier research examining the impact of food cues on the self-regulation of dieters has shown that chronic dieters have stronger appetitive reactions to the perception of food than non-dieters. Much of this research was inspired by the concept of "restrained eating" (i.e., chronic dieting, Herman & Polivy, 1980) and the apparent inability of these individuals to keep to their diet (cf. Herman & Mack, 1975). Restrained eaters are chronically concerned with dieting and weight loss. However, they appear to be characterized by their continuous efforts at weight loss more than by their actual success, and their dieting behavior is accompanied by occasional lapses of restraint. Thus, restrained eaters have been described as very motivated, but rather unsuccessful long-term dieters (Gorman & Allison, 1995; Heatherton, Herman, Polivy, King, & et al., 1988; Herman & Polivy, 1980, p. 223). Restrained eating is commonly assessed by the Revised Restraint Scale (Herman & Polivy, 1980), which consists of two subscales. The concern for dieting subscale assesses the chronic motivation to diet, and the weight fluctuation subscale measures participants' history of weight cycling (van Strien, Breteler, & Ouwens, 2002).

Numerous studies were conducted to scrutinize the overeating of restrained eaters, finding for example that restrained eaters respond with higher levels of salivation to the presence of palatable food (Brunstrom, Yates, & Witcomb, 2004; Klajner, Herman, Polivy, & Chhabra, 1981; Tepper, 1992) and to the smell of food (LeGoff & Spigelman, 1987). Moreover, olfactory and cognitive food cues were shown to elicit stronger urges to eat this food in restrained than in unrestrained eaters (Fedoroff, Polivy, & Herman, 1997, 2003; Harvey, Kemps, & Tiggemann, 2005). Food cues also exert a strong impact on restrained eaters' actual eating behavior, as they eat more than unrestrained eaters after having been primed with the sight, the smell, or with thoughts about palatable food (Collins, 1978; Fedoroff et al., 1997; Jansen & Van den Hout, 1991; Rogers & Hill, 1989). In sum, these studies have shown that following exposure to palatable food, restrained eaters' cognition and behavior is influenced more by the pleasure that can be gained from food rather than by their dieting goal. We suggest that there is a common

mechanism underlying these findings, namely that palatable food cues elicit in restrained eaters pleasure-oriented, hedonic thoughts about food which then guide their behavior and lead to overeating, despite their chronic dieting goal (Papies, Stroebe, & Aarts, 2007).

To account for the difficulties which restrained eaters experience in resisting palatable food, Stroebe and colleagues (Stroebe, Mensink, Aarts, Schut, & Kruglanski, 2008) recently developed a Goal Conflict Model of Eating that specifies the psychological processes underlying restrained eaters' eating regulation. According to this theory, restrained eaters are especially sensitive to the hedonic aspects of food, so that perceiving palatable food easily triggers in them the goal of eating that food (Papies et al., 2007). However, this could lead to overconsumption of palatable, high-calorie food, and eventually to weight gain. As our society favors a rather slim physique, weight gain will sooner or later trigger the motivation to diet in order to control one's body weight. The goal conflict theory suggests that as a result of this process, restrained eaters are dieters who hold two incompatible goals with regard to food and eating, namely the hedonic goal of eating good food, which is based on their increased sensitivity to palatable food, and the goal of dieting and weight control, which has emerged in order to control the potential weight gain. Unrestrained eaters, on the other hand, are less sensitive to the hedonic aspects of food and therefore need to be less concerned with their body weight, so that they do not experience the same goal conflict as restrained eaters.

The goal conflict theory suggests that normally, restrained eaters' weight control goal curbs their hedonic thoughts about food, so that they are able to resist the temptation of high-fat, palatable food and refrain from eating it. However, this fragile balance between hedonic thoughts about food and the goal of weight control can easily be disturbed by cues that activate hedonic thoughts in restrained eaters, such as the sight or smell of palatable food. If hedonic thoughts are activated, the mental representation of the conflicting goal of weight control will become less accessible (Shah, Friedman & Kruglanski, 2002). The hedonic thoughts are then highly active, whereas the weight control goal is temporarily less accessible in mind. As a result of this process, restrained eaters' subsequent cognition and behavior will be dominated more by a hedonic orientation towards food than by the goal of weight control.

Experimental tests of the processes proposed by this goal conflict model confirmed the idea that restrained eaters react to palatable food cues with hedonic

thoughts about food (Papies et al., 2007). In two studies, which used the concern for dieting scale to identify chronically restrained eaters, restrained and unrestrained participants read behavior descriptions involving either palatable food or neutral food. After each behavior description, participants were probed unobtrusively for the mental accessibility of hedonic thoughts about food. Results indicated that for restrained eaters, hedonic thoughts about food were more accessible, but only after behavior descriptions that involved palatable food and not neutral food. These findings show that restrained eaters are readily triggered to think hedonically about food, which is in conflict with the goal of dieting.

Indeed, recent evidence shows that the perception of palatable food not only triggers restrained eaters to think hedonically about food, but also leads them to inhibit the conflicting dieting goal. In two sequential priming studies, Stroebe et al. (2008) primed restrained and unrestrained participants briefly with palatable food words or control words and examined the accessibility of the mental representation of the dieting goal with a lexical decision task. Restrained eaters who were primed with palatable food words showed decreased access to diet-related words compared to restrained eaters who were primed with control words. Unrestrained eaters' access to diet-words was not influenced by the nature of the prime. This suggests that the subtle exposure to palatable food cues caused restrained eaters to temporarily inhibit their dieting goal, as this is incompatible with their hedonic thoughts about food.

As these findings show, the exposure to palatable food cues seems to lead to a two-fold cognitive reaction in restrained eaters: it triggers hedonic thoughts about food (Papies et al., 2007), and it inhibits the mental representation of the dieting goal (Stroebe et al., 2008). We propose that this two-fold reaction will influence restrained eaters' subsequent processing of food cues, as this will be guided by the highly accessible hedonic thoughts rather than by their dieting goal. Thus, the allocation of selective attention will be influenced by hedonic thoughts about food, leading to increased attention for food items that match the current hedonic orientation (Lang, Bradley, & Cuthbert, 1997). In the present studies, therefore, we hypothesized that the exposure to palatable food cues triggers hedonic food thoughts in restrained eaters and therefore leads restrained eaters to allocate increased selective attention to hedonically relevant food. Furthermore, we test the assumption that the accessibility of the dieting goal plays a pivotal role in this process.

Selective attention to palatable food

Previous research on the role of eating restraint in directing selective attention towards food has led to equivocal results. While some studies found restrained eaters displaying greater Stroop interference on food words than unrestrained eaters (Francis, Stewart, & Hounsell, 1997; Stewart & Samoluk, 1997), other studies found no evidence of selective attention for food stimuli in dietary restraint (Boon, Vogelzang, & Jansen, 2000; for a review, see Dobson & Dozois, 2004; Sackville, Schotte, Touyz, Griffiths, & Beumont, 1998). There are two possible reasons for these conflicting results, namely (1) the influence of restrained eaters' dieting concern on attentional processes, and (2) the type of measures traditionally used to examine these processes.

The first reason may be found in the interference of restrained eaters' dieting goal during the assessment of attention for food. Since restrained eaters chronically try to reduce their weight by dieting, the mental representation of the dieting-goal has enhanced mental accessibility for them (Stroebe et al., 2008) and could prevent increased attention for high-calorie food items. Due to the high cognitive accessibility of dieting thoughts, restrained eaters might initially direct no selective attention towards tempting food stimuli which constitute a potential threat to their diet (cf. Boon et al., 2000). Only when repeated exposure to palatable food cues has triggered hedonic thoughts about food and at the same time, made the chronic dieting goal less accessible, will restrained eaters display increased selective attention for relevant food items. We therefore designed two experiments to examine restrained eaters' selective attention for hedonically relevant food, not as a general phenomenon, but as a function of the pre-exposure to food cues and the resulting hedonic orientation towards food (Papies et al., 2007).

The measures generally used to assess attentional processes might be the second reason why to date, we have no complete understanding of the pattern of restrained eaters' attention for food. Most studies investigating this issue have made use of the Stroop color-naming paradigm. However, reaction time differences that are found with the Stroop paradigm could also be due to increased concern with certain stimuli (Francis et al., 1997), as Stroop effects have also been observed for threatening stimuli, for example in phobias or anxiety (e.g., Mattia, Heimberg, & Hope, 1993; Mogg, Bradley, Williams, & Mathews, 1993). Thus, when individuals are confronted with cues which are related to a chronic concern, they display increased color naming latencies for these cues. Since restrained eaters typically experience concern about high-fat, palatable food, Stroop

effects for such food stimuli cannot distinguish between an attentional bias that is driven by the goal to avoid this food or by a hedonic orientation towards it.

We suggest that the visual probe paradigm (MacLeod, Mathews, & Tata, 1986), might be more suited to measuring a hedonically motivated attentional bias, since it assesses shifts of selective attention towards relevant cues. In this task, participants are confronted with two stimuli presented simultaneously, one of which is the critical cue. Subsequently, a probe is presented in the same location as one of the two stimuli, and participants are required to press a key as quickly as possible in response to the probe. This response is facilitated if the probe appears in the same location as the critical cue, since this attracts increased attention from the participants. The visual probe task thus directly measures the allocation of attention between two competing stimuli (Ehrman et al., 2002). In recent years, the visual probe task has successfully been used to demonstrate an attentional bias for drug-related cues among, for example, smokers, alcoholics, and users of heroin or cannabis (e.g., Ehrman et al., 2002; e.g., Field, Mogg, & Bradley, 2004; Lubman, Peters, Mogg, Bradley, & Deakin, 2000; Townshend & Duka, 2001). In the present research, we used this experimental paradigm to examine the effects of palatable food cues on the shifting of attention of restrained eaters towards these food cues.

The present research

We conducted two experiments to examine the hypothesis that palatable food cues will attract the attention of restrained eaters, but only if hedonic food thoughts have been activated and the dieting goal has been inhibited in mind (cf. Papies et al., 2007; Stroebe et al., 2008). In the present studies, a food pre-exposure manipulation was used to initiate this hedonic orientation towards food. This pre-exposure was implemented as a lexical decision task which contained either palatable food words or food-unrelated words and was presented to participants before the selective attention task.

The hedonic thoughts that are triggered by this pre-exposure to food cues will subsequently direct restrained eaters' attention towards items with high perceived hedonic quality. Therefore, in Study 4.1 it was hypothesized that after the pre-exposure to food cues, restrained eaters would display increased selective attention towards palatable food as a function of their hedonic ratings of this food. We expected this effect to occur not for food in general, but only for palatable food, since only palatable food is likely to trigger hedonic thoughts in the first place. Therefore, we included both palatable and

control food words as items in the visual probe task. The control food words refer to neutral food that is neither liked nor disliked by participants (e.g., carrots, oatmeal) and which is therefore not relevant as a target of hedonic food thoughts. The palatable food words, on the other hand, will attract increased attention from restrained eaters, depending on their subjective hedonic quality.

In Study 4.2, we additionally examined the role of the accessibility of the concept of dieting in restrained eaters' attention for food by priming participants subliminally with diet-related words after the pre-exposure to food cues. If repeated exposure to palatable food items triggers hedonic thoughts about this food, resulting in the inhibition of the dieting goal (Stroebe et al., 2008) and in selective attention being directed towards hedonically relevant food, then priming the dieting goal should curb the hedonic thoughts and prevent the allocation of hedonically motivated attention. In line with previous work on goal priming and goal pursuit (e.g., Bargh, Gollwitzer, Lee Chai, Barndollar, & Troetschel, 2001), we therefore expected that priming the concept of dieting would reactivate the dieting goal in restrained eaters and as a consequence prevent their attentional bias for hedonically relevant food after food cue exposure. Although this constitutes only an indirect test of our hypothesis that the attentional bias is contingent on the inhibition of the dieting goal, it might provide us with a first indication that changes in accessibility of the dieting goal play a pivotal role in the cognitive regulation of restrained eaters' attention and behavior.

Study 4.1

Study 4.1 was designed to test the hypothesis that the pre-exposure to food cues elicits in restrained, but not unrestrained eaters, an attentional bias for palatable, hedonically relevant food. Participants' hedonic ratings of the food items were used to test the hypothesis that food cue exposure triggers restrained eaters to shift their attention towards palatable food items to the degree that they subjectively experience them to be enjoyable.

A visual probe task was employed to examine attention for palatable and control food words compared to non-food words. A facilitated response for probes that appear in the same location as relevant cues is interpreted as increased attention for such cues. In the present experiment, participants were required to respond by indicating the type of probe rather than the location of the probe, since this version of the visual probe task

more directly encourages participants to monitor both sides of the screen equally (Bradley, Mogg, Wright, & Field, 2003).

Method

Participants and design

One hundred and four students (25 men, 79 women) of Utrecht University participated in the study for course credit or € 2,50. The design of the study was a 2 (pre-exposure: food cue vs. non-food cue) x 2 (restraint: restrained vs. unrestrained) x 2 (type of food: palatable vs. control) x 2 (probe location: congruent vs. incongruent), with the first two factors varying between participants and the latter two factors within participants. In addition, hedonic ratings of all food items were obtained from participants.

Materials

In the lexical decision task, participants were presented with 40 words and 40 pronounceable non-words. In the food pre-exposure condition, half of the words were food items, namely 10 palatable food items (e.g., pizza, chocolate, cake) and 10 control food items (e.g., radish, oatmeal, raisins). The categorization of food items was based on a pilot study (N = 51). In the non-food pre-exposure condition, only food-unrelated words were presented in the lexical decision task.

In the visual probe task, the same food words were used as in the food pre-exposure condition of the lexical decision task. Each food word was matched with an office-related word of equal length (e.g., book, pencil, desk) to be presented simultaneously. In addition, words from two food-unrelated categories were used in filler trials.

Procedure

Upon arrival at the laboratory, participants were seated in individual cubicles containing a desktop computer. Participants were randomly assigned to the food pre-exposure or the non-food pre-exposure condition. All materials and instructions were presented on the computer. Participants were informed that the experiment consisted of several different tasks.

Lexical decision task. First, the lexical decision task was introduced, asking participants to indicate as quickly and accurately as possible whether the presented word was an existing Dutch word or not. All words were preceded by a fixation cross for 500 ms and remained on the screen until the participant had responded by pressing the “yes”-

button or the "no"-button marked on the keyboard. There was an inter-trial interval of 1 s. The lexical decision task consisted of 80 trials. For the participants in the food pre-exposure condition, these were the 20 food words described above, 20 office words, and 40 non-words. Participants in the non-food pre-exposure condition were presented with 40 nature-related words and 40 non-words. All trials were presented in random order. Both groups of participants first completed 10 practice trials with unrelated words to familiarize themselves with the task.

Probe classification task. After participants had completed the lexical decision task, the probe classification task was introduced. In this task, two words were presented simultaneously on the screen, followed by a small arrow pointing either upwards or downwards. On half of the critical trials, the probe appeared in the same location as the food word (congruent trials), and in the other trials, the probe appeared in the location of the control word (incongruent trials). Participants were instructed to indicate as fast and as accurately as possible whether the arrow was pointing upwards or downwards, using the "2" and "8" keys on the numerical part of the keyboard. Each trial started with a fixation cross for 500 ms, followed by the word pair for 200 ms and then by the probe that remained on the screen until a response was given. The words were approximately 6 mm high and presented next to each other with a distance of approximately 4 cm between their inner edges. Probes were 1 cm in height. In the probe classification task, twenty food-office word pairs and twenty filler word pairs were each presented four times: twice on each side of the screen, and twice in each congruence condition.

Thus, the probe classification task consisted of 160 trials, which were presented in random order. In the beginning of the task, 20 unrelated practice trials were presented to participants. After 80 trials, there was a break of 1 minute.

Restrained eating scale. After the probe classification task, a filler task followed after which participants were asked to fill out the Dutch version of the Revised Restraint Scale (Herman & Polivy, 1980). In line with earlier studies on the cognitive processes in restrained eating, we used the Concern for Dieting subscale (see Appendix A, Chapter 3), which has been recommended to assess participants' chronic motivation to control their weight by dieting (Stroebe et al., 2008; van Strien et al., 2002).

Perceived palatability. Subsequently, participants rated the hedonic quality of the twenty food items that were presented in the previous tasks. Ratings were given on a

9-point scale from “not tasty at all” to “very tasty”. After they had completed the ratings, participants were debriefed, paid, and thanked.

Results

Lexical decision task

The lexical decision task allowed us to examine if there were baseline differences in the mental accessibility of palatable and control food words between restrained and unrestrained eaters in the food pre-exposure condition. The reaction times for these words in the lexical decision task were analyzed with restraint scores, hedonic ratings and their interaction as predictors. In order to reduce multicollinearity, predictor variables were transformed to standardized scores before computing cross-product terms (Dunlap & Kemery, 1987). Regression analyses revealed no significant effects of restraint scores, hedonic ratings, or their interaction (all $t < .6$).

Probe classification task

The main dependent variable was the time it took participants to classify the arrow as pointing upwards or downwards as a measure of selective attention in the probe classification task. Reaction times on trials with errors and reaction times shorter than 100 ms or longer than 1500 ms were excluded from analyses (3.8%; Townshend & Duka, 2001). The data of one participant were discarded because of an exceptionally high error rate (21%). Attentional bias scores were obtained by subtracting reaction times on congruent trials from reaction times on incongruent trials. Higher scores then indicate faster reactions on probes replacing food words compared to probes replacing control words, i.e., an attentional bias for food words. These difference scores were computed separately for palatable food words and control food words for each participant.

Palatable food words. An initial test in the general linear model was conducted to examine the effect of eating restraint and hedonic ratings on attentional bias for palatable food words in both pre-exposure conditions. This analysis revealed an interaction between restraint scores and hedonic ratings of the these food words, $F(1, 96) = 4.71$, $p = .03$, $\eta^2 = .05$. This two-way interaction was qualified by a three-way interaction between restraint scores, hedonic ratings and pre-exposure condition, $F(1, 96) = 4.15$, $p = .04$, $\eta^2 = .04$. In order to examine the nature of this interaction and test our specific hypothesis, the effects of restraint scores and hedonic ratings on attention for palatable food were tested in the food pre-exposure and the non-food pre-exposure conditions separately[1].

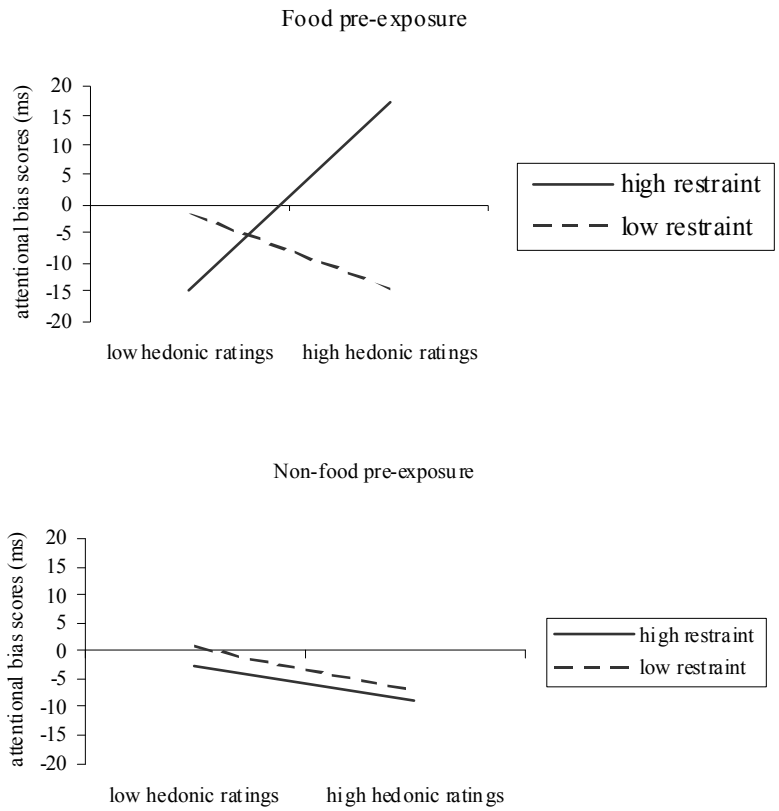

Figure 4.1. Predicted attentional bias scores for palatable food words as a function of restraint scores and hedonic ratings in the food pre-exposure and non-food pre-exposure conditions.

In the food pre-exposure condition, a regression analysis using restraint scores, hedonic ratings and their interaction as predictors revealed a significant interaction of restraint with hedonic ratings, $\beta = .38$, $t(46) = 2.92$, $p = .005$, while none of the main effects were significant. To examine the nature of this interaction, we computed simple slopes for the regression of the attentional bias scores on hedonic ratings for unrestrained eaters (one standard deviation below the mean restraint score) and restrained eaters (one standard deviation above the mean; see Aiken & West, 1991; see Figure 4.1). A significant relation between hedonic ratings and attentional bias for palatable food words was observed for restrained eaters, $\beta = .54$, $t(46) = 2.95$, $p = .005$, but not for unrestrained eaters, $\beta = -.20$, $t(46) = -1.12$, $p = .27$. These results indicate that for restrained eaters, attention for palatable food words increased as a function of the perceived hedonic

quality of the presented food. For unrestrained eaters, hedonic ratings of the food did not influence their attentional bias scores.

In the non-food pre-exposure condition, the interaction of restraint scores and hedonic ratings was not significant, $\beta = .02$, $t(50) = .10$, $p = .92$. This pattern of results suggests that only after food pre-exposure, restrained eaters have an attentional bias for palatable food words that is dependent on the perceived hedonic quality of these food items. For unrestrained eaters, there is no association between hedonic ratings and attention for palatable food words in either pre-exposure condition.[2]

Control food words. With regard to control food items, the same analyses did not reveal the interaction of eating restraint, hedonic ratings of the control food words, and pre-exposure condition, or any significant main effects.

Error rates. An analysis of variance on the proportion of errors on the trials with palatable food words revealed a significant Restraint x Hedonic ratings interaction, $F(1, 96) = 4.30$, $p = .04$, $\eta^2 = .04$, such that restrained eaters' accuracy on congruent trials increased with the perceived hedonic quality of the presented food items. The same interaction effect was found for errors on control food trials, $F(1, 96) = 4.28$, $p = .04$, $\eta^2 = .04$. No other effects were significant. This suggests that restrained eaters' faster reactions on congruent trials with palatable food items were not made at the cost of accuracy.

Discussion

The present experiment revealed the expected pattern of selective attention for food: the pre-exposure to food cues elicited in restrained eaters an attentional bias for palatable food such that higher hedonic ratings of palatable food were associated with increased selective attention for these food items. For unrestrained eaters, no shifts in selective attention were observed. Moreover, both groups did not display selective attention for control food words. These results could not be attributed to differences either in the baseline accessibility of food words or the priming of items per se, since reaction times in the lexical decision task were not associated with restraint scores or hedonic ratings, and pre-exposure did not lead to a main effect on selective attention. Thus, while priming manipulation did not show differences in semantic accessibility of the specific food items in memory, it did influence the allocation of restrained eaters' visual attention to these stimuli as a function of their hedonic value.

Taken together, the present findings offer preliminary support for our contention that the exposure to food cues leads restrained eaters to direct their attention towards food cues which are hedonically relevant.

Study 4.2

The results of Study 4.1 showed that after exposure to food cues, restrained eaters allocate selective attention towards hedonically rated food. Based on the results of Papies et al. (2007), we suggest that the exposure to food cues activates hedonic thoughts in restrained eaters, which then guide their attention towards such food stimuli which match this hedonic orientation. In Study 4.2, we explore in more detail this process that might underlie restrained eaters' shifts in selective attention.

Based on previous research (Stroebe et al., 2008), we propose that the exposure to food cues disturbs the fragile balance between hedonic food thoughts and the goal of weight control that normally allows restrained eaters to regulate their eating behavior. The perception of palatable food activates restrained eaters' hedonic thoughts about food, and as a consequence, the mental representation of the conflicting dieting goal is inhibited (Stroebe et al., 2008). As a result, this goal can no longer curb the influence of the hedonic thoughts, and the subsequent processing of food cues is guided by hedonic thoughts rather than by the goal of dieting. We suggest that this cognitive reaction to food cues is the underlying mechanism that leads restrained eaters to allocate their attention towards such food stimuli which match their current hedonic orientation.

In order to further examine this proposed cognitive mechanism underlying restrained eaters' attention for palatable food, we set up a second study which included a priming manipulation after the pre-exposure to food cues in order to enhance the accessibility of the dieting goal and assesses its influence on restrained eaters' selective attention. If selective attention for certain food stimuli is the result of hedonic thoughts that are activated by the pre-exposure to food cues and that inhibit the dieting goal, then priming this dieting goal after the food pre-exposure should restore its effect and prevent the shifting of selective attention towards palatable food.

In this experiment, half of the participants in the food pre-exposure condition received a version of the visual probe task in which diet-related words were presented before the word pairs in order to prime the goal of dieting. The other participants were presented with control primes in the visual probe task. We reasoned that a diet-prime

would reinstate the dieting goal, which should then again curb the hedonic thoughts about food and preclude their influence on attentional processes (cf. Bargh et al., 2001). Therefore, in the condition where the food pre-exposure was followed by a diet-prime, we expected restrained eaters to display no attentional bias for palatable food stimuli, as in the non-food pre-exposure condition. Because we were especially interested to see whether restrained eaters' self-regulatory mechanisms can be triggered nonconsciously, the diet-primes were presented subliminally to prevent conscious processing. In addition, we wanted to preclude that restrained eaters become aware of the goal of the study and actively avoid the food words because of demand characteristics. Therefore, although supraliminal reminders of one's dieting goal might be effective in other situations, using a subliminal presentation technique seemed most appropriate in the context of our study.

With this extension, Study 4.2 served two main goals. Firstly, it was designed to replicate the results of Study 4.1 and confirm their robustness. Secondly, the addition of a diet-prime in Study 4.2 allows us to investigate the potential for restoring the balance between hedonic thoughts and the weight control goal in chronic dieters. If, as we hypothesize, the diet prime serves to prevent the attentional bias despite the prior food pre-exposure, we have some important evidence that nonconsciously reinstalling one's dieting goal might preclude the influence of hedonic thoughts on attentional processes in restrained eaters and curb the motivation to eat tempting food.

Method

Participants and design

One hundred and thirty-eight students (40 men, 98 women) of Utrecht University participated in the study for course credit or € 3. Participants were randomly assigned to one of three conditions: non-food pre-exposure, food pre-exposure, or food pre-exposure plus diet prime. Apart from this, the experimental design was the same as in Study 4.1. This resulted in a 3 (condition: non-food pre-exposure vs. food pre-exposure vs. food pre-exposure plus diet prime) x 2 (restraint: restrained vs. unrestrained) x 2 (food type: palatable vs. control) x 2 (probe location: congruent vs. incongruent) design, with the first two factors varying between participants, and the latter two factors within participants. Moreover, as in Study 4.1, hedonic ratings of the food items were obtained from all participants. Gender did not have a main effect, nor did it interact with the other factors. Therefore, it is not discussed any further.

Materials

The same materials were used as in Study 4.1. In addition, five words that reflect the concept of eating restraint (dieting, weight, slim, diet, losing weight) were used to prime participants in the food pre-exposure plus diet prime condition.

Procedure

Upon arrival at the laboratory, participants were seated in individual cubicles containing a desktop computer. All materials and instructions were presented on the computer. Participants were informed that the experiment consisted of several different tasks.

Lexical decision task. First, the lexical decision task was introduced, which was the same as in Study 4.1.

Probe classification task. After participants had completed the lexical decision task, the probe classification task was introduced. This task was identical to the probe task in Study 4.1, except that the fixation cross used in Study 4.1 was replaced by random letter strings in which a prime was inserted. Each trial started with a letter string that served as a fixation for 250 ms. Then, a prime was presented for 30 ms (see for a similar priming method, Aarts et al., 2005; Shah, Friedman, & Kruglanski, 2002). In the non-food pre-exposure and food pre-exposure condition, these primes were non-word letter strings, and in the food pre-exposure plus diet prime condition, the primes were five words related to dieting. The prime was followed by a postmask letter string for 350 ms, and then by the word pair for 200 ms. After the word pair, the probe appeared and remained on the screen until participants had classified it according to its direction. The size and location of the stimuli and the number and organization of trials was the same as in Study 4.1.

After the probe classification task and a filler task, participants completed the Restraint Scale and the hedonic ratings as in Study 4.1. Participants were debriefed and probed for awareness of the primes by using a procedure similar to that suggested by Bargh and Chartrand (2000). None of the participants indicated to have noticed the appearance of words between the random letter strings. Finally, participants were paid, and thanked for their participation.

Results

Lexical decision task

In order to assess the accessibility of the palatable and neutral food words for restrained and unrestrained eaters in the food pre-exposure conditions, the reaction times for these words in the lexical decision task were analyzed with restraint scores, hedonic ratings and their interaction as predictors. Again, all predictor variables were transformed to standardized scores before computing cross-product terms. Reaction times of incorrect responses and reaction times longer than 2000 ms were excluded from these analyses. Regression analyses revealed no significant effects (all $t < 1.2$).

Probe classification task

The main dependent variable was the time it took participants to classify the arrow as pointing upwards or downwards. Reaction times on trials with errors and reaction times shorter than 100 ms or longer than 1500 ms were excluded from analyses (3.1%). Difference scores were obtained by subtracting reaction times on congruent trials from reaction times on incongruent trials. Higher difference scores then indicate faster reactions on probes replacing food words compared to probes replacing office words, i.e., an attentional bias for food words. These difference scores were computed separately for palatable food words and for control food words for each participant.

Palatable food words. An initial test in the general linear model was conducted to examine the effect of eating restraint and hedonic ratings of the palatable food on attentional bias scores for palatable food words in the three experimental conditions. This analysis revealed a three-way interaction between restraint scores, hedonic ratings and condition, $F(2, 126) = 4.08$, $p = .02$, $\eta^2 = .06$. In order to examine this interaction effect and test our specific hypotheses, the effects of restraint scores and hedonic ratings of palatable food on attention for palatable food words were tested in the non-food pre-exposure, the food pre-exposure and the food pre-exposure plus diet prime conditions separately.

In the food pre-exposure condition, this analysis revealed a significant interaction of restraint scores with hedonic ratings, $\beta = .39$, $t(43) = 2.71$, $p = .009$. To examine the nature of this interaction, we computed simple slopes for the regression of attentional bias scores on hedonic ratings for unrestrained eaters (one standard deviation below the mean restraint score) and restrained eaters (one standard deviation above the mean; see Aiken & West, 1991). As in Study 4.1, a significant relation between hedonic

ratings and attentional bias for palatable food was observed for restrained eaters, $\beta = .67$, $t(43) = 2.68$, $p = .01$, but not for unrestrained eaters, $\beta = -.32$, $t(43) = -1.48$, $p = .15$. These results show that only for restrained eaters, attention for palatable food increased as a function of the perceived hedonic quality of this food, thereby replicating the pattern of results obtained in Study 4.1. For unrestrained eaters, attention for food words was not related to hedonic ratings.

In the non-food pre-exposure condition, the interaction of restraint scores and hedonic ratings was not significant, $\beta = .17$, $t(43) = 1.01$, $p = .32$. In the food pre-exposure plus diet prime condition, this effect was also not significant, $\beta = -.23$, $t(40) = -1.41$, $p = .16$. None of the main effects were significant (all $t < 1.5$). This suggests that the diet prime which was presented in the pre-exposure plus diet prime condition served to reinstate the dieting goal and thus to prevent the hedonically motivated shift of attention towards palatable food.

These results are displayed in Figure 4.2. Following the suggestions of Aiken & West (1991), we present the attentional bias scores at one standard deviation below and one standard deviation above the respective means of the restraint scores and hedonic ratings.

Control food words. For the control food words, analyses did not reveal the interaction of eating restraint, hedonic ratings of the control food words and pre-exposure condition, or any significant main effects.

Error rates. In an analysis of variance on the proportion of errors on the trials with palatable food words, a significant Condition x Restraint interaction was found, $F(2, 126) = 4.30$, $p = .02$, $\eta^2 = .06$, such that higher restraint scores were associated with higher accuracy on congruent trials only in the non-food pre-exposure condition, $\beta = -.32$, $t(45) = -2.27$, $p = .03$, but not in the food pre-exposure and the food pre-exposure plus diet prime conditions. No significant effects were found on error rates on trials with control food words.

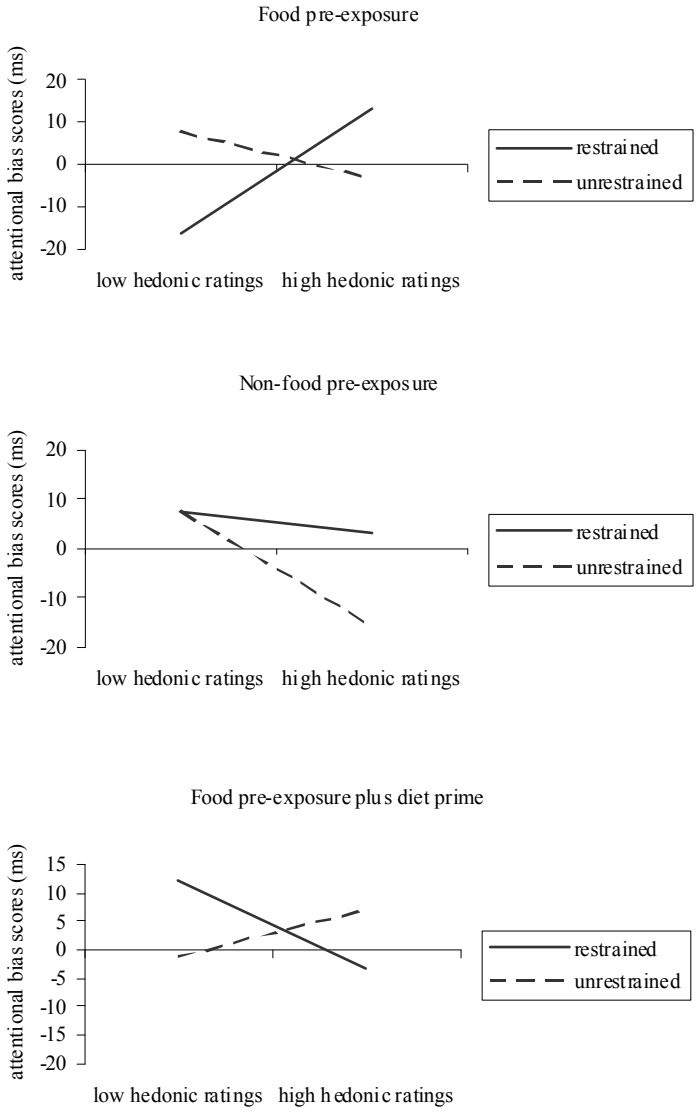

Figure 4.2. Predicted attentional bias scores for palatable food words as a function of restraint scores and hedonic ratings in the food pre-exposure, non-food pre-exposure, and food pre-exposure plus diet prime conditions.

Discussion

Study 4.2 revealed the predicted pattern of attention for food cues among restrained and unrestrained eaters. First of all, the results of Study 4.1 were replicated by showing that the food pre-exposure triggers in restrained eaters an attentional bias for palatable food items that increases with the perceived hedonic quality of these items. When participants were not pre-exposed to food cues, restrained eaters did not differ from unrestrained eaters in the attention they allocated to food. These results are in line with our reasoning that the hedonic thoughts which palatable food elicits in restrained eaters (Papies et al., 2007) serve to guide subsequent attention towards hedonically relevant cues.

In addition, however, Study 4.2 revealed another interesting finding about attentional processes in restrained eating. The study demonstrated that restrained eaters' attentional bias for palatable food did not emerge when they were exposed to subliminally presented diet words after the pre-exposure to food cues. Although the accessibility of the dieting goal was not measured directly, these findings might indicate that our priming manipulation served to reinstall restrained eaters' dieting goal and to reinstate the subtle balance between their hedonic thoughts and their goal of dieting, with the result that selective attention was no longer directed towards tempting food items. Taken together, the results of Study 4.2 illustrate the implicit interplay of the weight control goal and a hedonic orientation towards palatable food in the self-regulation of restrained eaters.

General Discussion

The present studies examined the dynamics of restrained eaters' attention for palatable food as a function of the exposure to food cues. This way, our work extends previous research on the self-regulation of restrained eaters by focusing on the cognitive processes that potentially lead to overeating in response to tempting food cues. Taken together, our findings are consistent with the notion that restrained eaters hold two conflicting goals with respect to food, namely the goal of weight control, and the hedonic goal of eating good food (Stroebe et al., 2008). While their weight control goal in principle serves to protect restrained eaters against the lure of tempting food, this self-regulatory balance is easily disturbed by the exposure to palatable food cues, as this causes in restrained eaters enhanced accessibility of hedonic thoughts and decreased accessibility of the conflicting weight control goal. As a result, restrained eaters' visual attention is directed towards food items which are relevant for their current hedonic orientation. However, when the conflicting dieting goal is re-activated by dieting cues, the balance between hedonic thoughts and the weight control goal is reinstalled and the hedonically motivated attentional bias disappears. The present studies illustrate how external cues can influence restrained eaters' attentional processes with regard to food stimuli, and together with previous findings which demonstrated that the perception of attractive food can lead to the inhibition of the dieting goal (Stroebe et al., 2008), offers converging evidence for the role of the accessibility of the dieting goal in restrained eaters' responses to food cues. However, in the present studies, the effects of food-related goals were assessed only indirectly by examining their impact on subsequent cognitive-motivational processes. Future studies could use more direct measures of goal activation to confirm these results.

One of the most intriguing issues that research on restrained eating is dealing with pertains to the fact that the confrontation with palatable food can easily entice restrained eaters into overeating on palatable, high-calorie foods, despite their chronic dieting goal (e.g., Fedoroff et al., 1997). The results of the present studies suggest that the exposure to food cues could influence restrained eaters by triggering an attentional bias for hedonically relevant food cues. Once such an attentional bias is triggered, it will result in the maintenance of hedonic thoughts about food since further hedonic food cues will be processed preferentially, while competing stimuli are less likely to draw attention (Franken, 2003; Lang et al., 1997). This focus on attractive, pleasurable food cues is

likely to influence subsequent ingestive behavior (Mischel, Cantor, & Feldman, 1996), rendering overeating more likely. As such, the present studies could help us understand the mechanism by which external food cues can trigger restrained eaters to indulge in high-calorie, palatable food despite their chronic dieting goal.

To be sure, our studies assessed these processes in a design which was necessarily partly correlational, thus raising the question of potential covariates of restrained eating that could influence attentional processes for food. Restrained eating has not been found to be associated with more positive evaluations of food (Roefs, Herman, MacLeod, Smulders, & Jansen, 2005; Stroebe et al., 2008), so that the reported effects on attentional processes in attention are most likely not due to differences in liking. However, restrained eaters have repeatedly been found to be heavier than unrestrained eaters, even though the correlations between restraint scores and body mass index tend to be low to moderate (see Gorman & Allison, 1995, for an overview). However, overweight is not associated with a hedonic motivation towards food (e.g., Roefs & Jansen, 2002). Moreover, we argue that overweight per se is unlikely to lead to the cognitive processes addressed here without implying the dieting goal as a mechanism. This is especially true for Study 4.2, where diet primes triggered processes of successful self-regulation in restrained eaters. Further studies should disentangle the effects of weight status and dieting concerns on attentional processes.

In other domains of health behavior, attentional biases for tempting stimuli have been used to assess individual differences in motivation, for example with respect to cigarettes, alcohol and other addictive substances (for an overview, see Franken, 2003). Regular users of these substances have been found to allocate increased selective attention towards drug-related cues, especially when they are experiencing abstinence or cravings and are thus especially motivated to use the drug (Field et al., 2004; Mogg & Bradley, 2002; Townshend & Duka, 2001). Thus, biases in selective attention seem to reflect individual differences in motivation to obtain or consume a certain stimulus (cf. Robinson & Berridge, 2000). Similarly, in the domain of personality research, attentional biases for stimuli of immediate relevance have been studied in relation to individual differences in temperament, such as impulsivity, sensitivity to reward or extraversion. For example, individuals high in sensitivity to reward have been shown to allocate enhanced attention to cues signaling reward rather than punishment (Derryberry & Reed, 1994). Taken together, these findings support the notion that shifts in attention toward stimuli of

immediate relevance reflect motivational processes stemming from rather stable individual differences, as well as in temporary differences in motivation, as individuals direct their attention automatically towards those stimuli that are relevant given their current motivational state (Lang et al., 1997).

In light of this, the current findings on attentional processes in restrained eating might reflect not only purely cognitive, but rather implicit motivational differences with respect to palatable food, such that the exposure to food cues triggers in restrained eaters an increased motivation to consume certain palatable food items. This notion is corroborated by previous experimental evidence showing that the exposure to attractive food cues instigates in restrained eaters stronger anticipatory salivation (e.g., Brunstrom et al., 2004) and stronger urges to eat the cued food (Fedoroff et al., 2003; Harvey et al., 2005). In our reading of the present findings, the exposure to food cues triggers in restrained eaters a motivational response towards food items with a high hedonic quality, which might manifest itself as a craving to eat this food and as such have a strong impact on actual eating behavior.

As discussed so far, the present research suggests a possible mechanism underlying restrained eaters' appetitive reactions to food cues, and as such, it is instructive about the failure of self-regulation in chronic dieting behavior. However, the current findings also point out a promising avenue towards more successful dieting behavior. By confronting restrained eaters with their dieting goal, we were able to prevent the occurrence of an attentional bias for food in Study 4.2. Thus, although external food cues can have a strong impact on restrained eaters' cognitions and potentially interfere with the pursuit of their dieting goal, external cues can similarly contribute to successful self-regulation by re-installing the dieting goal, even nonconsciously, which can then keep in check the pleasure-oriented motivation to indulge in high-fat, palatable food.

A similar perspective has been proposed in recent research exploring the role of automatic processes in the regulation of eating behavior. Fishbach, Friedman and Kruglanski (2003) showed that successful dieters automatically activate their dieting goal when they encounter temptations that could potentially interfere with this goal, which is a functional self-regulation mechanism. In the current studies, restrained eaters needed an external reminder of their dieting goal in order to prevent appetitive reactions to the palatable food items, possibly because the majority of restrained eaters are rather

unsuccessful dieters (Gorman & Allison, 1995; Herman & Polivy, 1984). Moreover, participants in the present studies were exposed to palatable food cues repeatedly in the first phase of the experiment, which may have overruled the activation of the dieting goal even in successful dieters. This may explain why unlike the Fishbach et al. studies, the present studies showed no evidence of dieting goal activation in response to the food cue exposure. Nevertheless, when participants were primed with dieting, nonconscious self-regulation was successful.

Traditionally, the over-eating of restrained eaters has mostly been explained in terms of conscious, deliberative processes, such as the "what-the-hell-cognitions" about overeating suggested by Herman and Polivy (1984), in which restrained eaters are argued to deliberately abandon their diet when they have eaten high-calorie food. In more recent research, evidence is accumulating that automatic self-regulation in the domain of restrained eating is possible, too. At the same time, there is a growing consensus that environmental cues may be of considerable influence on the eating behavior of restrained and obese individuals (Mela, 2006; Wadden et al., 2002; see also Schachter, 1968). Individuals differ with respect to the sensitivity to external cues representing palatable food (cf. Mela, 2006) and in their sensitivity to rewards in general, which might increase one's susceptibility to overweight (Franken & Muris, 2005). The present studies contribute to this new direction in eating research by examining the interplay of environmental food cues with personal goals and preferences and their influence on automatic processes that guide eating behavior.

However, the present studies are also instructive for research on the more general problem of dealing with temptations that can endanger goal pursuit, and for the recent debate about situational versus personal control over behavior (Bargh & Chartrand, 1999; Fishbach et al., 2003; Trope & Fishbach, 2005). Our findings suggest that while the accessibility of individuals' long-term goals may in the first place equip them to ignore the presence of attractive temptations, the repeated exposure to temptation cues in the environment can trigger an attentional bias for short-term rewards at the cost of the conflicting long-term goal.

Once such a shift in attention is triggered, it becomes increasingly difficult to disengage from the attractive cues. For example, one's attempts to quit smoking might be undermined by the presence of an ashtray on a restaurant table: the perception of such a smoking cue can trigger cravings for a cigarette, which in turn can lead to increased

selective attention for further smoking cues in the environment and thus to a perseverance of one's cravings and the motivation to smoke (Ehrman et al., 2002; Franken, 2003). In the case of restrained eaters, once an attentional bias for palatable food has been triggered, this will serve to continuously stimulate hedonic thoughts about food, which in turn will maintain biases in selective attention for tempting food. Thus, attentional biases in self-regulation are not only a reflection of increased motivation to gain access to a certain stimulus, they also function to reinforce this motivation by triggering a cognitive focus on the temptations that are in conflict with one's long-term goal. This way, temptation cues in a given situation can interfere with the personal control over one's goal strivings by directing attention and motivation away from one's long-term goals. Although we would like to suggest that such processes of motivated attention are likely to have a strong impact on temptation-related behavior, the present studies did not measure the behavioral effects of attentional biases. Future studies should attempt to establish direct causal links between these cognitive processes in self-regulation and behavioral outcomes.

While our discussion so far outlines a rather bleak picture for our attempts at self-control, there are also indications that situational cues can help us to resist the temptations that we may encounter during goal pursuit. In the studies presented here, the subliminal presentation of diet-related words served to re-install restrained eaters' dieting goal despite the presence of attractive food cues, and this overriding goal prevented the shift of selective attention towards the conflicting temptations. This result is consistent with recent research on automatic self-regulatory processes showing that goal primes inhibit alternative goals and temptations (Aarts, Custers, & Holland, 2007; Fishbach et al., 2003, Study 2; Shah et al., 2002), a mechanism that has been termed goal shielding (Shah et al., 2002). While earlier studies have provided evidence for goal shielding by showing that the activation of a focal goal causes alternative goals to become less accessible in memory, our findings corroborate this mechanism by showing that alternative, short-term goals cease to trigger hedonically motivated processes when a conflicting long-term goal has been primed. In conclusion, the present experiments serve to advance our understanding of the processes by which the abundance of luring temptations in our environment threaten to pull us off our path of successful self-regulation, and how we can shield our long-term goals in order to prevent this.

Footnotes

[1] Note that in both Study 4.1 and Study 4.2, pre-exposure condition did not affect restrained and unrestrained eaters' hedonic ratings of the food items, as the main effect of pre-exposure and the interaction with restraint scores on hedonic ratings were not significant (all $p > .16$). Only in Study 4.2 there was a main effect of restraint, such that restrained eaters indicated to like the palatable food items less than unrestrained eaters, $F(1, 132) = 5.73$, $p = .02$.

[2]Additional analyses revealed that the predicted three-way interaction between restraint scores, hedonic ratings and pre-exposure condition was qualified by a four-way interaction with gender, $F(1, 88) = 8.47$, $p < .01$, $\eta^2 = .09$. Analyses conducted separately for men and women showed that the three-way interaction between restraint scores, hedonic ratings, and pre-exposure condition was highly significant for men, $F(1, 17) = 8.53$, $p = .01$, $\eta^2 = .33$, while it did not reach significance for women, $F(1, 71) = 2.03$, $p = .16$, $\eta^2 = .03$. However, consistent with our prediction, the second-order interaction between restraint scores and hedonic ratings was significant for both men and women within the food pre-exposure condition, and not in the neutral pre-exposure condition.

CHAPTER 5

Healthy cognition:
Processes of self-regulatory success in restrained eating

Two studies examined self-regulatory success in dieting. Previous research has indicated that restrained eaters (i.e., chronic dieters) might fail in their attempts at weight control because the perception of attractive food cues triggers hedonic thoughts about food and inhibits their dieting goal. However, recent work suggests that in some dieters, temptation cues activate the relevant goal and thus facilitate self-regulation. The present work extends these findings by showing that self-regulatory success moderates the effect of food cues on restrained eaters such that food cues activate the dieting goal in successful restrained eaters and inhibit the dieting goal in unsuccessful restrained eaters. The specific time course of these effects was examined. Moreover, a correlational study revealed that only successful restrained eaters translate their dieting intentions into action. Results are discussed in the context of nonconscious self-regulation and the role of automatic processes in the link between intention and behavior.

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The ability to overcome one's first impulses in order to strive for a more abstract, higher-order goal is crucial in many domains of life. Such efforts have been termed self-control, or self-regulation, and attracted a large amount of research from psychologists (Vohs & Baumeister, 2004). What seems to be crucial in order to ward off attractive temptations that constitute a challenge for self-regulation is to keep in mind the goal one eventually wants to reach (Shah, Friedman, & Kruglanski, 2002). It is easier, for example, to resist buying an attractive-looking pair of shoes if you remind yourself of the fancy car you are saving for, and the dieter may be able to resist a tempting dessert only by thinking about her desire for a slim figure. At the same time, those who spontaneously "forget" that they were on a diet while standing in front of the buffet are likely to succumb to the temptations of tasty food and will be less successful in their dieting attempts. In the present research, we address this issue by examining the impact of temptation cues on the accessibility of the overriding goal, and we will show how this is related to actual success in goal pursuit.

An area in which self-regulation seems to be especially difficult for many people is the domain of eating and dieting behavior. The prevalence of overweight and obesity is constantly increasing in Western societies (Flegal, 2005), and dieting is a very popular means of weight-regulation (Kruger, Galuska, Serdula, & Jones, 2004). However, most people find it difficult to maintain a successful weight-loss diet. Only a small minority of dieters are able to reduce their body weight in the long term, while the majority at least regain the weight initially lost through dieting (Jeffery et al., 2000; Mann et al., 2007). Thus, trying to diet seems to be a largely ineffective strategy of reducing one's body weight.

Restrained eaters and the impact of food cues

It has been suggested that a so-called "toxic environment" where highly palatable and calorically-dense foods are very visible and easily available, contributes to these difficulties in weight-regulation and to the high prevalence of obesity (Hill & Peters, 1998; Wadden, Brownell, & Foster, 2002). Indeed, dieters' eating behavior seems to be strongly influenced by the perception of attractive food in their environment. Much research in this area has focused on the eating behavior of so-called restrained eaters (Herman & Polivy, 1980), who are chronic, yet rather unsuccessful dieters (Gorman & Allison, 1995; Heatherton, Herman, Polivy, King, & et al., 1988). According to restraint theory, restrained eaters chronically try to regulate their food intake by adhering to self-

set dieting rules rather than responding to internal hunger signals. Because they try to override internal cues in order to restrict intake, they are especially responsive to external food and eating cues (Herman & Polivy, 1980, 1984).

Research on the eating behavior of restrained eaters has confirmed that their eating regulation can easily be disturbed by external food cues. Restrained eaters display higher levels of salivation when they are confronted with attractive food (e.g., Brunstrom, Yates, & Witcomb, 2004). Moreover, the sight, the smell, or thoughts about palatable food elicit in restrained eaters stronger urges to eat the cued food than in unrestrained eaters (Fedoroff, Polivy, & Herman, 1997, 2003; Harvey, Kemps, & Tiggemann, 2005). Finally, restrained eaters easily overeat when confronted with such food cues (Collins, 1978; Fedoroff et al., 1997; Jansen & Van den Hout, 1991; Rogers & Hill, 1989). In sum, these studies indicate that when restrained eaters have been confronted with attractive food cues, they no longer behave in line with their chronic dieting goal.

Recently, it has been suggested that there might be a common mechanism underlying these findings, namely that the perception of palatable food cues leads to the inhibition of the dieting goal in restrained eaters, and that this process can affect subsequent behavior. This idea was advanced in the goal conflict theory of eating by Stroebe and colleagues (Stroebe, Mensink, Aarts, Schut, & Kruglanski, 2008; Stroebe, 2008). This theory suggests that restrained eaters hold two incompatible goals with respect to food and eating, namely the goal of eating good food, and the goal of dieting and weight control. While the dieting goal normally curbs restrained eaters' hedonic orientation towards food and helps to restrain their eating behavior, the fragile balance between the two opposing goals can easily be disturbed by the exposure to attractive food cues. The theory proposes that perceiving palatable food leads to the inhibition of the mental representation of the dieting goal in restrained eaters. As a consequence, subsequent food-related cognition and behavior will be dominated by the hedonic goal of eating good food more than by the dieting goal, and restrained eaters are more likely to overeat on attractive food.

Research testing hypotheses derived from this theory confirm that restrained eaters spontaneously activate a hedonic orientation towards food when they perceive palatable food cues. In two recent studies (Papies, Stroebe, & Aarts, 2007), restrained and unrestrained participants read behavior descriptions involving either palatable food or neutral food, after which they were probed unobtrusively for the mental accessibility of

hedonic thoughts about food (e.g., delicious). Results showed that restrained eaters activated such hedonic thoughts, but only after reading behavior descriptions involving palatable food rather than neutral food. In a related series of studies, we examined restrained eaters' processes of visual attention after they had been exposed to attractive food cues (Papies, Stroebe, & Aarts, in press a). Using a visual probe task, we found that restrained eaters allocated increased selective attention to food as a function of their liking of this food. However, this attentional bias only occurred for palatable food, and not for neutral food. These studies confirm that the perception of attractive, rather than neutral food cues, triggers in restrained eaters a hedonic orientation towards food, which makes such cues especially relevant for understanding restrained eaters' processes of self-regulation.

Moreover, Stroebe and colleagues found that restrained eaters, who are chronic, yet rather unsuccessful dieters, have a tendency to inhibit the mental representation of the dieting goal when they are confronted with palatable food cues (Stroebe et al., 2008; see also Papies et al., in press a). Participants in the studies of Stroebe et al. were primed subliminally with palatable food words or with control words and subsequently probed for the accessibility of the dieting goal in a lexical decision task. While the food prime had no influence on the accessibility of diet-related words in unrestrained eaters, restrained eaters showed decreased access to diet-related words when they were primed with food words compared to control words. This suggests that the subtle exposure to palatable food cues causes restrained eaters to temporarily inhibit their dieting goal, as this is incompatible with their hedonic orientation towards food (cf. Aarts, Custers, & Holland, 2007). The goal conflict theory proposes this inhibition of the dieting goal as the mechanism possibly underlying restrained eaters' dieting failures when they are confronted with tempting food.

The theory of temptation-elicited goal activation, however, which has been proposed by Fishbach and colleagues (2003), makes rather different predictions about the impact of tempting food cues on dieters. Rather than explaining why dieters are often unsuccessful, it suggests a mechanism by which dieters can in fact successfully regulate their eating behavior. Fishbach et al. (2003) argue that when individuals repeatedly try to exert self-control in tempting situations, temptation cues will eventually become associated with the mental representation of the overriding goal that the temptation might undermine. As a result, facilitative links develop between temptations and goals, and the

perception of a temptation cue will subsequently lead to the activation, rather than the inhibition, of the overriding goal. In a series of studies testing this theory (Fishbach et al., 2003), the accessibility of specific goal representations was measured after participants had been primed with words that represent a temptation potentially interfering with the pursuit of that goal. The findings in the domain of dieting show that priming temptations (e.g., chocolate) indeed increased the mental accessibility of the relevant overriding goal (e.g., dieting), but only for those dieters who reported being successful in their self-regulation. Thus, self-regulatory success seems to be associated with an increased tendency to activate the relevant goal in a situation where self-regulation is required (e.g., the confrontation with tempting food).

These findings seem inconsistent with the findings reported by Stroebe et al. (2008), who sought to explain why restrained eaters generally are not successful. Moreover, the findings by Fishbach et al. (2003) seem surprising given the literature on restrained eating behavior showing that restrained eaters overeat in response to tasty food cues (e.g., Fedoroff et al., 1997; Jansen & Van den Hout, 1991). However, although there is ample evidence for dieters' self-regulatory failures, the idea of successful self-regulation in chronic dieting is interesting and has potentially promising implications. Therefore, we will consider a number of methodological differences between these studies in order to assess the degree to which they could be integrated. First of all, the Fishbach et al. (2003) study on dieting (Study 4) used a self-constructed measure of "importance of dieting" to identify dieters, whereas Stroebe et al. (2008) used the Concern for Dieting scale of the Revised Restraint Scale (Herman & Polivy, 1980) as a measure of dieting motivation. According to extensive research in the domain of restrained eating, this scale identifies very motivated dieters who are chronically concerned with weight and dieting, but who are also rather unsuccessful in this endeavor (e.g., Gorman & Allison, 1995; Heatherton et al., 1988; Herman & Polivy, 1980). This difference in measures used could explain why the Stroebe et al. studies showed, on the whole, a pattern of inhibition of the dieting goal following attractive food cues, as this might be typical of unsuccessful dieters.

A second difference between the two series of studies is also related to the issue of self-regulatory success. In fact, this individual difference was not assessed among the participants of the Stroebe et al. (2008) studies. However, self-regulatory success could qualify the reported effects, as different levels of self-regulatory success might even be

found among restrained eaters. This would suggest that the two sets of findings could be integrated if one assumes that successful restrained eaters activate the dieting goal, while unsuccessful restrained eaters inhibit the dieting goal in response to tempting food cues.

Finally, a third reason for the apparent inconsistencies between the two sets of findings might lie in the specific effects reported in both studies. Stroebe et al. (2008) compared the reaction times to diet words in the food prime to reaction times in the neutral prime condition, showing that for restrained eaters, the recognition of diet-words was slowed down by the food prime as compared to the neutral prime. Fishbach et al. (2003), on the other hand, analyzed the reaction time to diet words following food primes as a function of importance of dieting and perceived self-regulatory success, showing that successful dieters recognize diet words after food primes faster than unsuccessful dieters. However, the reaction times to diet words after food primes were not compared directly to diet words after neutral primes. Hence, although suggestive, this study presents no conclusive evidence for actual facilitation or inhibition of the dieting goal among successful and unsuccessful dieters due to the presentation of food temptations.

These differences between the studies by Fishbach et al. (2003) and Stroebe et al. (2008) suggest that both temptation-elicited goal activation and goal inhibition could occur in restrained eaters, depending on levels of self-regulatory success. The present research was therefore designed to replicate and integrate these findings and thus answer the intriguing question whether restrained eaters can actually diet successfully. For this reason, the current studies used the validated measure of Concern for Dieting (Stroebe et al., 2008; Herman & Polivy, 1980) to identify chronically restrained eaters, and the measure of self-regulatory success introduced by Fishbach et al., (2003) to assess levels of self-regulatory success.

An interesting issue that might provide us with further insight into the processes underlying goal-activation and inhibition is the time course of these priming effects. While in both the Fishbach et al. (2003) as well as in the Stroebe et al. (2008) studies, the food primes themselves were presented too short for conscious perception (50 ms and 23 ms, respectively), the onset of the diet-target only occurred at least half a second later (700 ms and 500 ms, resp.), adding up to a stimulus-onset asynchrony (SOA) of 750 ms and 523 ms, respectively. The SOA is of relevance as it influences the amount of processing that the prime receives before the actual target is presented, thus determining the prime's impact on the accessibility of related concepts. Research on the time course

of priming effects has revealed that both the activation as well as the inhibition of related concepts require some amount of processing time, especially when the prime and the target are not very strongly associated (Burgess & Simpson, 1988; Neely, 1977; Simpson & Burgess, 1985). In order to augment our understanding of the processes underlying the effects of food primes, the present study examined the time course of the temptation-elicited goal activation and inhibition by systematically varying the SOA between food primes and diet targets. We hypothesized that both the activation and the inhibition of the dieting goal after the food prime would be especially pronounced at longer SOAs. In Study 5.1, then, we examined the hypothesis that while unsuccessful restrained eaters will inhibit their dieting goal in response to food temptations, successful restrained eaters will activate this goal when they perceive tempting food, especially at longer SOAs. Study 5.2 was designed to assess the behavioral implications of self-regulatory success by testing whether it increases restrained eaters' adherence to their dieting plans over an extended period of time. This way, we hoped to gain insight into self-regulatory success by examining its effects on behavior as well as its cognitive underpinnings.

Study 5.1

Study 5.1 was set up to test the impact of palatable food primes on the accessibility of the dieting goal for successful and unsuccessful restrained eaters. Words related to the goal of dieting were presented in a lexical decision task following the subliminal presentation of palatable food primes or neutral primes. In order to examine the time course of the prime effect and get a better understanding of its underlying process, the time interval between the presentation of the food prime and the presentation of the target (i.e., stimulus onset asynchrony, SOA) was varied within participants. We expected the accessibility of the dieting goal to differ from baseline only at the longer time interval and not at the shorter time intervals between the onset of prime and target.

Method

Participants and design

Fifty-two students (13 men, 39 women) of Utrecht University participated in the study for course credit or € 2,50. The study used a mixed design with trial type (baseline vs. 180 ms vs. 360 ms vs. 540 ms SOA) as a within-participants factor and restrained eating and self-regulatory success as continuous predictors. Gender did not have a main

effect, nor did it interact with the other predictors. Therefore, it will not be discussed any further.

Materials

Five words related to the goal of dieting (weight, slim, diet, losing weight, weight watching) served as targets in the lexical decision task. Five office-related words of equal word length served as control targets (book, staple, office, desk, file). Moreover, there were 10 neutral words and 20 non-words that served as targets in filler trials. Five palatable food items (chocolate, cookies, pizza, French fries, chips; all single words in Dutch) were used as subliminal palatable food primes. Random letter strings were used as primes on filler and baseline trials and as pre- and post-masks for the food primes.

Procedure

Upon arrival at the laboratory, participants were seated in individual cubicles containing a desktop computer, which presented all materials and instructions.

Lexical decision task. Participants were instructed to indicate as fast and as accurately as possible whether the words presented between asterisks on the screen were existing Dutch words or not, using the clearly marked keys on the keyboards for their responses. They were instructed that series of letter strings would appear in between words, and they were not supposed to react to these letter strings. Five practice trials were presented to familiarize participants with this task.

The lexical decision task used here was adapted in such a way as to accommodate the different stimulus onset asynchronies necessary to test our specific hypothesis. Participants were presented with a letter string presented for 30 ms followed by a letter string presented for 150 ms, again followed by a letter string of 30 ms, and so on. At random intervals, a target word was presented between asterisks, and participants were required to respond. This way, the length of a trial varied between 900 ms to 2.5 seconds, and participants were not able to form expectancies as to when the next target would appear. On critical trials, a food prime was presented for 30 ms and followed by varying numbers of letter strings until the diet-word or office-word was presented 180 ms, 360 ms, or 540 ms after the onset of the subliminal food prime (see Figure 5.1 for an example of a critical trial). On baseline trials, as well as on filler and non-word trials, the target word was preceded only by letter strings. The lexical decision task consisted of 20 food-target trials, 20 office-target trials, 40 filler trials, and 80 non-word trials, adding up to a total of 160 trials. Trials were presented in a random order but with critical trials in

fixed positions in order to ensure enough distance between them. After 80 trials, there was a break of 30 seconds.

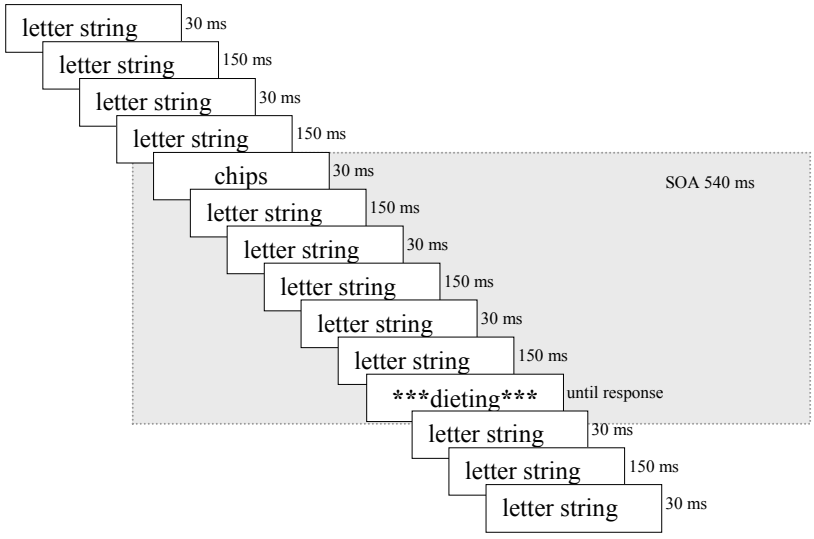

Figure 5.1. Example of a critical trial with an SOA of 540 ms.

Restrained eating scale. Subsequently, participants filled out the Dutch version of the Concern for Dieting subscale of the Revised Restraint Scale (Herman & Polivy, 1980, see Appendix A, Chapter 3). This scale assesses chronic concern with dieting by means of six items such as "Do you often diet?" and "Do you feel guilty after overeating?". Participants were also asked to report their body weight and height.

Dieting importance. We assessed the importance that participants attached to dieting with the 2-item scale developed by Fishbach et al. (2003) by asking them to indicate on a 7-point scale how concerned they were with watching their weight and with being slim.

Perceived self-regulatory success. Finally, we measured perceived self-regulatory success in dieting with the 3-item scale developed by Fishbach et al. (2003) by asking participants to indicate on a 7-point scale how successful they were in losing weight, how successful they were in watching their weight, and how difficult they found it to stay in shape (last item reverse coded). After they had answered all questions, participants were debriefed, paid, and thanked.

Results

The correlations between the two measures of dieting and the measure of self-regulatory success are displayed in Table 5.1. The correlation between restrained eating and importance of dieting is high, indicating that these two scales assess related concepts. Moreover, the correlation of self-regulatory success with restrained eating is negative, which confirms our reasoning that restrained eaters on the whole are rather unsuccessful dieters. Body mass index (BMI) was calculated by dividing participants' body weight by the square of their height. As expected, higher self-regulatory success was associated with lower BMI values.

		M (SD)	1	2	3	4
1.	Restraint (concern for dieting)	6.81 (3.55)	–			
2.	Dieting Importance	9.69 (2.70)	.70**	–		
3.	Dieting Success	12.21 (3.29)	-.42**	-.30*	–	
4.	BMI	22.41 (3.19)	.45**	.30*	-.48**	-

Table 5.1 Statistics of the measures used, and correlations between the concern for dieting subscale of the Restraint Scale (Herman & Polivy, 1980), the importance of dieting and the dieting success measures by Fishbach et al. (2003), and body mass index (BMI). * p <.05 , two-tailed. ** p < .01, two-tailed.

The main dependent variable in the present study was the time it took participants to indicate that the diet-words presented in the lexical decision task were existing Dutch words. Response latencies of incorrect responses or larger than three standard deviations from the mean were excluded from analyses. The remaining response latencies were analyzed as a function of restrained eating, self-regulatory success, and their interaction in order to assess the accessibility of the dieting goal after the food prime at different SOA's for successful and unsuccessful restrained eaters. In order to reduce multicollinearity, predictor variables were transformed to standardized scores before computing cross-product terms (Dunlap & Kemery, 1987).

Regression analyses revealed a three-way interaction between restraint scores, success scores, and trial type on diet-targets, $F(3, 46) = 4.17$, $p = .01$, $\eta^2 = .21$. In order to further examine this interaction and test our specific hypothesis, we examined the effect of self-regulatory success on the response latencies of restrained eaters (one standard

deviation above the mean, see Aiken & West, 1991) at the different types of trials. This analysis revealed a marginally significant main effect of self-regulatory success, $F(1, 48) = 3.65$, $p = .06$, $\eta^2 = .07$, which was qualified by an interaction between success and trial type, $F(3, 46) = 3.02$, $p = .04$, $\eta^2 = .17$. These results are displayed in Figure 5.2. Contrast analyses showed that successful restrained eaters (one SD above the mean of the success scale) responded significantly faster to diet words when they were preceded by a food prime compared to baseline trials, but only when the SOA was 540 ms, $F(1, 48) = 5.94$, $p = .02$, $\eta^2 = .11$, and not when the SOA was 180 ms, $F(1, 48) = .86$, $p = .36$, $\eta^2 = .02$, or when the SOA was 360 ms, $F(1, 48) = .21$, $p = .64$, $\eta^2 = .00$. However, unsuccessful restrained eaters (one SD below the mean of the success scale) took significantly longer to respond to diet words when these were preceded by a food prime compared to baseline trials, but only when the SOA was 540 ms, $F(1, 48) = 5.80$, $p = .02$, $\eta^2 = .11$, and not when the SOA was 180 ms, $F(1, 48) = 1.00$, $p = .32$, $\eta^2 = .02$, or when the SOA was 360 ms, $F(1, 48) = 1.30$, $p = .26$, $\eta^2 = .03$. Thus, at the SOA of 540 ms, the food prime led to an activation of the dieting goal above baseline in successful restrained eaters, and to its inhibition below baseline in unsuccessful restrained eaters.

The same pattern of results emerges in a between-subjects analysis when comparing the reaction times of successful and unsuccessful restrained eaters at the different types of trials. Results showed that their responses did not differ at baseline, $F(1, 48) = .41$, $p = .53$, $\eta^2 = .01$. The effect of success approached significance at the SOA of 180 ms, $F(1, 48) = 2.88$, $p = .10$, $\eta^2 = .06$, and at the SOA of 360 ms, $F(1, 48) = 2.42$, $p = .13$, $\eta^2 = .05$, and it was significant at the SOA of 540 ms, $F(1, 48) = 6.89$, $p = .01$, $\eta^2 = .13$.[1] This difference between successful and unsuccessful restrained eaters is a conceptual replication of the findings reported by Fishbach et al. (2003).

There were no significant effects on trials in which office-words served as targets.

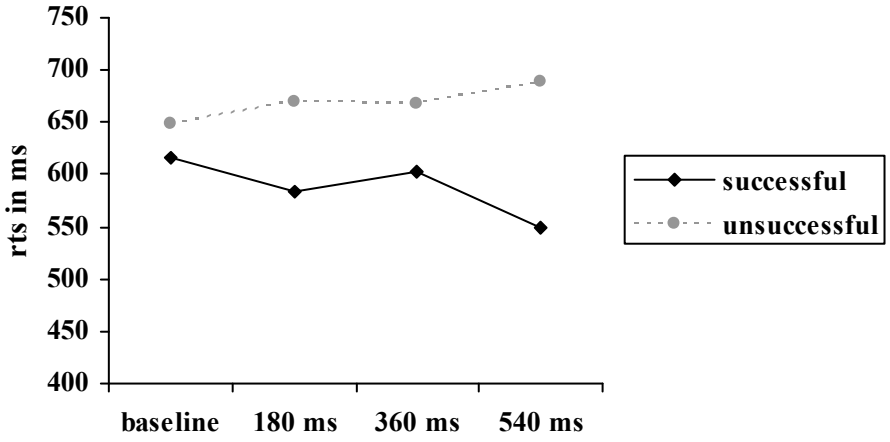

Figure 5.2. Restrained eaters' mean response latencies to diet targets as a function of self-regulatory success and stimulus-onset-asynchrony (SOA). Successful and unsuccessful groups represent one standard deviation above vs. below the mean of the success scale.

Discussion

The findings of Study 5.1 confirmed our hypothesis that the subliminal presentation of an attractive food prime has a differential impact on the accessibility of the dieting goal in restrained eaters, depending on their self-regulatory success. For successful restrained eaters, food primes led to the facilitation of the dieting goal compared to baseline, while for unsuccessful restrained eaters, food primes caused the inhibition of the dieting goal. Moreover, these priming effects were observed only in the condition with a time delay of 540 ms between the onset of the food prime and the onset of the diet target. At shorter SOA's, food primes did not affect the accessibility of the dieting goal. This result mirrors the findings of Fishbach et al. (2003) and Stroebe et al. (2008), which also relied on relatively long SOA's (750 ms and 523 ms, resp.) to assess effects of temptation primes.

The goal of Study 5.1 was to integrate the finding of Fishbach et al. (2003) and Stroebe et al. (2008), who reported seemingly inconsistent findings with regard to the effect of food primes on the dieting goal. The present study replicated the findings by Fishbach et al. (2003, Study 4) with the slight modification of using the Concern for Dieting Subscale of the Restraint Scale as a predictor, and it showed that those restrained

eaters who are relatively more successful display facilitation of the dieting goal in response to food primes. At the same time, we replicated the findings by Stroebe et al. (2008) by demonstrating the inhibition of the dieting goal after food primes, but only in unsuccessful restrained eaters. These findings point towards self-regulatory success as the crucial moderating variable in the effects of food primes on the dieting goal. The question remains, however, whether the effect of self-regulatory success extends not only to goal accessibility, but also to the corresponding goal-directed behavior. This is the central question of Study 5.2.

Study 5.2

Recent research on goal-directed behavior has provided ample evidence that the accessibility of a behavioral goal is a crucial parameter in the subsequent pursuit of that goal. Unobtrusively increasing the accessibility of a goal by a priming manipulation makes subsequent behavior in pursuit of that goal more likely, for example when participants who are primed with the goal of socializing subsequently expend more effort in order to win tickets for a student party (Custers & Aarts, 2007; Bargh, Gollwitzer, Lee Chai, Barndollar, & Troetschel, 2001; Aarts, Gollwitzer, & Hassin, 2004). Thus, if self-regulatory success increases the accessibility of the dieting goal when a temptation is perceived, we argue that it might also facilitate the pursuit of the dieting goal in tempting situations, that is, align one's action with one's intentions.

Fishbach et al. (2003) report a study which appears to be relevant to this issue as it investigates the effects of temptation priming on the behavior of diet-concerned individuals (Study 5). After participants had been primed with either attractive food cues, diet cues, or neutral cues, the mental accessibility of the dieting goal was measured in a lexical decision task. Then, participants could choose between a healthy, diet-congruent gift (apple) and an unhealthy, palatable gift (chocolate bar) from the experimenter. Results showed that both the attractive food prime as well as the diet prime increased the mental accessibility of the dieting goal and also triggered participants to choose the diet-congruent parting gift more often than in the control condition. Thus, this study seems to indicate that attractive food primes increase dieters' adherence to the dieting goal. While all participants of this study were somewhat concerned with weight and dieting, their self-regulatory success was not measured. It is therefore difficult to relate the findings of this study to the differences reported earlier between successful and unsuccessful dieters.

Based on earlier findings, one would expect that only successful dieters will behave in line with their dieting intentions in such a tempting situation. Less successful dieters, as we have seen above, have a tendency to overeat when confronted with tempting food cues, and they should be more likely to choose the chocolate bar instead of the apple (e.g., Fedoroff et al., 1997, 2003). Therefore, we designed a second study to test the hypothesis that only successful dieters pursue their dieting intentions in tempting situations.

In this study, we specifically examined the role of self-regulatory success in restrained eaters' adherence to their dieting plans over a two-week period. As prior research has shown that restrained eaters activate hedonic cognitions and easily abandon their diets when confronted with high-calorie, palatable food (e.g., Papies et al., 2007, in press a; Fedoroff et al., 1997, 2003), we were especially interested in restrained eaters' dieting behavior with respect to abstaining from such food items. We hypothesized that unsuccessful restrained eaters, who have been shown to inhibit the dieting goal when confronted with palatable food, would not translate their intentions not to eat the critical food items into behavior, as the representation of the dieting goal is not available to guide their actions in the relevant situations. Successful restrained eaters, on the other hand, have a tendency to activate their dieting goal when they are confronted with palatable food, which enables them to execute their diet-related intentions. In sum, therefore, self-regulatory success should moderate the intention-behavior relationship for restrained eaters.

Method

Participants and design

Sixty-five students of Utrecht University (12 men, 53 women) participated in this study in exchange for either course credit or € 2 and the chance to win an additional prize of € 30. The study used a longitudinal design with two measurements separated by a time interval of two weeks. Dietary restraint, dieting success, and not-eating intentions were measured at time one and used as continuous variables to predict eating behavior measured at time two. [2]

Procedure

Time One. Participants were seated in individual cubicles and completed several questionnaires on the computer. Restrained eating and perceived self-regulatory success were assessed the same way as in Study 5.1. As a measure of the goal to diet, participants

were then asked to indicate on a 7-point scale their intentions not to eat five palatable food items (e.g., pizza, chocolate) within the next two weeks. These were the same five food items that had been used as primes in Study 5.1. After this, participants were paid and thanked for their participation. They had no indication that they would be contacted again.

Time Two. Each participant was contacted by email exactly 15 days after their initial participation. They were asked to complete a short electronic questionnaire concerning the same food items as in the first measurement. They indicated how often they had eaten the food items in the past two weeks on a 7-point scale ranging from "never" to "very often". Participants returned the questionnaire by email either on the day they received it or on the following day.

Results

The frequency of eating the critical food items was analyzed in order to test our hypothesis that intentions not to eat certain food items predict behavior only for successful restrained eaters, but not for unsuccessful restrained eaters. In order to reduce multicollinearity, predictor variables were transformed to standardized scores before computing cross-product terms (Dunlap & Kemery, 1987). Regression analyses revealed a main effect of intention, $\beta = -.61$, $t(57) = -4.41$ $p = .00$, such that intentions not to eat the food items in question were associated with a lower frequency of eating them. However, this effect was qualified by the predicted three-way interaction between intentions, restraint and success, $\beta = -.31$, $t(57) = -2.10$, $p = .04$. To further examine this interaction, the effect of intentions and success was assessed for unrestrained and restrained eaters separately (one standard deviation below vs. above the mean of the restraint scale, see Aiken & West, 1991). For unrestrained eaters, there was a strong main effect of intentions, $\beta = -.67$, $t(57) = -3.90$, $p = .00$, such that intentions not to eat the food items was associated with a lower frequency of eating them. For restrained eaters, however, the main effect of intention, $\beta = -.55$, $t(57) = -2.96$, $p = .01$, was qualified by a significant interaction between intentions and success, $\beta = -.43$, $t(57) = -2.10$, $p = .04$. In line with our hypothesis, simple slope analyses showed that intentions only predicted the behavior of successful restrained eaters, $\beta = -.98$, $t(57) = -3.85$, $p = .000$, such that stronger intentions not to eat the critical food items corresponded with eating them less frequently. For unsuccessful restrained eaters, these intentions did not predict how often they ate the critical food items, $\beta = -.12$, $t(57) = -.40$, $p = .69$.

Discussion

The results of Study 5.2 confirmed our hypothesis that self-regulatory success among restrained eaters influences their actual eating behavior. We found that successful and unsuccessful restrained eaters differed in the degree to which they were able to translate their diet-related intentions into actual behavior, such that intentions not to eat certain food items predicted the self-reported frequency of actually eating these items only for successful restrained eaters. For unsuccessful restrained eaters, the frequency of eating the critical food items was not related to their intentions. Thus, self-regulatory success emerged as a moderator of the intention-behavior link in restrained eaters.

In order to successfully execute one's intentions, it is essential that one remembers them at the right moment. Study 5.1 showed that unsuccessful restrained eaters have a tendency to inhibit their dieting goal in tempting situations, and we argue that this might be the critical process which interferes with the execution of dieting intentions in unsuccessful restrained eaters. Since their dieting goal is inhibited when they perceive an attractive food item, they might simply not think of the fact that they had formed an intention not to eat it. Although we did not directly assess the effect of the accessibility of the dieting goal on eating behavior, Study 5.2 presents converging evidence for this hypothesized process underlying restrained eaters' self-regulatory failure. By examining the effects of self-regulatory success on actual behavior, we extended the findings of Study 5.1 as well as the findings by Fishbach et al. (2003) which focused on the cognitive processes associated with success. Thus, this study confirms that self-regulatory success is a meaningful dimension among restrained eaters, as it is reflected not only in processes of goal activation, but also in goal-directed behavior.

General Discussion

The presence of attractive food has a profound impact on the cognitions and behavior of dieters and their efforts at self-regulation (e.g., Fedoroff et al., 1997, 2003). Given the omnipresence of food cues in our living environment, is there any hope at all for the dieters among us? The present paper suggests that there is, and presents cognitive and behavioral characteristics of dieting success.

Study 5.1 confirmed earlier findings by Fishbach et al. (2003) that dieters who indicate to be successful in their weight regulation have a tendency to activate their dieting goal when they perceive tempting food. Our study found evidence of this process

of successful self-regulation even among restrained eaters, who previously were found to be chronic, but rather unsuccessful dieters on the whole. However, restrained eaters who indicated to be unsuccessful showed the opposite tendency: these dieters inhibited their dieting goal after the presentation of attractive food primes, which resembles the findings of earlier studies by Stroebe and colleagues (2008) for a subgroup of relatively unsuccessful dieters. Thus, the results of Study 5.1 integrate the findings of two lines of research and present us with a differentiated picture of the impact of attractive food cues on the dieting goal in restrained eaters, as this is moderated by self-regulatory success. Study 5.2 then extended these findings to actual dieting behavior and showed that successful dieters are more likely to enact their dieting intentions than unsuccessful dieters. Taken together, our studies corroborate the existence of the mechanism of temptation-elicited goal activation associated with dieting success (Fishbach et al., 2003) and also provide evidence for the behavioral effects of dieting success.

What are the implications of these findings for our understanding of the impact of food cues on restrained eaters? A large number of studies demonstrated the detrimental effects of attractive food cues on the self-regulation of restrained eaters, providing evidence of restrained eaters' appetitive responses and overeating when they are confronted with attractive food cues (e.g., Fedoroff et al., 1997, 2003; Harvey et al., 2005; Jansen & Van den Hout, 1991). The goal conflict model (Stroebe et al., 2008; Stroebe, 2008) has been developed to explain these instances of self-regulatory failure and points towards the activation of hedonic thoughts and the inhibition of the dieting goal as the possible underlying mechanisms. The present studies, however, suggest that these processes might be especially relevant for a subgroup of restrained eaters, namely those who report to be rather unsuccessful at their dieting attempts. Those dieters who are successful trigger their dieting goal in tempting situations, so that they should be less prone to overeat when confronted with the sight, the smell, or thoughts of attractive food.

Note that the present studies only examined restrained eaters' cognitive and behavioral responses to high-calorie, palatable food, and it is possible that successful restrained eaters activate their dieting goal even in response to other, less tempting food cues. An additional limitation of our studies is that our measure of dieting behavior relied on participants' self-reported frequency of eating the critical food items, without controlling for the frequency of actually having been exposed to these temptations. Future studies might further examine successful dieters' cognitive and behavioral

strategies of self-regulation and relate them to instances of eating behavior in more controlled situations.

Our finding that dieting success emerged as a significant moderator of the intention-behavior link in restrained eaters is in line with earlier research on the execution of diet-related intentions, which has identified individuals' perceived control with respect to losing weight as a moderator of the intention-behavior link (Schifter & Ajzen, 1985). In the study by Schifter and Ajzen (1985), perceived control was measured by asking participants to indicate the likelihood that their attempts at weight-control would be successful, which closely resembles the measure of self-regulatory success used in the present studies. Thus, both scales might tap into the same underlying construct, namely participants' perceived ability to reduce their body weight, which helps dieters to translate their dieting intentions into actual behavior. In all of these studies, however, self-regulatory success was assessed by assessing participants' own perceptions of success, so that it remains unclear how these measures are related to more objective standards of weight control. In the present work, we made a first step towards including such objective standards by computing the correlation with Body Mass Index and confirming that successful participants had a relatively lower BMI. However, future studies should include more extensive assessments of dieting success.

Another moderator of the intention-behavior link that has emerged from earlier research and that is relevant to the current investigation is goal accessibility. That is, in order to have an effect on behavior, goals should be increasedly accessible at the time of action. Evidence for the beneficial effect of the accessibility of the behavioral goal in intention-behavior relations stems mostly from research on implementation intentions (for a meta-analysis, see Gollwitzer & Sheeran, 2006; Sheeran, 2002). These are concrete plans which specify when, where, and how one is planning to pursue a goal, thereby producing a cognitive association between certain situational cues on the one hand, and the behavioral goal that one wants to pursue on the other hand. Forming implementation intentions increases the likelihood that the mental representation of the goal becomes highly accessible when the relevant situation is encountered, which in turn contributes directly to the actual execution of the intention (Webb & Sheeran, 2007). Although our current studies did not examine the behavioral effects of the accessibility of the dieting goal directly, the combined findings of Studies 5.1 and 5.2 might point in this direction, that is, that changes in goal accessibility might be the cognitive process underlying the

reported effects of self-regulatory success on the link between intention and behavior in restrained eaters.

The fact that self-regulatory success emerges as such a crucial parameter in restrained eating raises questions about the mechanism underlying the activation or inhibition of the dieting goal. How do some restrained eaters manage to spontaneously activate their long-term dieting goal in the face of an attractive short-term temptation? Fishbach et al. argue that such a facilitative link between temptations and goals arises from repeated attempts at self-control in a given domain (Fishbach et al., 2003), for example by repeatedly trying to diet when one is confronted with a tasty food temptation. Our earlier studies (Papies et al., 2007) showed that perceiving attractive food triggers in restrained eaters the activation of hedonic thoughts about food. Thus, once such hedonic thoughts have been activated, attempts at self-control require a restrained eater to overrule the tendency to translate these into action (i.e., eating the good food) by consciously thinking about their dieting goal and then pursuing it (i.e., refraining from eating the food). By doing so repeatedly, the association between hedonic thoughts about food and the goal of eating the food will be weakened, and at the same time, the association between hedonic thoughts and the dieting goal will be strengthened (Bargh, 1990; Bargh & Gollwitzer, 1994).

Note that this mechanism necessitates a conscious effort on behalf of the dieter to substitute one course of action by another, which might eventually also lead to the substitution of one cognitive association by another, more beneficial one. Once the new association is overlearned to a sufficient degree, attractive food cues can trigger the dieting goal unconsciously and efficiently, two important aspects of automaticity (Bargh, 1994). The effectiveness of such a conscious "intervention" to replace an existing unwanted behavior with a new, more desirable one has recently been demonstrated in a field-study on implementation intentions (Holland, Aarts, & Langendam, 2006). The actual strength of the goal, i.e., the degree to which it is seen as desired by the individual, could influence the likelihood that a dieter will consciously decide to pursue it in critical situations, and thus contribute to the development of self-regulatory success (Ferguson, 2007; see also Custers & Aarts, 2005).

In sum, the process that we suggest helps restrained eaters to be successful in their dieting attempts resembles the concept of implementation intentions in two important dimensions. Firstly, both strategies of self-regulation are effective because they

increase the accessibility of the behavioral goal in the critical situation. And secondly, both require conscious planning of the individual to change their behavior, which might eventually lead to a change in the underlying cognitive structure that triggers responses to certain situations. This way, our current studies fit in a new direction in psychological research that focuses not only on the detrimental effects of automatic processes for health behaviors, such as in unhealthy habits that are hard to break (e.g., Sheeran et al., 2005; for an overview, see Aarts, 2007), but points also at the potential benefits of both conscious planning and automatic processes for one's healthy goal pursuits.

Footnotes

[1]The mean reaction times of successful and unsuccessful restrained eaters at the different types of trials were M = 616 (SE = 38.85) vs. M = 648 (SE = 23.61; baseline); M = 583 (SE = 39.48) vs. M = 669 (SE = 24.00; SOA 180 ms); M = 603 (SE = 32.59) vs. M = 668 (SE = 19.80; SOA 360 ms) and M = 549 (SE = 41.21) vs. M = 688 (SE = 25.05; SOA 540 ms).

[2]Although 126 participants completed the first part of the study, only 65 participants returned the email questionnaire that was sent to them 2 weeks later. This relatively high attrition rate is probably due to the fact that participants were not aware that they would be contacted again for the second part of the study. However, there were no differences on the measures of restraint, success, or intentions at Time 1 between participants who did and those who did not respond to the email follow up (all $F < .8$).

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SAMENVATTING – SUMMARY IN DUTCH

Overgewicht is een groot gezondheidsprobleem in veel Westerse samenlevingen, en steeds meer mensen proberen om hun gewicht te reduceren of te controleren door aan te lijn doen. Het lukt echter vaak niet om dit lang vol te houden. Terwijl de meeste mensen wel in staat zijn om op korte termijn gewicht te verliezen, is de kans groot dat men na een tijdje weer aankomt. Veel lijners worden op de lange termijn zelfs zwaarder dan niet-lijners. De centrale vraag in dit proefschrift is daarom: waarom is het voor lijners zo moeilijk om de verleiding van lekker eten te weerstaan?

Om deze vraag te beantwoorden brengt dit proefschrift twee gebieden van onderzoek bij elkaar, namelijk onderzoek naar externe invloeden op eetgedrag, en onderzoek naar onbewuste psychologische processen. Onze leef-omgeving confronteert ons elke dag met ontelbaar veel cues die aan lekker eten doen denken. We zien aantrekkelijk voedsel in reclames en etalages, we ruiken het in winkels en op het station, en het is makkelijk beschikbaar in kantines, supermarkten, en in onze keukenkastjes. Uit onderzoek is gebleken dat lijners na het zien of ruiken van zulke eet-cues meer zin krijgen in lekker eten en er ook daadwerkelijk meer van eten als ze de kans krijgen. Recent sociaal psychologisch onderzoek heeft bovendien laten zien hoe subtiele cues uit de omgeving het gedrag van mensen kunnen sturen zonder dat mensen zich er bewust van zijn. Het huidige proefschrift brengt deze twee recente ontwikkelingen samen om het eet-gedrag van lijners beter te begrijpen, namelijk door te onderzoeken hoe aantrekkelijke eet-cues uit de omgeving de onbewuste, cognitieve processen van lijners beïnvloeden en daardoor bijdragen aan het falen van hun zelf-regulatie.

Dit proefschrift omvat vijf hoofdstukken. Hoofdstuk 1 biedt een korte introductie en een overzicht van het gehele proefschrift. Hoofdstuk 2 introduceert de theoretische achtergrond van het onderzoek dat in de latere hoofdstukken wordt gepresenteerd. Eerst wordt eerder onderzoek besproken dat zich bezig houdt met de vraag waarom lijners vaak te veel eten. Dit onderzoek concentreert zich vooral op het herkennen van interne signalen en op bewuste processen in de regulatie van eetgedrag. Zo zouden lijners niet meer in staat zijn om te herkennen wanneer zij hongerig zijn of

juist vol zitten, en daarom hun eetgedrag sturen via bewuste processen. Hierdoor zouden zij vaak overeten als zij denken dat zij toch al te veel hebben gegeten. Er is echter weinig bewijs dat aantoont dat lijners hun interne honger-signalen slechter kunnen herkennen dan niet-lijners, of dat lijners bewust hun lijn-doel opgeven als ze te veel hebben gegeten. Bovendien kan deze theorie niet verklaren waarom lijners zelfs te veel gaan eten als zij lekker eten alleen maar zien of ruiken.

Veel recente studies tonen aan dat de hedonische waarde van eten (i.e., hoe lekker men iets vindt) in sterke mate bepaalt wat en hoeveel mensen eten. Bovendien is gebleken dat lijners sterker op hedonisch relevante eet-cues reageren dan niet-lijners, bijvoorbeeld met sterkere "cravings", meer speeksel-ontwikkeling, en verhoogde consumptie van het lekkere eten. Het lijkt er dus op dat lijners als zij lekker eten waarnemen, sterk op de aantrekkelijkheid van het eten afgaan en zich minder laten leiden door het doel om te lijnen. Dit is de essentie van het doel-conflict model dat in Hoofdstuk 2 wordt geïntroduceerd om het eetgedrag van lijners te verklaren.

Het doel-conflict model suggereert dat lijners twee conflicterende doelen hebben met betrekking tot eten, namelijk het doel om lekker te eten, en het doel om te lijnen. Hoewel het lijndoel normaal gesproken ervoor zorgt dat het hedonische doel om lekker te eten niet de overhand neemt, kunnen lekkere eet-cues uit de omgeving ervoor zorgen dat lijners in hedonische termen over eten gaan denken en daardoor het lijndoel cognitief wegdrukken (i.e., inhiberen). Vervolgens zullen hun cognitieve processen en hun gedrag sterk worden bepaald door het doel om lekker te eten, en niet door het doel om te lijnen, met over-eten als mogelijk gevolg.

Het doel-conflict model specificeert dus de onderliggende cognitieve processen die ertoe bijdragen dat lijners gaan overeten als zij met lekker eten zijn geconfronteerd. Om dit model te toetsen zijn een aantal studies uitgevoerd, die in Hoofdstukken 3 tot 5 worden besproken.

Hoofdstuk 3 gaat in op de vraag of lijners in hedonische termen over eten denken als zij met aantrekkelijk eten worden geconfronteerd. In Studie 3.1 kregen proefpersonen zinnen te lezen die aangeven dat een persoon lekker of neutraal eten aan het eten is ("Bart neemt een hap van de warme pizza."), of iets anders doet met lekker of neutraal eten ("Janine pakt de rozijnen uit de kast."). Na elke zin die met eten te maken had, werd een woord op het scherm gepresenteerd dat het genieten van eten aangeeft, bijvoorbeeld "lekker" of "smullen". Deze worden waren echter niet in de voorgaande

zinnen voorgekomen. Proefpersonen moesten zo snel mogelijk aangeven of het woord deel had uitgemaakt van de voorgaande zin of niet. In deze taak wordt ervan uitgegaan dat het langer duurt om het goede antwoord te geven (i.e., dat het woord niet in de voorafgaande zin stond) naarmate men bij het lezen van de zin sterker aan het woord moet denken. De resultaten van Studie 3.1 toonden aan dat lijners er langer over deden om aan te geven dat een lekker woord niet deel van de voorgaande zin had uitgemaakt als deze zin over lekker eten ging dan als de zin over neutraal eten ging. Bij niet-lijners trad dit verschil niet op. Dit geeft aan dat lijners, maar niet niet-lijners, spontaan aan "lekker" dachten als ze de zinnen met aantrekkelijk eten lazen. In Studie 3.2 werd hetzelfde effect aangetoond, maar met een andere, vergelijkbare taak.

Hoofdstuk 4 richt zich op de vraag of lijners na het waarnemen van lekker eten verhoogde aandacht hebben voor lekkere eet-stimuli in hun omgeving. Mensen hebben over het algemeen meer visuele aandacht voor stimuli die op een gegeven moment motivationeel relevant voor hun zijn. Zo kijken bijvoorbeeld rokers meer naar sigaretten en gerelateerde stimuli als zij trek hebben in een sigaret, en drugs-verslaafden hebben meer aandacht voor drugs-gerelateerde stimuli dan niet-verslaafden. Omdat lijners spontaan aan de hedonische kwaliteit van lekker eten denken als zij aan lekker eten zijn blootgesteld, verwachtten wij dat zij als gevolg hiervan meer aandacht zouden hebben voor eet-stimuli die zij hedonisch relevant vinden. Deze hypothese werd getoetst in twee studies.

Proefpersonen werden eerst op een onopvallende manier aan lekkere eet-woorden of aan niet-eet-gerelateerde woorden blootgesteld. Vervolgens werd de visuele aandacht voor lekkere eet-objecten gemeten in een computer-taak waarin men telkens moet reageren op een pijltje dat op het scherm verschijnt. Vóór het verschijnen van het pijltje verschijnen kort twee woorden op het scherm. Als het pijltje vervolgens verschijnt op dezelfde plek als het woord waar men langer naar bleef kijken, dan kan men sneller op het pijltje reageren dan als het op de plek van het andere woord verschijnt. Zo kan men aan de hand van de reactietijden in deze taak de visuele aandacht van proefpersonen voor de gepresenteerde woorden afleiden. Na deze taak werden proefpersonen nog gevraagd om aan te geven hoe lekker zij de verschillende eet-objecten vinden.

De resultaten van Studie 4.1 lieten zien dat lijners verhoogde visuele aandacht hebben voor lekkere eet-objecten naarmate ze deze lekkerder vinden, maar alleen als zij eerst onopvallend aan lekker eten zijn blootgesteld. Bij niet-lijners trad dit effect niet op.

Dit suggereert dat het blootstellen aan lekker eten bij lijners ervoor zorgt dat hun visuele aandacht wordt gestuurd door de hedonische gedachtes over eten, met als gevolg dat zij meer aandacht hebben voor stimuli die zijn hedonisch relevant vinden.

In Studie 4.2 werd dit effect gerepliceerd, maar werd er ook een uitbreiding toegevoegd om het onderliggende mechanisme van deze aandachts-bias te onderzoeken. Het doel-conflict model suggereert dat hedonische gedachtes over eten niet samengaan met het doel om te lijnen. Dit zou betekenen dat de hedonisch gestuurde aandacht voor lekker eten zou moeten verdwijnen als men lijners herinnert aan het doel om te lijnen. Om dit te onderzoeken, werd één groep proefpersonen tijdens het meten van de visuele aandacht heel kort blootgesteld aan woorden zoals dieet, lijnen en afvallen. Op deze manier werd het lijndoel weer geactiveerd. Zoals voorspeld, vertoonden de lijners onder deze omstandigheden geen verhoogde aandacht voor lekkere eet-objecten, hoewel zij eerst aan lekker eten waren blootgesteld. Dit suggereert dat de aandachts-bias voor lekker eten bij lijners daardoor ontstaat dat het lijndoel tijdelijk geïnhibeerd is.

Hoofdstuk 5 gaat in op de vraag of er ook succesvolle lijners bestaan, en welke processen hierbij een rol spelen. Recent sociaal psychologisch onderzoek heeft namelijk laten zien dat mensen onder sommige omstandigheden aan hun lange-termijn doel denken als zij met een aantrekkelijke verleiding worden geconfronteerd. Zo werd bijvoorbeeld gevonden dat lijners die kort aan lekkere eet-objecten werden blootgesteld spontaan aan hun lijn-doel dachten, maar alleen als ze succesvol waren in hun lijnpogingen. In eerste instantie lijkt dit de aannames van het doel-conflict model tegen te spreken, dat juist suggereert dat lijners hun lijdoel inhiberen als zij lekker eten waarnemen. In Studie 5.1 werd daarom onderzocht hoe deze effecten zich tot elkaar verhouden. Proefpersonen werden heel kort aan lekkere eet-objecten blootgesteld en vervolgens werd de toegankelijkheid van het lijn-doel gemeten in een lexicale beslissingstaak. Hierin moeten mensen heel snel aangeven of een gepresenteerd woord een bestaand Nederlands woord is of niet. De reactiesnelheid in deze taak wordt als maat gebruikt voor de toegankelijkheid van de gepresenteerde woorden in het geheugen. De resultaten van Studie 5.1 lieten zien dat bij succesvolle lijners het lijndoel verhoogd toegankelijk was na het waarnemen van een lekker eet-object, terwijl het lijndoel bij niet-succesvolle lijners juist minder toegankelijk werd. Succesvolle lijners activeren dus hun lijn-doel in een verleidelijke situatie, terwijl niet-succesvolle lijners het lijn-doel inhiberen.

In Studie 5.2 werden deze bevindingen gerelateerd aan daadwerkelijk lijn-gedrag. Wij vroegen deelnemers naar hun lijn-intenties voor de volgende twee weken, en twee weken later vroegen wij hun naar hun daadwerkelijk lijngedrag in die tijd. Zo als voorspeld, leefden succesvolle lijners hun lijn-intenties goed na. Bij niet-succesvolle lijners echter was er geen samenhang tussen hun intenties en hun gedrag. Dit zou ermee te maken kunnen hebben dat succesvolle lijners aan hun lijn-doel denken als zij met verleidelijk eten worden geconfronteerd, terwijl niet-succesvolle lijners de neiging hebben om hun lijn-doel te inhiberen als zij lekker eten zien. Omdat dit doel dan cognitief niet beschikbaar is om het gedrag aan te sturen, zou dit proces er dus voor kunnen zorgen dat zij bepaalde dingen toch gaan eten, ook al waren zij eigenlijk van plan om zich in te houden.

De uitkomsten van de studies uit dit proefschrift ondersteunen grotendeels het doel-conflict model dat in Hoofdstuk 2 werd gepresenteerd en bieden nieuwe inzichten in de onderliggende processen die een rol spelen bij de regulatie van lijngedrag. Het feit dat lijners makkelijk gaan overeten als zij met aantrekkelijk eten worden geconfronteerd kan erdoor verklaard worden dat zij zich spontaan richten op de lekkere eigenschappen van het eten en daardoor het conflicterende lijndoel cognitief inhiberen. Als gevolg daarvan wordt het gedrag van lijners gestuurd door het doel om van lekker eten te genieten, en niet door het doel om te lijnen. Deze psychologische processen vinden buiten het bewustzijn om plaats en zijn daarom slechts moeilijk door bewuste intenties te reguleren. Door deze processen kunnen externe eet-gerelateerde cues interfereren met de zelf-regulatie processen van lijners. Op deze manier kunnen de bevindingen van dit proefschrift eerder onderzoek naar de zelfregulatie van lijners verklaren, maar ze zijn ook relevant om te begrijpen hoe mensen ook in andere domeinen hun gedrag aansturen en omgaan met aantrekkelijke verleidingen.

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CURRICULUM VITAE

Esther was born on February 5, 1980 in Bielefeld, Germany. After attending the Rudolf-Steiner-Schule for four years, she continued her education at the Ceciliengymnasium Bielefeld, graduating in 1999. The same year, she started her undergraduate studies at University College Utrecht, where she studied Sociology, Political Science, Psychology, and History. After a short but pleasant intermezzo at the University of California, Berkeley, Esther graduated summa cum laude in May 2002, and continued her studies in Social Psychology at Utrecht University. Esther obtained her MSc degree in September 2003 and then started her graduate work with Wolfgang Stroebe and Henk Aarts, which resulted in the present dissertation. Esther is currently working as a postdoctoral researcher and is affiliated with Maastricht University and Utrecht University.