Psychological Review
2013, Vol. 120, No. 1, 110–138

0033-295X/13/$12.00 DOI: 10.1037/a0030849

Why Most Dieters Fail but Some Succeed: A Goal Conflict Model of Eating Behavior

Wolfgang Stroebe
Utrecht University and University of Groningen

Guido M. van Koningsbruggen
VU University Amsterdam

Esther K. Papies and Henk Aarts
Utrecht University

Theories of eating regulation often attribute overweight to a malfunction of homeostatic regulation of body weight. With the goal conflict model of eating, we present a new perspective that attributes the difficulty of chronic dieters (i.e., restrained eaters) in regulating their food intake to a conflict between 2 incompatible goals—namely, eating enjoyment and weight control. This model explains the findings of previous research and provides novel insights into the psychological mechanism responsible for both dietary failure and success. According to this model, although chronic dieters are motivated to pursue their weight control goal, they often fail in food-rich environments because they are surrounded by palatable food cues that strongly prime the goal of eating enjoyment. Due to the incompatibility of the eating enjoyment goal and the weight control goal, such increase in the activation of the eating enjoyment goal results in (a) an inhibition of the cognitive representation of the weight control goal and (b) preferential processing of palatable food stimuli. Both these processes interfere with the effective pursuit of the weight control goal and facilitate unhealthy eating. However, there is a minority of restrained eaters for whom, most likely due to past success in exerting self-control, tasty high-calorie food has become associated with weight control thoughts. For them, exposure to palatable food increases the accessibility of the weight control goal, enabling them to control their body weight in food-rich environments. Evidence for these proposed psychological mechanisms is provided, and implications for interventions are discussed.

Keywords: dieting, self-regulation, restrained eating, goal conflict model of eating

That dieters often fail to control their weight is nearly a truism. Although more and more people are chronically dieting (Andreyeva, Long, Henderson, & Grode, 2010), obesity rates have more than doubled in the United States between 1980 and 2004 (C. L. Ogden et al., 2006). Even though dieters are often able to achieve substantial weight loss while actively dieting, most regain the lost weight in the years to follow (Mann et al., 2007; Powell, Calvin, & Calvin, 2007; Wing, 2004). However, there is suggestive evidence that not all dieters fail. Based on a U.S. representative sample, a recent study estimated that more than one out of every six U.S. adults who has ever been overweight or obese has accomplished weight loss of at least 10% for more than 1 year. These individuals reported that it had been on average of 14.8 years since they had weighed their maximum weight (Kraschnewski et al., 2010). Furthermore, studies of the 6,000 members of the National Weight Control Registry in the United States, who have on average lost 10% of their body weight and maintained this weight loss for at least 1 year, have identified strategies associated with successful weight control (Thomas, Bond, Hill, & Wing, 2011; Wing & Hill, 2001). But information about successful weight control techniques tells us little about the *psychological mechanisms* that enable these individuals to keep to their diet.

This article presents a recently developed theory of eating regulation and dieting, the goal conflict model of eating (e.g., Stroebe, 2008; Stroebe, Mensink, Aarts, Schut, & Kruglanski, 2008), to explain why most dieters fail but some succeed, and reports findings of a research program that has been conducted to assess the validity of this theory. In contrast to earlier theories of eating regulation, the goal conflict model does not focus on the importance of homeostatic regulation for the development of overweight and obesity but rather postulates that hedonic aspects (i.e., eating enjoyment) are the major determinants of dietary failure. It conceives of weight regulation as a self-control dilemma between two goals, the goal of eating enjoyment and the goal of weight control.

This article was published Online First December 10, 2012.

Wolfgang Stroebe, Department of Psychology, Utrecht University, Utrecht, the Netherlands, and Department of Social Psychology, University of Groningen, Groningen, the Netherlands; Guido M. van Koningsbruggen, Department of Communication Science, VU University Amsterdam, Amsterdam, the Netherlands; Esther K. Papies and Henk Aarts, Department of Psychology, Utrecht University.

Writing this article was supported by ZonMw Grant 121520001, VICI Grant 452-02-047, and VENI Grant 451-10-02 from the Netherlands Organization for Scientific Research.

Correspondence concerning this article should be addressed to Wolfgang Stroebe, Department of Psychology, Utrecht University, P.O. Box 80140, 3508 TC Utrecht, the Netherlands. E-mail: w.stroebe@uu.nl

Before we outline the goal conflict model of eating and discuss the empirical work driven by it, we first briefly review earlier research programs on human eating behavior and dieting to provide a proper background and to discuss a few issues that have not been clearly addressed and solved so far. Our review distinguishes three phases in theorizing about eating regulation that differ in the type of question they address as well as in their theoretical perspective. Phase 1 theories were theories of the determinants of overweight and obesity. They addressed the question why some people became overweight and others did not. They focused on how the eating regulation of overweight and obese individuals differed from that of normal weight individuals (psychosomatic theory; externality theory). Phase 2 theories focused on dieting and the question, why chronic dieters often failed in their attempts to achieve lasting weight loss (set-point theory; boundary model of eating). With the exception of set-point theory (e.g., Nisbett, 1972), these early theories conceive of weight problems as the result of a malfunction of the homeostatic regulation of body weight (Bruch, 1961; Herman & Polivy, 1984; Kaplan & Kaplan, 1957; Schachter, 1971). Our own theorizing about eating regulation, represented by the goal conflict model of eating, offers a theory of the third generation that provides novel insights into the psychological mechanism responsible for unsuccessful as well as successful weight control.

Phase 1: Theories of Overweight and Obesity

Psychological theories of overweight and obesity attribute the weight-control problems of overweight individuals to two related causes—namely, (1) a reduced responsiveness to internal hunger and satiation cues and (2) an increased responsiveness to cues unrelated to hunger and satiation. These theories differ, however, in the types of cues they consider important. Some focus on *internal* states and conceive of eating as determined by emotions (i.e., emotional eating; Bruch, 1961; Kaplan & Kaplan, 1957). Others consider eating as determined by *eating-related external* cues (i.e., external eating; Kaplan & Kaplan, 1957; Schachter, 1971).

Emotional Eating

In an influential theoretical article published in 1957, Kaplan and Kaplan expressed the then novel idea that obesity was not caused by a metabolic disorder but was the result of overeating. One reason why some people overeat according to Kaplan and Kaplan was that eating reduces fear or anxiety. Because fear and anxiety are negative drive states, behavior that reduces fear and anxiety results in drive reduction and is thus reinforced. Individuals who have learned that eating reduces fear or anxiety will therefore be motivated to eat whenever they experience fear or anxiety without feeling any "conscious increase in hunger or appetite" (Kaplan & Kaplan, 1957, p. 198).

Bruch (1961), a psychiatrist with a psychoanalytic background, offered an alternative explanation why emotions could induce overeating. She concluded from clinical observations that obese individuals were often unable to differentiate the sensation of hunger from other states of bodily arousal. She attributed this inability to childhood experiences, in particular to parents using food as expression of love or to pacify or reward rather than offering food in response to the child's nutritional needs. As a result, the child does not learn to recognize internal hunger signals or to distinguish hunger from other states of bodily arousal.

There have been two approaches to research on the association between negative emotions and obesity—namely, correlational and experimental. Whereas the correlational approach used measures assumed to identify individuals who have a tendency to overeat when emotional, experimental studies induced fear to assess whether obese or overweight individuals were more likely to overeat under high rather than low fear conditions.

Correlational studies. Based on the theoretical assumptions about the association between negative emotions and obesity developed by Kaplan and Kaplan (1957) and by Bruch (1961), a number of individual difference measures have been developed that are supposed to identify individuals who have a tendency "to overeat in response to negative emotions such as anxiety or irritability" (Van Strien et al., 2007, p. 106). Examples of scales that measure the self-reported tendency to eat when being emotional are the Emotional Eating Scale (Arnow, Kenardy, & Agras, 1995), the Emotional Overeating Questionnaire (Masheb & Grilo, 2006), and the Emotional Eating subscale of the Dutch Eating Behaviour Questionnaire (van Strien, 2005).

Findings of research on these kinds of individual differences in eating response to negative emotions are not very conclusive. Oliver, Wardle, and Gibson (2000) and O'Connor, Jones, Conner, McMillan, and Ferguson (2008) found that stressed emotional eaters had a higher calorie intake than unstressed emotional eaters or stressed nonemotional eaters, but other studies reported no support for the moderating role of emotional eating (Conner, Flitter, & Fetcher, 1999; Evers, de Ridder, & Adriaanse, 2009). The report of Evers et al. (2009) is particularly informative, because it is based on findings from four experiments with different emotional induction procedures. The dependent measure was the actual consumption of different food types. In all studies, self-reported emotional eaters did not increase food intake during emotional encounters in the laboratory, although the experimental manipulations had strong effects on the emotions experienced by the participants (see also Adriaanse, de Ridder, & Evers, 2011).

Experimental studies. Although the results of experimental studies have also not been quite consistent (for a detailed review, see Stroebe, 2008), there are two factors that distinguish studies that found anxiety or stress to induce overeating from studies that failed to find an effect—namely, *type of food offered* and *cue salience*. Tasty snack food such as peanuts (Pine, 1985), candy, or chocolate cookies (McKenna, 1972; Slochower, 1983) are more likely to trigger overeating than crackers (Abramson & Wunderlich, 1972; Schachter, Goldman, & Gordon, 1968) or "bland, practically tasteless, dry . . . greenish-gray Scotch shortbread" (McKenna, 1972, p. 314). However, even tasty food triggers overeating only when individuals are induced to focus on the taste of food (i.e., cue salience). Thus, anxiety or stress does induce overeating in overweight or obese individuals, but only when the food on offer is tasty *and* when individuals are induced to focus on the taste of food.

In summary then, the evidence for the hypothesized association between emotions and eating is mixed. Whereas the results of studies guided by the individual difference approach and based on normal weight individuals are overwhelmingly negative, the findings of experimental studies that compared the eating response of obese and normal weight individuals are mostly supportive. As we argue later, in our discussion of the boundary model and of the goal conflict model, emotional experiences can induce overeating under certain circumstances.

External Eating

The role of external eating-relevant cues in inducing overeating was first emphasized by Kaplan and Kaplan (1957) in their classic article. They suggested that overeating can be due to "a disturbance in hunger and appetite" (Kaplan & Kaplan, 1957, p. 197) as a consequence of appetite having become conditioned to nonnutritional factors that were consistently associated with eating. However, since Kaplan and Kaplan provided no empirical evidence for this assumption, the role of external factors in eating became most strongly associated with Schachter's (1971) externality theory. In developing his theory, Schachter was influenced by empirical evidence from two studies that seemed to indicate that overweight and obese individuals are insensitive to internal cues of hunger and satiation (Schachter et al., 1968; Stunkard & Koch, 1964). Stunkard and Koch (1964) had demonstrated that gastric motility was related to self-report of hunger in normal weight, but not overweight individuals. Furthermore, Schachter et al. (1968) found that feeding individuals with roast beef sandwiches before a taste test (i.e., preloading), in which they had to evaluate the taste of crackers, reduced cracker consumption among normal weight but not among overweight or obese individuals. Since the results of Schachter et al. (1968) also appeared to rule out emotional eating, Schachter (1971, p. 130) concluded "that eating by the obese seems unrelated to any internal, visceral state, but is determined by external, food-relevant cues such as the sight, smell, and taste of food." This assumption would explain why these individuals often overeat in food-rich environments. He suggested that the role of hypothalamic feeding centers in appetite regulation might be responsible for this difference.

In a series of innovative laboratory and field studies that assessed the impact of external, eating-relevant cues on eating behavior, Schachter and colleagues provided ample evidence that these factors played a greater role in the eating regulation of overweight than of normal weight individuals (e.g., Goldman, Jaffa, & Schachter, 1968; McArthur & Burstein, 1975; Nisbett, 1968; L. Ross, 1974; Schachter, 1971; Schachter & Friedman, 1974; Schachter et al., 1968; Schachter & Gross, 1968; Tom & Rucker, 1975; for a review, see Stroebe, 2008) and that the impact of these external cues was strengthened if their salience was increased (McArthur & Burstein, 1975; Ross, 1974; Schachter & Friedman, 1974; Slochower, 1983).

However, Schachter (e.g., Schachter & Friedman, 1974) then extended the theory suggesting a generalized external responsiveness of overweight individuals to external stimuli regardless of whether they were relevant to eating, and the empirical evidence did not support this. For example, Rodin, Slochower, and Fleming (1977) failed to find a correlation between degree of overweight and degree of external responsiveness as well as low intercorrelations between different measures of external responsiveness. Acknowledging these problems, Rodin (1981) denounced externality theory in an article entitled "Current Status of the Internal-External Hypothesis of Obesity: What Went Wrong?" Even though Rodin's critique applied mainly to the (over-)extended version of externality theory, readers appear to not have made this distinction and the article delivered a death blow to externality theory in general. The article gave the wrong answer to the rhetorical question about what went wrong with externality theory. What really went wrong was that the sound insight that individuals with weight control problems are overly responsive to external food-relevant cues was overextended to sensitivity to all external cues, food-relevant or not. It is this latter assumption that had not stood up to empirical tests.

Phase 2: Theories of Dieting

In contrast to Phase 1 theories, which addressed the question why some people became overweight and others did not, Phase 2 theories (set-point theory; boundary model of eating) focused on the question why chronic dieters failed in their attempts to achieve lasting weight loss.

Set-Point Theory

With his set-point theory, Nisbett (1972), a student of Schachter, greatly elaborated Schachter's (1971) hypothesis about the role of hypothalamic feeding centers in regulating appetite. According to set-point theory, an individual's weight is regulated by a set-point that differs individually and "hypothalamic feeding centers appear to adjust food intake so as to maintain fat stores at the 'set-point' level" (Nisbett, 1972, p. 435). The most important derivation of set-point theory is that the organism will defend its body weight against pressure to change. Because a person with an elevated set-point will be at great social pressure to reduce weight, increased responsiveness to eating-relevant external cues of obese individuals could be due to the fact that they are permanently hungry and to a decrease in metabolic rate. Thus, set-point theory would explain why people typically find it difficult to lose weight and why most individuals who have lost weight, regain it afterwards (e.g., Mann et al., 2007). However, evidence from longitudinal studies challenges the assumption that weight is tightly controlled (e.g., Willet et al., 1995). Furthermore, the fact that obesity rates have increased dramatically in practically all industrialized countries is also inconsistent with this assumption (e.g., C. L. Ogden et al., 2006).[1]

The Boundary Model of Eating

Although set-point theory did not prove to be a viable theory, it stimulated one of the most prolific and successful programs of eating research (for reviews, see Herman & Polivy, 1984, 2005, 2008). Herman, Polivy, and their colleagues reasoned that because it is people's attempts at weight control and the ensuing state of hunger rather than their (over-)weight that is responsible for their heightened responsiveness to external cues, one should use a measure of eating restraint rather than weight as predictor of overeating, even though these measures are often correlated. When Herman and Mack (1975) developed the Restraint Scale (RS) as a measure of the degree of self-imposed restriction of food intake, this measure (in the revised version of Herman, Polivy, Pliner, Threlkeld, & Munic, 1978) replaced obesity as the predictor of

[1] For an extensive critique of the set-point model, see Pinel et al. (2000).

overeating. The revised RS consists of two moderately correlated subscales, one measuring concern for dieting (e.g., How often are you dieting? How conscious are you of what you are eating?), and the other measuring weight fluctuation (e.g., In a typical week, how much does your weight fluctuate? What is your maximum weight gain within a week?).

It soon became obvious that dieters identified with the RS were more notable for their lapses than for their success in dieting (e.g., Herman & Mack, 1975; Herman & Polivy, 1980). Therefore, Herman, Polivy, and their colleagues abandoned the idea that the RS would identify dieters who were below their biological set-point (for a discussion, see Heatherton, Herman, Polivy, King, & McGree, 1988). They integrated the concept of restrained eating into their boundary model of eating that dominated eating research for the next few decades. According to this model, biological pressures work to maintain food intake within a certain range, demarcated by two boundaries, the "hunger boundary" at the lower end and the "satiety boundary" at the top. These boundaries indicate where the zone of biological indifference ends and zones of biologically determined aversion begin. Hunger pangs can be extremely unpleasant and so can be the feeling of being absolutely "stuffed."

The eating behavior of normal eaters[2] is guided by the internal cues reflected by these two boundaries. Normal eaters begin to eat when they are hungry and stop when they are satiated. Restrained eaters, however, impose a "diet boundary" within the zone of biological indifference, consisting of specific dieting rules that to achieve weight loss or at least prevent weight gain. Thus, whereas food intake of normal eaters is more or less automatically regulated by internal cues, eating behavior of restrained eaters is cognitively controlled and requires checking food intake against dieting rules. As a consequence the eating behavior of restrained eaters is at greater risk of being deregulated (e.g., under cognitive load), and they become less sensitive to bodily signals of hunger and satiation. Therefore, their zone of biological indifference becomes extended.

As long as restrained eaters are able and motivated to monitor their food intake, they are quite capable of keeping it below their diet boundary. However, if their ability or motivation to control their food intake is impaired, then the diet boundary no longer sets an upper limit for their intake and other factors might affect intake, such as social influence and palatability. Most of the early research testing the boundary model has focused on two factors that are likely to impair the motivation and ability of restrained eaters to control their food intake—namely, *emotional distress* and actual or perceived *dietary violation.* However, since emotional distress is only one factor impairing the cognitive resources needed for monitoring the diet boundary, other factors affecting cognitive resources (e.g., alcohol use) have also been studied (e.g., Polivy & Herman, 1976a, 1976b).

Eating restraint and emotional distress. The main difference between research on emotion from the perspective of the boundary model and earlier research on emotional eating is that the research reviewed in this section is based on the assumption that strong emotions induce overeating mainly in individuals who chronically try to restrict their food intake. This "emotion hypothesis" has typically been tested in experiments that compared the eating behavior of restrained and normal eaters under negative mood induction compared to eating without mood induction or even when positive mood had been induced. A variety of manipulations have been used to induce negative mood. Participants were stressed with the threat of shock (Heatherton, Herman, & Polivy, 1991; Herman & Polivy, 1975), task failure (Baucom & Aiken, 1981; Eldredge, 1993; Heatherton et al., 1991; Heatherton, Polivy, Herman, & Baumeister, 1993; Polivy & Herman, 1999; Ruderman, 1985; Stephens, Prentice-Dunn, & Spruill, 1994; Tanofsky-Kraff, Wilfley, & Spurrell, 2000), the anticipation of public speaking (Heatherton et al., 1991; Tanofsky-Kraff et al., 2000), interpersonal rejection (Tanofsky-Kraff et al., 2000), expecting blood samples to be taken (Bleau, 1996), watching unpleasant videos (Cools, Schotte, & McNally, 1992; Schotte, Cools, & McNally, 1990; Wardle & Beales, 1987), reading Velten-self-referent statements (Frost, Goolkasian, Ely, & Blanchard, 1982; Lowe & Maycock, 1988; Ridgway & Jefferey, 1998), remembering negative autobiographical experiences (Tuschen, Florin, & Baucke, 1993), Stroop tasks with forbidden food words (Mitchell & Epstein, 1996), or watching a sad film (Sheppard-Sawyer, McNally, & Harnden Fischer, 2000). Most of these studies used taste tests offering a variety of attractive test foods as dependent measures.

In most of these studies, induction of negative emotions increased eating among restrained eaters (e.g., Bleau, 1996 [16-year-old girls]; Cools et al., 1992; Frost et al., 1982; Heatherton et al., 1991 [task failure, anticipated speech]; Heatherton, Herman, & Polivy, 1992; Heatherton et al., 1993 [simple failure, failure with distraction]; Herman & Polivy, 1975; Polivy & Herman, 1999; Polivy, Herman, & McFarlane, 1994; Ruderman, 1983; Schotte et al., 1990; Tuschen et al., 1993; Tanofsky-Kraff et al., 2000 [interpersonal manipulation]; Wallis & Hetherington, 2004; Wardle & Beales, 1987 [Experiment 2]). However, there are also several experiments (or experimental conditions) that failed to observe an increase in eating among restrained eaters following induction of a distressing emotion (e.g., Eldredge, 1993; Heatherton et al., 1991 [physical threat condition]; Lowe & Maycock, 1988; Oliver et al., 2000; Ridgway & Jefferey, 1998; Rotenberg & Flood, 1999 [memory of sad events]; Sheppard-Sawyer et al., 2000; Stephens et al., 1994; Tanofsky-Kraff et al., 2000 [failure experience, anticipated speech threat]). Only one of these studies found distress to *reduce* eating among restrained eaters (Eldredge, 1993). This could have been due to the fact that participants had to respond to a body image scale before the taste test, which might have made body dissatisfaction highly salient. All other studies either found no effect or a difference in the right direction that did not reach acceptable levels of significance. Furthermore, most of the studies that failed to find an effect of emotion induction (Haynes, Lee, & Yeomans, 2003; Lowe & Maycock, 1988; Oliver et al., 2000; Rotenberg & Flood, 1999; Ridgway & Jefferey, 1988) did not use the Restraint Scale (RS) developed by Herman, Polivy, and their colleagues (e.g., Herman et al., 1978). One can therefore conclude that overall the evidence tends to support the assumption that emotional distress disinhibits eating among restrained eaters, at

[2] We use "normal eaters" to refer to individuals, who score low on the restraint scale, because the term "unrestrained eaters" is often misunderstood.

least when eating restraint is assessed with the RS to define restrained eaters (Heatherton et al., 1988).[3]

These findings are also consistent with an interpretation in terms of cognitive load. Coping with anxiety and stress requires cognitive resources and thus reduces the ability of restrained eaters to cognitively control their eating. This would also be consistent with the ego depletion model of Baumeister and colleagues (e.g., Baumeister, Bratslavsky, Muraven, & Tice, 1998). Support for this hypothesis comes from studies that show that putting restrained eaters under cognitive load results in overeating (Boon, Stroebe, Schut, & Ijtema, 2002; Lattimore & Caswell, 2004; Rutledge & Linen, 1998; Ward & Mann, 2000). The study of Lattimore and Caswell (2004) is particularly relevant, because they used a distracting and a nondistracting stressor task. Although both tasks produced the same amount of self-rated anxiety, only the distracting task resulted in overeating.

Eating restraint and dietary violations. The effect of *dietary violation* on food intake of restrained and normal eaters has typically been studied with a modification of the preload paradigm originally introduced by Schachter et al. (1968). Instead of using the preload to satiate participants with sandwiches, Herman and Mack (1975) preloaded half of their participants with very tasty, highly calorific and normally forbidden food (milk shake) and thus induced a violation of their diet boundary. Whereas the preload reduced ice cream consumption in a subsequent ice cream tasting test for normal eaters, it increased consumption among restrained eaters. Thus, restrained eaters were not merely insensitive to preloads (i.e., nonregulation) as in the study of Schachter et al. (1968); they even increased their ice cream consumption under preload condition (counterregulation).

Following Herman and Mack's (1975) study, the preload paradigm became very popular (Dritschel, Cooper, & Charnock, 1993; Herman, Polivy, & Esses, 1987; Hibscher & Herman, 1977; Jansen, Oosterlaan, Merckelbach, & Hout, 1988; Lowe, 1995; Lowe, Whitlow, & Bellwoar, 1991; Morgan & Jeffrey, 1999; J. Ogden & Wardle, 1991; Polivy, 1976; Polivy, Heatherton, & Herman, 1988; Polivy, Herman, Hackett, & Kuleshnyk, 1986; Rotenberg & Flood, 2000; Ruderman & Christensen, 1983; Spencer & Fremouw, 1979; van Strien, Cleven, & Schippers, 2000; Wardle & Beales, 1987; Westenhoefer, Broeckmann, Münch, & Pudel, 1994; Woody, Costanzo, Liefer, & Conger, 1981). A few of these studies replicated the original experimental paradigm (Dritschel et al., 1993; Herman et al., 1987; Hibscher & Herman, 1977; Jansen et al., 1988; Rotenberg & Flood, 2000; van Strien et al., 2000; Westenhoefer et al., 1994); others manipulated the perceived rather than the actual calorie content of the preload (Polivy, 1976; Spencer & Fremouw, 1979; Woody et al., 1981). It is interesting that preload effects could only be replicated in studies that used the RS to define restrained eaters. None of the studies that used other measures of eating restraint found a significant interaction between eating restraint and preload (e.g., Lowe & Kleifield, 1988; Morgan & Jeffrey, 1999; J. Ogden & Wardle, 1991; Wardle & Beales, 1987).

Since their first article on the boundary model in 1984, the boundary model has been substantially modified in the in the light of new empirical evidence (e.g., Herman & Polivy, 2005, 2008, 2011). For example, the fact 24-hr food-deprived individuals ate no more of unpalatable food that would have reduced their hunger than their nondeprived fellow participants (Kauffman, Herman, & Polivy, 1995) led to the notion "that hunger and satiety may not play as prominent a role in governing food intake as conventional wisdom assumes" (Herman & Polivy, 2005, p. 764). This can be seen as a major change, because in the original version of the model, it was supposedly hunger that made keeping to a dietary boundary difficult. With regard to the important distinction between normative external cues (environmental indicators of what or how much one should eat) and sensory external cues (properties of the food itself that determine the likelihood that it would be eaten), food palatability now plays a major role (Herman, Roth, & Polivy, 2003). Specifically, whereas normative cues such as portion size or the amount eaten by another person (i.e., social influence) indicate how much one should eat, palatability drives eating "not by indicating how much is appropriate to eat, but by asserting itself as a 'go' signal that overrides all other considerations, at least among vulnerable individuals"(Herman & Polivy, 2008, p. 726). How this "go signal" functions precisely to override dieting and health intentions (i.e., which psychological processes underlie these effects) has been subject to later research, which is described in the section on Phase 3 theories of eating and dieting behavior.

In 1984, Herman and Polivy attributed the tendency of restrained eaters to overeat on realization their dietary transgression to so-called "what-the-hell" cognitions. Having breached their dietary goals, dieters abandon all attempts at eating control and continue eating until they reach their satiation boundary. Although this explanation is intuitively plausible, it is inconsistent with quite a bit of evidence. First, no empirical support for "what-the-hell" cognitions could be found in studies that were specifically designed to test this assumption (French, 1992, Experiment 2; Jansen et al., 1988). Second, disinhibition effects have also been observed under conditions that did not involve transgression of the diet boundary, for example, after seeing or smelling tasty food or thinking about its taste and smell (e.g., Fedoroff, Polivy, & Herman, 1997, 2003; Jansen & van den Hout, 1991; Rogers & Hill, 1989; Shimizu & Wansink, 2011). Herman and Polivy (2011) later argued that this exposure to tempting food undermines the diet by making the prospect of eating more attractive and thus overwhelming the dieter's self-regulatory inhibition. This interpretation is consistent with the assumption of the goal conflict model of eating discussed later that the smell (or taste) of palatable food primes the eating enjoyment goal. We now turn to discussing the goal conflict model of eating behavior and the research supporting it, which specifies and tests the psychological mechanisms underlying these findings.

[3] Unlike other measures of eating restraint, such as the Three-Factor Eating Questionnaire (Stunkard & Messick, 1985) and the Dutch Eating Behavior Questionnaire (van Strien et al., 2007), the items of RS capture both restraint attempts and restraint failures. A factor analysis of Laessle, Tuschl, Kotthaus, and Pirke (1989) demonstrated that the RS—and particularly the Concern for Dieting subscale—is closely related to measures of disinhibition (Laessle et al., 1989).

Phase 3: The Conflict Between Weight Control and Eating Enjoyment—Toward a Goal Conflict Model of Eating Behavior

Why should the taste and smell of palatable food undermine the dieting intentions of chronic dieters? According to the goal conflict model of eating described below, the anticipated pleasure of eating tasty food often undermines the goal of weight control. This assumption would also explain why practically all successful empirical demonstrations of disinhibition effects in restrained eaters used ice cream or some other tasty food items[4] and why a preload study that manipulated the taste of ice cream found effects only with the good tasting ice cream (Woody et al., 1981).

Reward Mechanisms in Obesity and Eating Restraint

Although Ruderman (1986) already concluded that "the only variable that has consistently produced obese-normal differences in amount eaten is palatability" (p. 248), the importance of taste or food rewards as the major determinant of food intake has only recently been acknowledged by eating researchers (e.g., Lowe & Butryn, 2007; Pinel, Assanand, & Lehman, 2000; Stroebe, 2008). Pinel et al. (2000) postulated that "people are not driven to eat by declines in their energy resources below set-point. Rather, people are drawn to eat by the anticipated pleasure of eating" (p. 1109). Similarly, Lowe and Butryn (2007) proposed a distinction between homeostatic and hedonic eating, with homeostatic eating determined by energy deficits, and hedonic eating by palatability.

There is now a great deal of neuroscientific evidence demonstrating that in addition to the mechanisms through which hormonal regulators of hunger and satiety act on hypothalamic and brain stem circuitries to maintain energy homeostasis, brain reward systems also play an important role in regulating food intake (for reviews, see Berridge, Ho, Richard, & DeFiliceantonio, 2010; Kenny, 2011; Volkow, Wang, Fowler, & Telang, 2008). Human brain imaging studies using functional magnetic resonance imaging (fMRI) have demonstrated that food and food-related visual or olfactory cues can activate brain circuits known to be implicated in reward such as the orbitofrontal cortex, insula, amygdalae, hypothalamus, striatum, and midbrain regions including the ventral tegmental area and substantia nigra (Kenny, 2011). Whereas the orbitofrontal cortex and the amygdalae are thought to encode information related to the reward value of food, the insula is believed to process information related to the taste of food and its hedonic value (Kenny, 2011). The nucleus accumbens and striatum are assumed to regulate the motivational and incentive properties of food. They receive dopaminergic input from the ventral tegmental area and substantia nigra and play an important role in the rewarding effect of food stimuli (Berridge et al., 2010; Kenny, 2011).

Studies using fMRI have demonstrated that obese individuals show increased reactivity to high-calorie food cues as well as to the consumption of high-calorie food within brain regions assumed to mediate emotional and motivational response to food and to food cues (e.g., Stice, Spoor, Bohon, Veldhuizen, & Small, 2008; Stoeckel et al., 2008). These finding suggest that compared to lean individuals, obese individuals are more likely to direct their behavior toward eating palatable food, because they anticipate and experience greater pleasure or enjoyment from consuming palatable food. However, there is some evidence that weight gain can be associated with a reduction in striatal activation in response to palatable food, suggesting that weight increase might be associated with a decrease in the reward value of palatable food for obese individuals (Stice, Yokum, Blum, & Bohon, 2010). As there is also evidence that this association is a consequence of weight gain rather than a cause (Stice, Yokum, Burger, Epstein, & Small, 2011), it could reflect a down-regulation of neural activity involved in reward processing in response to prolonged and excessive activation of the reward system (Berridge et al., 2010). This would make overeating in the future to achieve the same level of reward experience more likely. Similar effects have been reported in studies of drug addiction (Volkow et al., 2008).

In normal eaters, the homeostatic and hedonic systems interact and the hedonic value of food is influenced by metabolic state (Berthoud, 2004, 2011; Kenny, 2011). Thus, the intensity of the activation of brain reward centers in response to high-calorie palatable food has been found to be far greater when individuals are hungry rather than well-fed (Goldstone et al., 2009). Furthermore, human participants who were treated with leptin to reduce appetite (Batterham et al., 2007) or who underwent gastric distention mimicking meal ingestion (Wang et al., 2008) showed reduced activity in reward-related brain regions.

A different pattern emerged in fMRI studies of restrained eaters (Coletta et al., 2009; Demos, Kelley, & Heatherton, 2011). In both studies, half of the participants were given a tasty milkshake before the fMRI session (45 min before in Coletta et al.'s, 2009, experiment, and directly before in Demos et al.'s, 2011, study). When shown pictures of highly palatable food, restrained eaters who had not been given a preload failed to show activation in areas implicated in the desire and expectation of rewards (Burger & Stice, 2011; Coletta et al., 2009). However, after some consumption of a tasty milkshake, palatable food stimuli resulted in greater activation of food reward centers in restrained than normal eaters (Coletta et al., 2009; Demos et al., 2011).[5] Thus, whereas satiation decreases the reward value of palatable food for normal eaters, it appears to increase it for restrained eaters who received a tasty preload. As we argue below, this pattern may not be due to satiation but to the fact that tasty preloads stimulate the eating enjoyment goal in restrained eaters (see Papies, Stroebe, & Aarts, 2007).

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[4] Of the 29 preload studies with restrained eaters included in the exhaustive review of Ouwens (2005), 16 used ice cream, and most of the others used cookies, candies, or nuts to measure food intake. Similarly, eight of the 19 studies of the impact of emotions on food intake employed ice cream, with most of the others using chocolate, cookies, or nuts.

[5] A study of identical twins who differed with regard to eating restraint failed to replicate these findings (Schur et al., 2012). Although exposure to fattening food stimuli elicited greater activation in the left amygdala, right thalamus, and occipital lobe of the restrained twins compared to their normal eater cotwins, the effect reversed after consumption of a milkshake. Restrained eaters showed less activation. This is inconsistent with the findings of Coletta et al. (2009) and Demos et al. (2011). However, in a separate experiment, consumption of a milkshake also failed to induce overeating in these restrained twins. Whereas this is consistent with their responses during the fMRI exams, it is inconsistent with the findings of studies on eating restraint and dietary violations. Another indication that these restrained eaters were in some way atypical is the fact that their body mass index was not significantly different from that of their normal eating cotwins.

Goals as Determinants of Behavior

The assumption that human behavior is goal-directed has a long history in psychology (for a review, see Gollwitzer & Moskowitz, 1996) from psychoanalysis (Freud, 1923/1962), behaviorism (e.g., Tolman, 1925), and German will psychology (Ach, 1905; Lewin, 1926) to theories of social behavior (e.g., Fishbein & Ajzen, 1975) and personality (e.g., Carver & Scheier, 1998, 2004). In psychological research, goals are defined as cognitive representations of desirable outcomes (e.g., Aarts & Elliot, 2012; Kruglanski, 1996). These goal representations are thought to originate from the human (or the brain's) capacity to predict and anticipate the outcomes of actions and the rewards they produce, and to control behavior such that rewarding outcomes are attained (Frith, Blakemore, & Wolpert, 2000; Gilbert & Wilson, 2007; Powers, 1973; Suddendorf & Corballis, 2007; Tolman, 1925). Thus, goals provide an advantage over controlling behavior when s–r links do not work or the stimuli are no longer present. As a general rule, individuals are more likely to pursue a goal when that goal is attainable and more attractive than the present state of affairs.

Goals do not exist in isolation but are part of knowledge structures of related goals. These knowledge structures are shaped by direct experience and other types of learning (Aarts & Dijksterhuis, 2003; Bargh & Ferguson, 2000; Kruglanski et al., 2002). Thus, the goal of weight control is related to other goals such as dieting, eating low-calorie meals, exercising, or achieving good looks and health. And the goal to enjoy good food may be related to other goals, such as visiting a restaurant, going to the kitchen, or simply opening the refrigerator and unwrapping a piece of cheese. These goals vary in abstractness, with, for example, eating low-calorie meals being fairly concrete and good health being quite abstract. Goal structures are organized hierarchically, and any goal can be broken down into subgoals that have to be reached in order to reach the higher level goal. Accordingly, setting a goal leads to activation of a number of associated behaviors lower in the hierarchy and ultimately prepares and controls motor programs to attain the goal (Carver & Scheier, 1981; Miller, Galanter, & Pribram, 1960; Gallistel, 1985; Powers, 1973; Vallacher & Wegner, 1987). In applying this notion to consumer behavior, Pieters, Baumgartner, and Allen (1995) distinguished three levels of goal-directed behavior, which they called the "what level," the "why level," and the "how level": "The 'what' level is the level at which goal pursuit is initially considered and it is the level at which a goal is set or an intention is formed" (Baumgartner & Pieters, 2008, p. 371). Goals above this basic level reflect the reasons, why the person wants to achieve this goal, whereas goals below the "what level" reflect the operational aspects of how the person intends to reach the focal goal.

The conceptualization of goals as cognitive representations implies that goals can vary in cognitive accessibility, that they can be primed by internal and external factors, and that this process can occur outside the conscious awareness of the individual. A great deal of work supports the assumption that goal priming can automatically affect goal setting and activate goal-directed behavior (for a review, see Custers & Aarts, 2005). For example, Holland, Hendriks, and Aarts (2005) exposed participants to the odor of an all-purpose cleaner without participants being aware of the presence of this scent. Nevertheless, the scent did not only increase the accessibility of the concept of cleaning but also the likelihood of listing cleaning in participants' desired plans of future home activities and actually cleaning up the environment (see also De Lange, Debets, Ruitenburg, & Holland, 2012). Also, Bargh, Gollwitzer, Lee-Chai, Barndollar, and Trötschel (2001) demonstrated that individuals primed with the desired goal of cooperation (by exposing them to words associated with this goal) were more cooperative in a subsequent resource dilemma task, providing evidence for goal priming effects on goal pursuit by exposure to semantic material.

Goals regulate behavior in two ways (Aarts, 2012): They guide the processing of relevant information to enhance the probability of engaging in goal-directed action, and they control attention to increase the probability that the goal will be kept in mind. With regard to the first process, there is evidence that goals can bias both the perception and the evaluation of goal-relevant objects. For example, based on the functional perception account as to the relation between motivation and size perception (Bruner, 1957), Veltkamp, Aarts, and Custers (2008) reported that thirsty participants perceived a glass of water as bigger than nonthirsty participants, but only if they had been reminded of the goal of drinking. Similarly, van Koningsbruggen, Stroebe, and Aarts (2011b) demonstrated that restrained eaters overestimated the size of a muffin, but only if the goal of eating enjoyment had been activated by exposing them to a palatable food prime beforehand. That goals affect the evaluation of goal-relevant objects has been demonstrated by Ferguson and Bargh (2004), who found that thirsty participants having the goal to drink evaluated goal-relevant objects (e.g., water) more positively than nonthirsty individuals. Similarly, Seibt, Häfner, and Deutsch (2007) showed that the desire to eat influenced the valence of food stimuli as well as spontaneous motivational tendencies toward them.

Effective goal pursuit requires a mechanism that keeps the representation of goals and of related information accessible until the goal is reached or alternatively, until the individual succeeded in disengaging from the goal. This is especially important when the goal-relevant information is no longer externally present. The Zeigarnik (1927) effect is a well-known illustration of this phenomenon. Successful goal pursuit also requires that individuals shield the goal from information that interferes with goal-directed attention and action. For example, in the area of stereotyping, Moskowitz, Gollwitzer, Wasel, and Schaal (1999) demonstrated that people who have egalitarian goals inhibit derogatory stereotypical traits upon exposure to stereotyped groups (see also Danner, Aarts, Papies, & deVries, 2011).

Given that goals can be primed unconsciously, one may wonder how people manage to pursue highly valued goals in the face of competing attractive alternative goals. In his analysis of how organisms manage multiple action systems, Shallice (1972) suggested that only one action system can be dominant at any given time. Usually the action system that is highly activated will be translated into action. If two action systems are activated, the one with the highest priority inhibits the activation level of the other. This inhibition can be applied automatically and without conscious awareness as a result of practice and habitualization (Shah, Friedman, & Kruglanski, 2002).

The Goal Conflict Model of Eating

The goal conflict model represents an application of theories that deal with the goal-oriented control of human action to the area of eating behavior. Specifically, by interpreting the difficulty of restrained eaters in resisting the temptation of tasty food as a goal conflict, the goal conflict model of eating builds on two important theoretical approaches, namely self-regulation theories (e.g., Carver & Scheier, 1998; Vohs & Baumeister, 2011) and goal theories (e.g., Aarts, 2012; Gollwitzer & Moskowitz, 1996; Kruglanski et al., 2002). These theories have flourished over the last decade or so by applying and adapting insights and methods from cognitive science to further the understanding and examination of the cognitive processes underlying human goal pursuit and effective self-regulation, particularly in social contexts. Accordingly, these recent advances in the study on self-regulation and goal pursuit do not only offer new insights into the difficulties restrained eaters have in keeping to their diet, they also facilitated the application of new methods to study eating behavior. According to the goal conflict model the difficulty restrained eaters experience in controlling their weight is not due to some malfunction of the homeostatic regulation of their food intake, but to the fact that they are very responsive to the anticipated enjoyment of eating food they find palatable (e.g., Veling, Aarts, & Papies, 2011).

Figure 1 summarizes the main assumptions of the goal conflict model: The eating behavior of restrained eaters is determined by two conflicting goals: the goal of eating enjoyment and the goal of weight control. Weight control (reaching and maintaining a target weight) is the focal goal for restrained eaters, a goal that is associated with highly valued but long-term consequences. The goal of eating enjoyment refers to people's tendency to anticipate or represent the experienced enjoyment they would have if they would eat specific (palatable) food. Activation of the eating enjoyment goal in dieters results from endured exposure to palatable food. Because restraint eaters are highly responsive to the eating enjoyment goal, and because this goal is in conflict with their weight control goal, activation of the eating enjoyment goal may inhibit the weight control goal and consequently lead to diet violation and unhealthy eating. Extended priming of weight control leads to the inhibition of the eating enjoyment goal (and to healthy eating). Whereas the goal of eating enjoyment is primed by cues signaling palatable food, the goal of weight control is primed by dieting cues (e.g., a reflection of one's bulging stomach, trousers that have become too tight, or weight or calorie information).

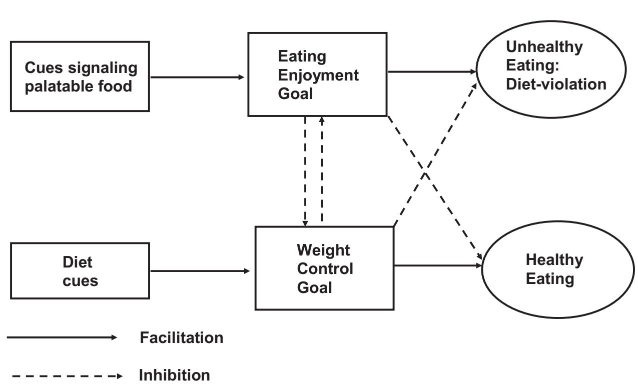

Figure 1. Schematic illustration of the goal conflict model of eating behavior used to explain the eating behavior of restrained eaters. Diet cues prime the weight control goal and lead to healthy eating by inhibiting the conflicting eating enjoyment goal and unhealthy eating responses. In contrast, palatable food cues (that are more prevalent than dieting cues in food-rich environments) prime the eating enjoyment goal and lead to unhealthy eating by inhibiting the weight control goal and healthy eating responses.

Before moving on, we would like to clarify the key concepts of our goal conflict model: First, the eating enjoyment goal does not imply that chronic dieters are gourmands in permanent search of good food to eat; rather, they are chronic dieters who try to restrict their intake, but at the same time are sensitive to anticipate the enjoyment they would have from eating palatable food they are extensively exposed to. Second, we use the term weight control goal rather than dieting goal, because dieting implies trying to lose weight and not all restrained eaters are currently trying to lose weight (e.g., Lowe, 1993), but may merely be trying to avoid weight gain. The concept "weight control" and "diet boundary" (Herman & Polivy, 1984) are in so far closely related, as both emphasize the importance of weight control for restrained eaters. Although we assume that weight control is a desired goal for many restrained eaters, it may be pursued in order to achieve higher order goals (e.g., improving their looks or health). Whatever the higher order goals are, weight control is likely to be central to restrained eaters and under their behavioral control. Third, with respect to the conflict of eating enjoyment and weight control: For individuals who enjoy grilled fish and salads, the goals of eating enjoyment and weight control would not be incompatible. However, for people who like hamburgers, pizza, and chocolate these two goals are incompatible in the sense that the pursuit of eating enjoyment increases weight, whereas the pursuit of weight control prevents them from enjoying favorite foods. Restrained eaters tend to belong to that second category. In fact, most people do, given our evolutionary predisposition to like sweet, fatty foods (Pinel et al., 2000).

The importance of environmental factors as determinant of individuals' ability to resist temptation has already been demonstrated by Mischel and colleagues in their research on delay of gratification in children (e.g., Metcalfe & Mischel, 1999; Mischel & Ayduk, 2004; Mischel, Shoda, & Rodriguez, 1989). However, even though very subtle reminders of food or eating behavior can trigger associative processes that activate the goal of eating enjoyment outside of our conscious awareness (Kavanagh, Andrade, & May, 2005), it is relatively easy to maintain weight control as the dominant goal in environments that are devoid of food stimuli (e.g., workplace, church). Unfortunately, at least for restrained eaters, most of us live in food-rich environments. Once we leave the relative safety of our workplace, we are likely to be surrounded by stimuli signaling palatable food (e.g., shop window of a delicatessen, advertisement for ice cream, delicious food smells wafting from a restaurant). Thus, the focal goal of weight control will be challenged by cues priming an incompatible eating enjoyment goal.

In such food-rich environments, pursuit of the weight control goal as a self-regulation process requires more cognitive resources than the pursuit of eating enjoyment. In order to continue pursuing the focal goal of weight control, restrained eaters need to focus their attention on this goal. Continued exposure to palatable food primes makes this more and more difficult for two reasons: First, due to its conflicting nature, increasing the cognitive accessibility of the eating enjoyment goal decreases the accessibility of the (incompatible) weight control goal. Second, the intrusive thoughts about eating enjoyment tax working memory capacity of restrained eaters (Green, Elliman, & Rogers, 1997; Kemps, Tiggeman, & Marshall, 2005) and further impair their ability to focus their attention on eating control (e.g., Barrett, Tugade, & Engle, 2004; Hofmann, Geschwender, Friese, Wiers, & Schmitt, 2008). Ultimately, the goal of weight control might be inhibited because of its interference with the selection and subsequent production of eating enjoyment goal-responses, rendering the goal of eating enjoyment more focal (e.g., Norman & Shallice, 1986; Stroebe et al., 2008).

Understanding Earlier Research Findings in the Context of the Goal Conflict Model

Before we review the novel evidence generated by the goal conflict model, we discuss how our model deals with the findings of research conducted in Phase 1 and 2 programs, which it builds on. As long as restrained eaters are in environments that are devoid of food stimuli, maintaining eating control as focal goal requires little motivational or cognitive resources. The findings of Goldman et al. (1968) that the more time religious Jews who were overweight spent on Yom Kippur (a religious day of fasting) in synagogue and thus away from tempting food stimuli, the less unpleasant they experienced fasting, are consistent with the goal conflict model. Although restrained eaters may experience intrusive thoughts about palatable food even in environments that are devoid of food stimuli (e.g., Kavanagh et al., 2005), their problems are greatly exacerbated in food-rich environments. Thus, once restrained eaters leave the safe havens of foodless environments and are exposed to stimuli that signal or reflect palatable food, focusing on their weight control goal rather than food temptations is likely to become more effortful. Our model would therefore predict that all factors that impair the ability of restrained eaters to focus on their weight control goal in situations where palatable food is available should facilitate overeating. Since coping with strong emotions, whether negative or positive, requires cognitive resources (e.g., Muraven, Tice, & Baumeister, 1998; Richards & Gross, 2000; Vohs & Heatherton, 2000), the findings that restrained eaters tend to overeat in such situations (reported in our discussion of the boundary model) are consistent with the goal conflict model.

The model would further predict that manipulations that increase the accessibility of the eating enjoyment goal in restrained eaters should also facilitate overeating in situations, where highly palatable food is available. We would argue that the preload manipulation used in experimental tests of the boundary model to induce overeating in subsequent taste tests can be interpreted in terms of food-exposure triggering eating enjoyment (see Papies, Stroebe, & Aarts, 2009a). As mentioned before, practically all of these studies preloaded participants with tasty food, a manipulation likely to prime eating enjoyment in restrained eaters. This interpretation of the effect of preloads would also explain why mere exposure to tasty food, that did not have to be eaten, also induced overeating in subsequent taste tests (e.g., Fedoroff et al., 1997, 2003; Jansen & van den Hout, 1991; Rogers & Hill, 1989; Shimizu & Wansink, 2011; Stirling & Yeomans, 2004).

Our model also extends the theoretical basis of externality theory. As we pointed out in our discussion of externality theory, Schachter (1971) offered no *psychological* explanation for his prediction that food consumption of overweight and obese individuals would be more strongly influenced by eating-relevant external cues than that of normal weight individuals. If one assumes that a substantial proportion of his overweight and obese participants were restrained eaters, the fact that eating-relevant external cues used in their research (e.g., taste, cue salience) activated the eating enjoyment goal offers a plausible theoretical explanation for findings of Schachter and his research group.

Our model is also consistent with more recent findings of Hofmann and colleagues (e.g., Friese, Hofmann, & Wänke, 2008; Hofmann, Friese, & Roefs, 2009; Hofmann, Rauch, & Gawronski, 2007). In their research, individuals' attitudes toward eating palatable but calorific food (mostly sweets) were assessed with explicit as well as implicit attitude measures. Subsequently participants whose cognitive or motivational resources were impaired (e.g., through alcohol or ego depletion) or not impaired had to evaluate these food items in the context of a (fake) taste test. The dependent measure in this research was the amount of palatable food consumed. These authors found consistently that explicit measures, such as participants' intentions to diet, predicted consumption when control resources were available to regulate the pursuit of the goal of dieting. When resources were low, however, implicit measures of the hedonic relevance of the food stimuli were better predictors of consumption.

As one would expect for individuals experiencing a goal conflict with regard to palatable food, the attitudes of restrained eaters toward palatable food are highly ambivalent (Papies, Stroebe, & Aarts, 2009b; Stroebe et al., 2008). They *like* tasty, high-calorie food, but they also *know* what enjoying it would do to their weight control. Since the impairment of participants' self-regulatory resources before a taste test should weaken the influence of conscious cognitions on eating, our model would be consistent with the finding that in the impairment conditions implicit measures and without impairment explicit measures were better predictors of food consumption. We would attribute these effects to the impact the impairment of self-regulatory resources had on restrained eaters and would predict an interaction between impairment of these resources and eating restraint. However, this hypothesis still awaits direct tests, as in earlier studies it was not examined whether the effect of impairment was moderated by the degree of eating restraint of their participants (Hofmann et al., 2009).

Testing Novel Predictions Derived From the Goal Conflict Model of Eating

We propose that exposure to palatable food sets into motion a cascade of processes in restrained eaters that ultimately causes them to pursue the goal of eating enjoyment and facilitate overeating: (1) Enduring exposure to palatable food cues increases the accessibility of the eating enjoyment goal. (2) Due to the incompatibility of the eating enjoyment and weight control goals for restrained eaters, the enhanced accessibility of the eating enjoyment goal is likely to inhibit access to the mental representation of the weight control goal. (3) Once eating enjoyment has become highly accessible, the palatable, high-calorie food will "grab" and "hold" the attention of restrained eaters. This will interfere with the pursuit of the weight control goal by pulling away from its limited regulatory resources. (4) If attention is continuously allocated to the affective information and no regulatory process is recruited, iterative hedonic processing will lead to maintenance and even amplification of hedonic responses. (5) As a result, unhealthy eating will be facilitated, and healthy eating will be inhibited. In the following section, we review research that has been conducted to test these predictions of the goal conflict model of eating.

Increased accessibility of the eating enjoyment goal. The hypothesis that exposure to palatable food increases the accessibility of the eating enjoyment goal in restrained eaters was tested in two studies (Papies et al., 2007). Following research on examining effects of goal priming on access to goal-related knowledge structures (e.g., Aarts & Dijksterhuis, 2000; Moskowitz, 2002), Papies et al. (2007) used the accessibility of hedonic food-related concepts as an indication of the accessibility of the goal of eating enjoyment. They assessed restrained eating with the Concern for Dieting subscale of the Dutch translation (Jansen et al., 1988) of the Revised RS of Herman and Polivy (1980). Unlike the weight fluctuation subscale, concern for dieting is a direct measure of individuals' motivation to diet and thus the most proximal indicator of the goal of weight control.

Experiment 1 used the probe recognition task developed by McKoon and Ratcliff (1986). This task assesses the spontaneous activation of specific concepts during text comprehension, including goal concepts (Hassin, Aarts, & Ferguson, 2005). Participants are presented with sentences, which are immediately followed by a probe word. Their task is to decide as quickly as possible whether the probe word was part of the sentence. The critical sentences in this study were six sentences describing an actor as eating palatable (e.g., "Bill is eating a piece of apple pie") or neutral food (e.g., "Bill is eating a piece of rye bread") and six sentences involving the same palatable or neutral food items, but with an eating-unrelated behavior (e.g., "Bill is giving away a piece of apple pie/rye bread"). These sentences were immediately followed by a hedonic probe word that had *not* been part of the sentence (e.g., "tasty," "appetizing"). In filler control trials, participants were, among others, presented with eating-related and eating-unrelated sentences followed by probe words that had been part of the sentence. If exposure to palatable food triggers hedonic thoughts about the tastiness of that food in restrained but not in normal eaters, restrained eaters should be slower in deciding that a hedonic probe was not part of a sentence. Supporting this assumption, restrained eaters responded more slowly to hedonic food words if they followed palatable rather than neutral food sentences, whereas there was no difference in response time for normal eaters. Whether the behavior description involved eating or an eating-unrelated behavior made no difference, suggesting that it is the palatability of the food and not the perception of eating behavior, which triggers hedonic thoughts and activates the eating enjoyment goal.

These findings were replicated in a second study in which they used a rapid serial visual presentation procedure (Long & Golding, 1992) with the behavior description appearing on the screen one word at a time at a rapid pace. After the final word, a lexical decision target was presented to assess the accessibility of the concept in question, in the case of the present study, eating-related hedonic words. Following previous work of this kind, it was assumed that the speed of recognizing the words as meaningful in this task would reflect the relative accessibility of goal concepts (e.g., Aarts & Dijksterhuis, 2003; Hassin et al., 2005; Neely, 1991). Using the same experimental sentences and hedonic probe words as in the first study, the dependent variable was participants' average response latency for indicating that the hedonic target words were existing words. Consistent with the hypothesis and the results of the first study, restrained eaters responded faster to hedonic words following sentences referring to palatable rather than neutral food words. The response latencies of normal eaters did not differ between sentences with palatable compared to neutral food. Thus, the findings of both studies support the hypothesis that exposure to palatable food stimuli activates the eating enjoyment goal (as measured by the accessibility of hedonic thoughts) in restrained but not in normal eaters.

Eating enjoyment and the inhibition of the weight control goal. Because the eating enjoyment and weight control goals are incompatible for restrained eaters who typically enjoy high-calorie food, the activation of the eating enjoyment goal should result in an inhibition of the weight control goal. This hypothesis was tested in two experiments by Stroebe et al. (2008). In the first study, participants were subliminally primed with the same words that had been used as hedonic probes by Papies et al. (2007). Participants in the control condition were primed with neutral words. The cognitive accessibility of the weight control goal was assessed with a lexical decision task after each prime. The words used to represent the goal concept of weight control were slim, weight-loss, weight, diet, and dieting. Consistent with predictions from the goal conflict model, the mean reaction times of restrained eaters to the five weight control targets was higher if they had been primed with hedonic eating-relevant words than with neutral primes. For normal eaters, response times to weight control targets were not affected by the type of prime (see Figure 2).

To test whether exposure to words describing palatable food would result in the same type of inhibition of weight control concepts as words that directly referred to eating enjoyment, Stroebe et al. (2008) repeated the first experiment using two types of eating enjoyment primes, namely five words reflecting hedonic responses to palatable food and five words referring to palatable

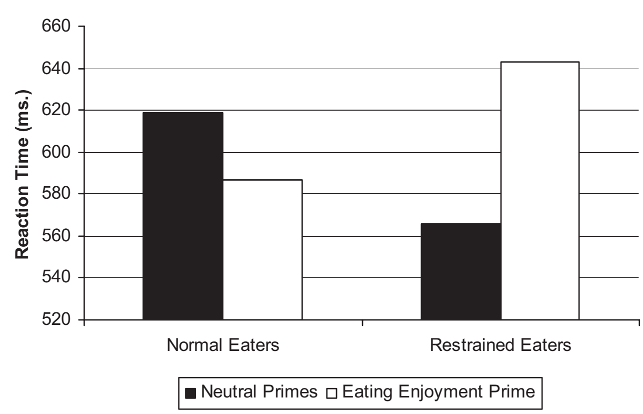

Figure 2. Mean reaction time to diet targets of restrained and normal eaters primed with eating enjoyment or neutral words. Adapted from "Why Dieters Fail: Testing the Goal Conflict Model of Eating," by W. Stroebe, W. Mensink, H. Aarts, H. Schut, and A. W. Kruglanski, 2008, *Journal of Experimental Social Psychology, 44,* p. 31. Copyright 2008 by Elsevier.

food (crisps, French fries, chocolate, pancakes, and ice cream). Eating enjoyment primes increased the response times of restrained but not of normal eaters to words related to weight control in the lexical decision task. Whether the eating enjoyment primes were words reflecting palatable food or eating-relevant hedonic responses did not make a difference. These findings support the second hypothesis that the increase in the cognitive accessibility of the eating enjoyment goal in response to exposure to palatable food results in an inhibition of the cognitive representation of the weight control goal.

Eating enjoyment and attentional bias. Research on substance dependent individuals has indicated that they display attentional bias to drug-related cues that in turn is associated with the subjective experience of drug craving. It is further assumed that attentional bias and craving are reciprocally related, with attention bias eliciting craving, while craving in turn triggers attention bias. Ultimately this process is assumed to result in self-administering of the drug (for reviews, see Field & Cox, 2008; Field, Munafo, & Franken, 2009). In view of the behavioral similarity between obesity and addiction, it has been suggested that obese individuals might also demonstrate enhanced attentional bias toward food-related stimuli and experience enhanced food cravings compared to normal-weight individuals (Nijs, Franken, & Muris, 2010). This attentional bias should impair their ability to process competing cues (e.g., dieting cues).

Unfortunately, research on attentional bias of obese compared to normal weight individuals has yielded inconsistent findings (Castellanos et al., 2009; Nijs, Franken, & Muris, 2010; Nijs, Muris, Euser, & Franken, 2010; Werthmann et al., 2011). While nearly all studies report greater attentional bias toward food than nonfood stimuli, findings with regard to differences between obese and normal weight individuals are mixed.

Nijs, Franken, and Muris (2010) reported that obese individuals reacted with greater P200 amplitudes than normal weight individuals to exposure to palatable food words in a Stroop task. The P200 amplitude is assumed to reflect automatic orienting toward stimuli. However, this pattern was not paralleled by other indicators of attentional bias such as the P300 of the electroencephalogram (EEG) or the Stroop color-naming reaction times. Both indices showed only a main effect, with responses to food-related words being slower than reaction times to neutral words.

The findings of three studies that tracked the eye movement of obese and normal weight individuals to pairs of food and nonfood images during a dot probe task were also inconsistent (Castellanos et al., 2009; Nijs, Muris, et al., 2010; Werthmann et al., 2011). During a dot probe task (e.g., MacLeod, Mathews, & Tata, 1986), participants are exposed to pairs of food and neutral pictures and requested to respond as fast as possible to a visual probe on the location of one of the pictures after they have disappeared. Reaction times are assumed to be faster if the visual probe replaces the picture (e.g., palatable food) that attention has already been drawn to. Although the speed of behavioral responses to the dot probes in dot probe tasks using a short time span after which the probe appears does not allow one to distinguish clearly between gaze orientation (i.e., grabbing attention) and gaze duration (i.e., holding attention), eye movement tracking allows such a distinction. Whereas the studies of Castellanos et al. (2009) and Nijs, Muris, et al. (2010) assessed attentional bias in obese and normal weight individuals, who were either food-deprived or satiated, Werthmann et al. (2011) neither manipulated nor measured levels of food deprivation.

In the study by Castellanos et al. (2009), the eye-movement data showed evidence of attentional bias both for gaze direction and gaze duration for food pictures for normal weight as well as obese participants. However, whereas normal weight individuals displayed these biases only when hungry, the obese also did after they had eaten a meal. There was no evidence of attentional bias in the behavioral response to the dot probes in dot-probe task. In contrast, Nijs, Muris, et al. (2010) found no difference in gaze direction or duration between weight groups either when hungry or when satiated, even though they replicated the finding that independent of weight or level of satiation there was an attentional bias toward food compared to nonfood pictures. However, Nijs, Franken, and Muris (2010) found attentional bias in the behavioral response to the dot probes in the dot probe task with hungry participants and obese participants showing an attentional shift toward food, although the difference for weight groups was only marginal. Finally, Werthmann et al. (2011) found that compared to normal weight participants, overweight individuals directed their first fixation more often to food than nonfood images, but there were no differences between these groups in gaze duration or in the dot probe response.

The association between attentional bias and craving has been demonstrated with chocolate craving in two studies using the dot-probe task (Kemps & Tiggemann, 2009). Participants were habitual chocolate cravers and noncravers. In the critical trials, one of the two pictures in the dot-probe task was a chocolate-containing food item, the other a picture of a palatable food item that did not contain chocolate (e.g., pizza). If the chocolate pictures grabbed the attention of these chocolate cravers, they should respond faster when the probe replaced the chocolate rather than the nonchocolate picture. In support of this hypothesis, chocolate cravers responded much faster in the trials where the probe appeared in the position of the picture of a chocolate-containing food item. For the noncravers, there was no difference in response times. Even more interesting, the same pattern emerged when Kemps and Tiggeman (2009) manipulated chocolate craving by asking half of their participants not to eat chocolate for 24 hr before the study and then exposing them to their favorite chocolate bar while they had to perform the dot probe task. These participants did not only report significantly higher chocolate craving, they also displayed the same pattern of reaction times in the dot-probe task.

The implicit assumption underlying these studies is that the focal goal of obese individuals or of people who habitually crave chocolate is enjoyment of palatable food in general or chocolate in particular. In contrast, the focal goal of restrained eaters, who participate in an experiment, is likely to be weight control. The fact that the overweight and obese participants in these studies had significantly higher restraint scores than normal weight individuals (e.g., Castellanos et al., 2009; Nijs, Muris, et al., 2010) suggests that a substantial proportion of these overweight and obese individuals were restrained eaters. This could have been responsible for some of these inconsistencies, because restrained eaters are unlikely to display attentional bias toward, or craving for, palatable food unless their eating enjoyment goal has been activated (i.e., "switched on").

In two studies designed to assess attentional bias toward food cues in restrained eaters, Papies, Stroebe, and Aarts (2008a) therefore manipulated the accessibility of the eating enjoyment goal by priming (exposure condition) half their participants with food words. This was done with a lexical decision task, where the word-targets were food words for half of the participants, but were nonfood words for the other half. Attentional bias was measured with the dot probe paradigm of MacLeod et al. (1986). On half of the critical trials, the probe appeared in the same location as the food word (e.g., pizza; congruent trials); in the other half, it appeared in the location of a matched, nonfood word (e.g., pencil; incongruent trials). Attentional bias in gaze direction toward food words is indicated by faster response times on congruent than on incongruent trials. Finally, they assessed participants' liking of the food items. Consistent with their hypothesis, restrained eaters attention was biased toward palatable food words as a function of their liking of the food, but only after exposure to food words in the first phase of the experiment. Without exposure to food words, there was no evidence of attentional bias, presumably because the eating enjoyment goal had not been triggered in restrained eaters to guide their visual attention to hedonically relevant stimuli. For normal eaters, food exposure had no effect. They showed no evidence for attentional bias under either condition.

Thus, exposure to food words appears to have disturbed the balance between the goals of eating enjoyment and weight control. Exposure to words representing palatable food was assumed to increase the accessibility of the eating enjoyment goal that resulted in inhibited access to the weight control goal. As a consequence, the weight control goal is less likely to curb the hedonic influence on attention to palatable food, and subsequent processing is guided by the goal of eating enjoyment rather than weight control.

If this interpretation were valid, then reestablishing the weight control goal after exposure to palatable food cues should prevent the attentional bias. Papies et al. (2008a) tested this assumption in a second experiment in which they subliminally primed half the participants with dieting words, after they had been exposed to food words. The other half were primed with neutral words. The priming was incorporated into the visual probe task. The task, which was used to assess visual attention for food, was the same as in Study 1, except that the fixation point that preceded the word pairs was replaced by two different letter strings with the diet-related prime words or control primes interspersed between them. In the control prime condition, the measure of attentional bias replicated the findings of the first experiment: Again, restrained eaters (but not normal eaters) displayed an attentional bias to food words after exposure to food words. However, restrained eaters who were subtly primed with diet-related words during the attention task displayed no evidence of attentional bias, even though they had been preexposed to attractive food in the first phase of the experiment. These findings suggest that their priming manipulation served to reinstate the weight control goal and thus to reestablish dieting as the dominant goal. As a result, the visual attention bias toward attractive food disappeared.

The findings of a study by Hollitt, Kemps, Tiggemann, Smeets, and Mills (2010) seemed to indicate attentional bias in restrained eaters, even without having been primed with palatable food primes. Attentional bias was assessed with a visual search task that required participants to locate the position of an odd-one-out target word within a matrix of neutral distractor words. Restrained eaters were significantly faster than normal eaters in detecting food word within a neutral matrix compared to a neutral word within a neutral distractor matrix. This finding was interpreted as indicating enhanced orientation toward food stimuli among restrained eaters. However, contrary to expectations, restrained eaters were also faster in detecting a neutral word within a matrix of food words compared to a neutral word within a neutral distractor matrix. If restrained eaters had difficulties in disengaging from food stimuli, they should have been slower on this task than normal eaters. This pattern might suggest that restrained eaters are simply faster than normal eaters in identifying discrepant stimuli in an eating-related context.

Eating enjoyment, attentional bias, and the inability to disengage. Once the eating enjoyment goal has been activated in restrained eaters through exposure to palatable food stimuli, restrained eaters find it difficult to down-regulate their hedonic responses. This hypothesis has been tested by Hofmann, van Koningsbruggen, Stroebe, Ramanathan, and Aarts (2010) in a study that used a modified version of the Affect Misattribution Procedure (AMP) of Payne, Cheng, Govorum, and Stewart (2005). With the AMP, participants are first presented with a picture representing the attitude object (prime stimulus) and then with a Chinese pictograph (supposedly a Chinese letter). They are asked to rate the pleasantness of the pictograph and their ratings are assumed to reflect the (misattributed) affective response to the prime (i.e., attitude object) presented before (but see Blaison, Imhoff, Huhnel, Hess, & Banse, 2012). The prime stimuli in the present study were pictures of palatable food (e.g., pizza, chocolate, cake). Before the administration of the AMP, food-exposure was manipulated using a lexical decision task with food or neutral words (cf. Papies et al., 2008a).

To test whether once tempted, restrained eaters are less able to disengage and to put the temptation out of their mind, Hofmann et al. (2010) varied the interstimulus interval (ISI) between the prime and the pictograph. Half the participants performed the task with the usual ISI of 100 ms. For the other half, the ISI was 10 times as long (1,000 ms). If restrained eaters maintain the hedonic reactions activated by the palatable food primes longer than normal eaters, differences should emerge at the long ISI. Whereas food-exposure was manipulated between participants, the extension of the ISI was a within participant manipulation.

Figure 3 presents the findings of this study. Without food-exposure, the hedonic responses of normal eaters are more positive than those of restrained eaters suggesting greater liking for palatable food. This is what one would expect as long as the goal of weight control is focal for restrained eaters and the negative consequences of eating calorific food items are highly salient and therefore affect even their implicit evaluative responses. Following food-exposure, restrained and normal eaters displayed the same level of hedonic response at short ISI. However, whereas the hedonic response of normal eaters was down-regulated at the longer ISI, that of restrained eaters was not. Thus, once their eating enjoyment goal was "switched on" and consequently thoughts about dieting were inhibited, restrained eaters liked palatable food as much as did normal eaters. However, whereas normal eaters seem to be able to disengage easily, restrained eaters had difficulties in down-regulating their hedonic response and put the thoughts about the temptation out of their minds. Hofmann et al. (2010) found no deterioration in the hedonic responses of restrained eaters

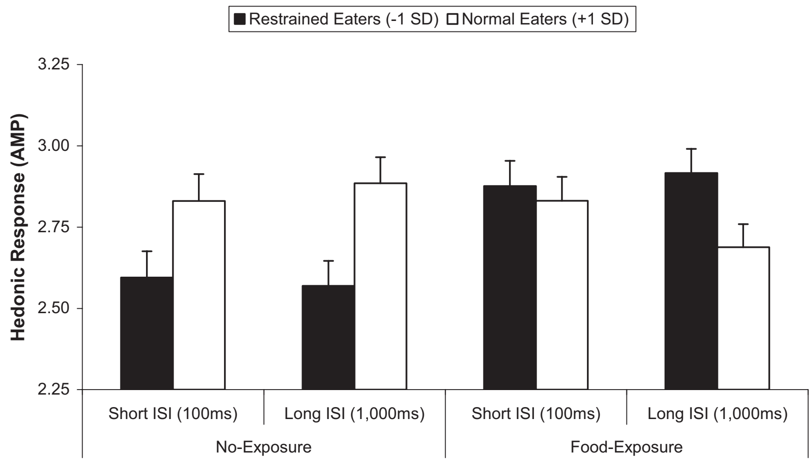

Figure 3. Hedonic responses to tempting food stimuli in the affect misattribution task as a function of food-exposure, length of interstimulus interval (ISI), and dietary restraint. AMP = Affect Misattribution Procedure. Error bars indicate the standard error of the mean. Adapted from "As Pleasure Unfolds: Hedonic Responses to Tempting Food," by W. Hofmann, G. M. van Koningsbruggen, W. Stroebe, S. Ramanathan, and H. Aarts, 2010, *Psychological Science, 21,* p. 1866. Copyright 2010 by Sage.

even after they extended the ISI to 1,500 ms in a second study. Thus, everybody likes palatable food, but whereas normal eaters can easily put temptations out of their minds, restrained eaters seem to be unable to disengage, once their eating enjoyment goal has been activated. As we mentioned earlier, this pattern is consistent with the assumption that goals remain activated until they are reached (or abandoned).

Food-exposure, eating enjoyment, and eating. Once eating enjoyment has become the dominant goal due to priming with palatable food items, restrained eaters persist in pursuing this goal. This has been demonstrated in a recent study of van Koningsbruggen, Stroebe, and Aarts (in press) that examined the impact of food-exposure on the incentive value of high-calorie versus low-calorie food for restrained eaters. They used an experimental task that had originally been developed by Goldfield and Epstein (2002), but modified by Giesen, Havermans, Nederkoorn, Strafaci, and Jansen (2009). Participants were first briefly exposed to either palatable food words or neutral words in a letter detection task before the experimental task. Thus, half of the participants were unobtrusively triggered with the goal of eating enjoyment. Next, all participants played a computer game, in which they could earn points for food by repeatedly making a choice between two food items displayed on the screen. The food items were M&Ms (the high-calorie, unhealthy option) and white grapes (the low-calorie, healthy option). Participants expected to receive the amount of food they had earned at the end of the session (10 points = 10 grams), and it would get harder to earn points for one of the two options as the task proceeded (the price for the unhealthy option was doubled with each round). Consistent with predictions, restrained eaters worked harder and harder for the unhealthy options for five lengthy rounds of the game, *but only* if their eating enjoyment goal had been activated through pre-exposure to tempting food cues.

However, even though the methods of cognitive psychology enable us to study the effects of exposure to palatable food on eating-relevant cognitive and motivational processes in restrained eaters, it needs ultimately to be demonstrated that food-exposure induces actual overeating among restrained eaters. Fortunately for the advancement of the science of eating behavior (but unfortunately for the obesity problem), ample evidence for such a relationship has been accumulated in the context of earlier research programs.

The first studies that assessed the effect of food-exposure on eating for restrained and normal eaters were conducted by Rogers and Hill (1989). In the food-exposure condition of Study 1, female participants were seated in front of a display of food (sandwiches and cream cakes) and were asked to "imagine as vividly as possible, any food you would like to eat at this moment" (p. 389). They were then asked to imagine that they were actually eating that food and to try "to imagine its taste and its texture . . . and the smell of the food" (Rogers & Hill, 1989, p. 389). Participants in the control condition were neither exposed to food nor did they have to imagine eating it. The dependent measure was the amount eaten in a subsequent taste test of five types of biscuits (e.g., milk chocolate digestives, custard creams, ginger nuts, and savory biscuits). For participants in the control group, biscuit consumption varied inversely with degree of dietary restraint ($r = -.55$). This reflects the greater self-imposed resistance to eating, that restrained eaters normally display. For participants in the food-exposure condition, the correlation was reversed ($r = .69$), with restrained eaters eating more than normal eaters. From the perspective of the goal conflict model, we would argue that without food-exposure, eating behavior was influenced by the eating control goal. In contrast, eating behavior following food-exposure was determined by the goal of eating enjoyment.

In Study 2, Rogers and Hill (1989) manipulated the palatability of the food to which participants were exposed before the taste test. Participants in the food-exposure conditions were either presented with food they liked or disliked and asked to imagine the smell and taste of that food. Participants in the control condition were not presented with any food. After that, participants in all three groups had to perform the same taste test as in the first experiment.

Whereas biscuit consumption following exposure to liked food was positively correlated with restraint ($r = .74$), the correlation between restraint and food intake was not significant for participants who had been exposed to disliked food, or had not been exposed to food at all. As Rogers and Hill concluded, "exposure to preferred food, but not to nonpreferred food, can induce restrained subjects to overeat" (p. 394). In terms of the goal conflict model, we would argue that only exposure to preferred food activates the eating enjoyment goal (Papies et al., 2008a).

The findings for exposure with tasty food items were replicated by Jansen and van den Hout (1991). Participants in their food-exposure condition were presented with dishes containing Dutch and English licorice, cakes, Smarties, nuts, and spice biscuits. They were instructed to hold the dishes under their noses and to concentrate on the smell of the food. They did not know that they could eat that food later. They then had to fill in a questionnaire on preferences concerning the food items they had been presented with. They were invited to eat as much of the food as they wanted. However, the questions were worded in a way that they could be responded to without trying the food. Participants in the no food-exposure control group waited in a neutral room that contained no food and were led into a room with the food afterwards, where they were asked to fill out the food preference questionnaire. Replicating the findings reported by Rogers and Hill (1989), food-exposure to palatable food items increased eating among restrained eaters. It also decreased consumption of normal eaters, but this decrease was not significant.

The most persuasive demonstration of the effects of food-exposure on the food consumption of restrained eaters comes from the pizza study of Fedoroff et al. (1997). In this study, two different methods of food-exposure were employed. In the "smell" condition, the smell of baking pizza wafted into the room in which participants filled in a number of questionnaires for 10 min. In the "pizza thought" condition, participants were asked to think about pizza for 10 min and to write down their thoughts on a piece of paper. In the "free thoughts" control condition, participants were instructed to think about whatever they wanted for 10 min and to write down their thoughts. After that, all participants were presented with slices of four freshly baked pizzas and asked to help themselves to the pizza pieces and to rate their taste on a number of rating scales. Consistent with the findings of earlier studies, both types of primes increased eating among restrained but not among normal eaters. There was also suggestive evidence that the effect of smell was somewhat greater than the effect of thought. Smelling pizza also increased craving for pizza and the desire to eat it among restrained eaters.

In a second study, Fedoroff et al. (2003) assessed whether food-exposure effects generalized across all palatable foods or were specific for the food categories tested. Participants in this study were either exposed to the smell of baking pizza or of baking chocolate cookies. In a subsequent taste test, they were offered a plate of freshly baked pizza or freshly baked chocolate cookies and were asked to evaluate the taste of these food items. Measures of food intake showed that food-exposure effects were specific rather than general. Restrained eaters ate significantly more cookies after being primed with cookie smells than after being primed with pizza, and they ate more than did normal eaters in the same condition. Similarly, restrained eaters ate more pizza after being primed with pizza smells than after being primed with cookie smells, and their intake was greater than that of normal eaters in this condition. Normal eaters were not influenced by specific cues.

Thus, the eating enjoyment goal, which Fedoroff et al. (2003) seemed to have primed in this study, was not a general desire for tasty food, but a specific desire for the type of food used as prime. This suggests a difference between priming eating enjoyment with specific food smells compared to priming subliminally with palatable food words. When restrained eaters are intensely exposed to the smell of pizza being baked (or have to think about the taste of pizza), they are likely to simulate eating the pizza and to imagine how good it would taste (e.g., Papies, Barsalou, & Custers, 2012). As a result, their eating enjoyment goal increases in cognitive accessibility and becomes their focal goal. However, due to the anticipatory enjoyment of eating a specific type of food, their eating enjoyment goal may be specific appetites for specific categories of food (e.g., sweet vs. savory). This suggests that exposure to palatable food does not only prime eating enjoyment, but also the means by which this goal can be reached. This is consistent with models on automated goal-directed behavior (Aarts & Dijksterhuis, 2000; Elsner & Hommel, 2001; Kruglanski et al., 2002) and the everyday experience that the smell of pizza may trigger the desire to eat pizza, whereas the picture of an ice cream cone triggers the desire for ice cream rather than a pizza. In contrast, subliminal primes of palatable food words increase the accessibility of eating enjoyment directly without allowing participants to simulate eating any of these foods. As a result, these subliminal primes increase the accessibility of a general eating enjoyment goal that is not directed at specific types of food.[6]

Finally, Shimizu and Wansink (2011) examined the impact of food-related film content on amount eaten by restrained and normal eaters. Participants in their study were given two types of candy bars to eat while watching either a food-related or non-food-related TV series. They expected to have to evaluate the candies after the end of the film. The dependent measure was the calories they consumed while watching the two types of film. Consistent with all the other studies, restrained eaters consumed more calories while watching an eating-related film compared to a film with no eating content. In contrast, there was no significant effect of film content on the amount of calories consumed by normal eaters.

In none of these studies has the chain of cognitive processes that we demonstrated in our research been measured and related to the amount of food eaten by restrained and normal eaters. Thus, we have no *direct* test of our interpretation of the relationship between exposure to palatable food and food consumption of restrained eaters. We would like to point out, however, that none of the earlier theories (e.g., boundary model) would have predicted our findings nor could they explain them (at least not without making additional assumptions that were not part of the original theory). In contrast, the goal conflict model did predict these finding and can

[6] The findings of Rogers and Hill (1989) could be inconsistent with this interpretation. Their preexposure manipulation consisted of having participants imagine their most preferred food. In the taste test, they were given sweet and savory biscuits. The fact that preexposure resulted in overeating in restrained eaters could suggest that their manipulation triggered general and undifferentiated eating enjoyment. However, since there is no information on the type of food participants imagined (i.e., sweet or savory) or on the type of biscuits (i.e., sweet vs. savory) that ultimately were responsible for these effects, their findings are difficult to interpret.

explain both the findings of the studies conducted with methods of cognitive psychology as well as the results of studies assessing the impact of mere exposure to food on eating.

Mechanism of Dieting Success

The research reviewed so far has provided insights into the mechanism inducing failures of dieting in chronic dieters living in food-rich environments. Their eating behavior is dominated by the eating enjoyment goal, often without accessing their weight control goal. However, even though the majority of chronic dieters appear to be unsuccessful in achieving long-term weight loss (e.g., Jeffery et al., 2000; Mann et al., 2007), there seem to be individuals who are more successful (Kraschnewski et al., 2010; Wing & Hill, 2001). The members of the National Weight Control Registry, who have lost at least 10% of their body weight and have maintained this weight loss for at least 1 year, reported consuming on average 1,381 kilocalories per day, with 24% of calories from fat, 19% from protein, and 56% form carbohydrates (Wing & Hill, 2001). They also engage in high levels of physical activity comparable to approximately 1 hr of brisk walking per day. Since these successful chronic dieters are likely to score high on any scale of eating restraint, the theoretically interesting question concerns the psychological mechanisms that make it possible for these dieters to resist the food temptations they encounter in their daily lives. In others words, what are the mechanisms that allow a minority of dieters to be successful and remain slim, despite exposure to attractive food, while the majority fails at this endeavor?

A potential solution has been proposed by Fishbach, Friedman, and Kruglanski (2003) with their theory of temptation elicited goal activation. Rather than explaining why dieters are often unsuccessful, their theory suggests a mechanism by which chronic dieters can successfully regulate their food intake. Fishbach et al. argued that when individuals repeatedly and successfully exert self-control in tempting situations, they will develop facilitative links between the temptation cues and the mental representation of the overarching goal. As a result, the perception of a temptation cue will subsequently lead to the activation, rather than the inhibition of the overarching goal.

Fishbach et al. (2003) tested their idea in a series of studies in which the accessibility of specific goal representations was measured after participants had been primed with words that represent temptations likely to interfere with that goal. Their findings in the domain of dieting appear to show that priming temptations (e.g., chocolate) increased the cognitive accessibility of the relevant overriding goal—namely, weight control—but only for those chronic dieters who perceived themselves as being successful in their self-regulation. Thus, self-regulatory success seems to be associated with an increased tendency to activate the overarching goal (e.g., weight control) in a situation in which this goal is being threatened (e.g., by exposure to palatable food).

These findings are surprising in the light of the literature on restrained eating reviewed earlier that suggests that exposure to tempting food cues generally results in overeating in chronic dieters. They also seem to be inconsistent with our goal conflict model and in particular with the findings reported by Stroebe et al. (2008). There are numerous methodological differences between the two studies that make their results difficult to compare (see Papies, Stroebe, & Aarts, 2008b, for a discussion). Most importantly, the findings of Fishbach et al. (2003) are specific to individuals who consider themselves successful dieters. This individual difference dimension was not assessed by Stroebe et al. (2008). Thus, if one assumes that the majority of chronic dieters are unsuccessful but that a small minority is successful, the inconsistency between the findings of Fishbach et al.'s and Stroebe et al.'s studies could be reconciled. Even more importantly, an investigation of the strategies by which these successful dieters manage to regulate their eating could provide important information that could help to train unsuccessful chronic dieters to become more successful.

As a first step, Papies et al. (2008b) replicated Stroebe et al.'s (2008) study, including Fishbach et al.'s (2003) measure of self-regulatory success (see Meule, Papies, & Kübler, 2012, for a validation of this scale). However, the same palatable food primes and weight control target words were used as in Stroebe et al.'s study. Like Stroebe et al., they also had a baseline control condition in which participants were primed with neutral words (e.g., book, office). Results demonstrated that the food primes increased the accessibility of weight control targets for successful, but decreased accessibility for unsuccessful restrained eaters relatively to the baseline control condition. Thus, whereas the findings for successful restrained eaters replicated the pattern observed by Fishbach et al., the results for unsuccessful restrained eaters replicated the findings reported by Stroebe et al. Furthermore, the correlation between dieting success and concern for dieting was significantly negative (−.42), consistent with the assumption that a majority of restrained eaters are unsuccessful. Indeed, a later study confirmed that restrained eaters with a higher body-weight display the same pattern of goal-oriented hedonic responses as unsuccessful restrained eaters when primed with tasty food, whereas restrained eaters with a lower body weight showed evidence of pursuing the dieting goal after such primes (Ouwehand & Papies, 2010).

Research on goal-directed behavior has provided ample evidence that the cognitive accessibility of a behavioral goal is strongly associated with the likelihood of goal pursuit (e.g., Aarts & Dijksterhuis, 2000; Aarts, Gollwitzer, & Hassin, 2004; Bargh et al., 2001). Thus, if self-regulatory success increases the accessibility of the weight control goal when a temptation is perceived, it might also facilitate the pursuit of the weight control goal in tempting situations. However, to assess the validity of this hypothesis, it would first be important to know whether these self-declared successful restrained eaters are indeed more successful in controlling their weight than restrained eaters, who score low on the measure of self-regulatory success. Second, on a theoretical level, it would also be important to see how successful restrained eating can be integrated into our goal conflict model.

With regard to the first question, the fact that the correlation between body mass index and dieting success was negative (−.42), whereas it was positive for concern dieting (.45), suggests that these self-declared successful restrained eaters are indeed more successful than the average restrained eaters in controlling their weight (see also van Koningsbruggen, Stroebe, & Aarts, 2011b; van Koningsbruggen, Stroebe, Papies, & Aarts, 2011; Meule, Papies, & Kübler, 2012). Further support for this assumption was provided by the results of a second study conducted by Papies et al. (2008b). Participant in this study were asked to indicate their intention not to eat five palatable food items during the next 2 weeks (e.g., pizza, chocolate). In addition, concern for dieting and self-regulatory success was assessed. Two weeks later, these participants were contacted again and (as part of a larger questionnaire) reported how often they had eaten each of the palatable food items. Regression analysis revealed a main effect for intention such that the intentions not to eat the food items in question were indeed associated with a lower frequency of eating them. However, this effect was qualified by the predicted three-way interaction between intention, restraint, and success. For normal eaters, there was only a main effect of intention, indicating a moderate level of consistency between their intentions and their behavior. For restrained eaters, the main effect of intention was qualified by a significant interaction between intention and regulatory success. Whereas intentions did not predict behavior for unsuccessful restrained eaters, successful restrained eaters acted in accordance with their intentions.

With regard to the second question about how to integrate successful restrained eating into our goal conflict model, Figure 4 indicates how this integration could be achieved. Assuming that repeated successful control of eating temptations creates a facilitative associative link between tempting food cues and representations of dieting and weight control, exposure to palatable food should increase the accessibility of the weight control goal. However, because these palatable food cues simultaneously activate the eating enjoyment goal, the question arises why activation of the weight control goal results in inhibition of the eating enjoyment goal rather than activation of eating enjoyment inhibiting weight control. Since this question relates to a second issue—namely, how successful restrained eaters managed to become successful in the first place (i.e., form an associative link between tempting food weight control)—we discuss it after presenting some empirical evidence as to whether the model suggested here is empirically viable.

Supportive evidence for this integration of the theory of temptation elicited goal activation (Fishbach et al., 2003) with the goal conflict model comes from two studies by van Koningsbruggen,

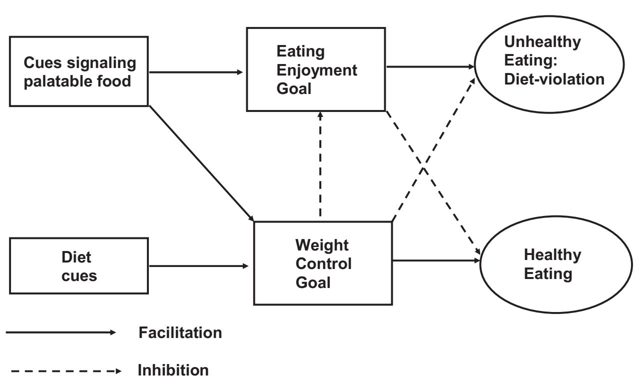

Figure 4. Schematic illustration of the goal conflict model of eating behavior used to explain the eating behavior of successful restrained eaters. Successful restrained eaters have formed a facilitative link from palatable food stimuli to eating control (presumably as a result of frequent successful past coping with eating temptations). Even though palatable food stimuli also prime the eating enjoyment goal, the increased accessibility of the dieting goal helps them to inhibit eating enjoyment and to engage in healthy eating.

Stroebe, Papies, and Aarts (2011) that we discuss in the section on intervention. These studies showed that forming the implementation intention to think of dieting when confronted with temptations (and thus increasing the accessibility of dieting thoughts on exposure to tempting food items) improved the ability of unsuccessful restrained eaters to resist temptation to the level of that of successful restrained eaters. As expected, the manipulation had no effect at all on successful restrained eaters, who when tempted would think of dieting anyway.

However, even though it is gratifying to know that restrained eaters who perceive themselves as successful dieters are indeed more successful in acting on their weight control goal and controlling their weight, it is equally important to understand how they *became* successful in the first place. The argument that they were so often successful in resisting palatable high-calorie food that for them such food became associatively linked to dieting and therefore trigger dieting thoughts rather than inhibiting them leaves unanswered the question how they became successful initially. After all, most restrained eaters try to avoid consuming high-calorie food. However, some remain unsuccessful, because they succumb to the pleasures promised by the enactment of the goal of eating enjoyment triggered by palatable food stimuli. And the answer to this should also provide an answer to the question raised earlier, why the simultaneous activation of eating enjoyment and weight control results in an inhibition of eating enjoyment rather than weight control.

There are three possible explanations: First, weight control could be a more important goal for successful restrained eaters than for their unsuccessful counterpart. However, since the concern for dieting subscale of the RS is negatively correlated with Fishbach et al.'s (2003) measure of success, this does not appear to be a plausible explanation.

Second, eating enjoyment could be less important for successful than for unsuccessful restrained eaters. If exposure to palatable food activates weaker hedonic responses in successful restrained eaters (compared to unsuccessful restrained eaters), then successful restrained eaters should find it less difficult to resist food temptations. In fact, if this were the case, successful restrained eaters would hardly experience a conflict between the goals of weight control and eating enjoyment, because eating enjoyment would not be a very desirable goal for them. This would make it easy for them to create an associative link between food temptations and dieting thoughts. However, there is no empirical evidence that successful restrained eaters like palatable food less than their unsuccessful counterparts. Additional (unpublished) analyses of the data of Hofmann et al.'s (2010) study failed to find a difference between successful and unsuccessful restrained eaters in terms of their hedonic responses to food. Another study that used a word completion task to assess the accessibility of hedonic thoughts following food-exposure also did not find any differences between successful and unsuccessful restrained eaters, even though food-exposure increased hedonic responding (van Koningsbruggen, Stroebe, & Aarts, 2011a). Consistent with this, successful and unsuccessful restrained eaters have been found to experience similar levels of (state) food cravings (Meule, Lutz, Vögele, & Kübler, 2012). These findings are inconsistent with the assumption that differences in hedonic reactions to food (and thus in temptation strength) explain the greater initial success of successful restrained eaters in coping with temptations.

Third, there is some tentative support for an interpretation in terms of differences in regulatory resources or capacities. There is evidence of a negative relation between perceived self-regulatory success in dieting and one kind of measure of impulsiveness (Meule, Lutz, et al., 2012), indicating that people who perceive themselves as successful weight regulators score lower on impulsiveness. Moreover, later research has revealed that this association holds only for restrained eaters (van Koningsbruggen, Stroebe, & Aarts, 2013). Specifically, van Koningsbruggen et al. (2013) found an interaction between impulsiveness and restraint that predicted 19% of the variance in scores on the measure of success. The findings of Hofmann et al. (2008) that individuals high in working memory capacity were more able to control food-intake in response to palatable food (e.g., eating candy) suggest that working memory capacity might be another factor that distinguishes successful from unsuccessful restrained eaters. Such individual differences could make it easier for some restrained eaters than for others to initially keep the dieting goal actively in mind in tempting situations, so that successful dieting episodes can accumulate to forge associative links between tempting food and the dieting goal. That is, the more capacity for working memory and control processes restrained eaters possess, the more effective they might be in solving the competition between weight control and eating enjoyment goals. However, these are certainly issues that need further empirical clarification.

Unresolved Issues and Future Directions

Although the goal conflict model of eating is promising in improving the understanding of diet violations in restrained eaters, there clearly are unresolved issues that need further empirical or theoretical attention. On the empirical level, one shortcoming of our research is that although we assume that changes in accessibility of the hedonic and dieting goals mediate the impact of food primes on eating in restrained eaters, we have no direct evidence for this mediation. One problem with testing this mediation is that one needs to assess the hedonic and dieting goals directly, which may interfere with the process and therefore wipe out the effects of the manipulation. Another approach would be to measure individual differences in goal strength and to examine whether this may moderate the priming effects on eating. Although correlational in nature, some supporting evidence for this idea comes from a recent set studies in which the dieting goal was subtly primed via environmental cues in a field setting, with effects on the behavior of restrained eaters but not unrestrained eaters (Papies & Hamstra, 2010; Papies & Veling, in press).

An important theoretical issue that deserves further attention is the relationship between our model and dual process theories. According to the goal conflict model of eating, diet violations in restrained eaters are the result of the interactive operations of two different types of goals. The processes involved in reaching these goals differ in the extent to which they require cognitive control. There are therefore similarities between aspects of the model we have proposed and the family of dual process models that have become popular in recent years (e.g., Chaiken, 1980; Kahneman, 2012; Petty & Cacioppo, 1986; Smith & DeCoster, 2000; Strack & Deutsch, 2004).

The basic assumption of dual process models is that two systems compete for influence over judgment and behavior. One is often termed associative or reflexive, the other reflective or deliberative (e.g., Carver, Johnson, & Joorman, 2008). The reflexive system chooses action properties on the basis of a network of associations that are activated by current stimulus conditions. Its influence on behavior is often characterized as being impulsive, because once an activation threshold for action is reached, the action proceeds without further thought. The reflective or deliberative system is said to be slower to act, because it analyzes the subjective likelihood as well as the valence of potential consequences of the action before the action proceeds.

As we have emphasized, we do not view our model as a dual process model, but rather as a competing goals model. We recognize that there are similarities, but there are also considerable differences. One similarity is that we assume that the two types of goals differ in the amount of resources and controlled processing they require for their pursuit. Thus, pursuing one's weight control goal is likely to require much more (self-)control than giving in to eating enjoyment goals. These assumptions are consistent with a dual process interpretation. A second similarity is that priming increases the accessibility of goals through activation of associative networks. Because associative networks become more activated over exposure time and over repeated exposure, dual process theories could also account for the finding that single exposure to palatable food is typically insufficient to disinhibit the eating behavior of restrained eaters.

However, there are also fundamental differences between dual process and goal theoretical approaches to behavior. First, most dual process theories assume that that the two processes reflect two different memory systems (e.g., Kahneman, 2012; Smith & DeCoster, 2000; Strack & Deutsch, 2004), an assumption that is not explicit part of our goal-theoretical model. Second, goals play no direct role in dual process theorizing, whereas they are the central determinant of action in our model. Because goal-directed behavior is controlled by representations of desired outcomes, it is much more persistent than impulsive behavior and persists until a goal is either reached or the individual has disengaged from it, even in the absence of actual palatable food stimuli. However, because some dual process theories assume that reflective and reflexive processes interact in guiding behavior, a more detailed analysis might be required to examine and assess whether and how the goal conflict model of eating behavior can be reconciled with a more dual system view of human behavior.

Given the similarities, it is hardly surprising that some of the support that was previously described for our model is easily interpreted in terms of either viewpoint. For example, findings that exposure to palatable food induces overeating in restrained eaters (e.g., Fedoroff et al., 1997, 2003; Jansen & van den Hout, 1991; Rogers & Hill, 1989) could be interpreted in terms of palatable food stimuli activating a network of associations that trigger overeating as an automatic response. Other findings are harder to interpret in terms of a dual process framework, at least without raising important questions about what the reflexive process actually consist of. For example, the findings of van Koningsbruggen, Stroebe, and Aarts (in press), who showed that once restrained eaters have chosen to pursue palatable, high-calorie food, they persist in that pursuit even in the absence of food cues, is less easily reconciled with dual process notions. Similarly, the findings of Hofmann et al. (2010) that once primed with palatable food stimuli restrained eaters maintained the positive affective reaction over an extended period of time is more consistent with the conception of goal-directed than impulsive behavior.

There can be no doubt, however, that eating behavior is sometimes impulsive. People may unthinkingly grab a piece of cake offered to them at a party or order some high-calorie meal option after a mouthwatering description given by a waiter in a restaurant. People mindlessly empty bowls of salted nuts, salt pretzels, or other snacks, typically when their cognitive resources are impaired, because they are watching a film, involved in a conversation, or under the influence of alcohol. This behavior can be considered impulsive in so far as it is guided by associative cues present in the current situation (Carver et al., 2008).

If diet violations can be the result of impulsive as compared to goal-oriented processes, it seems important to examine how we can differentiate between the two in order to develop programs to prevent such violations. If difficulty in eating restraint were a product of a general impulsiveness, one would expect to see an association between these constructs. The evidence on this issue is mixed. Jansen et al. (2009) found that restrained eaters who were more impulsive (measured with the Logan stop-signal task) were more likely to overeat following a preload. Furthermore, as mentioned earlier, van Koningsbruggen, Stroebe, and Aarts (2013) found that successful restrained eaters scored lower on the Barrat Impulsiveness Scale (BIS-11; Patton, Stanford, & Barratt, 1995). These findings are consistent with the fact that impulsiveness is correlated with the disinhibition scale of the Three-Factor Eating Questionnaire (TFEQ; Stunkard & Messick, 1985). However, for impulsivity to be a major contributor to the difficulties in resisting food temptations, one would expect it to be positively correlated with eating restraint. Neither the BIS-11 nor the Dickman Impulsivity Inventory (DII; Dickman, 1990) were correlated with the restraint scale of the TFEQ (Stunkard & Messick, 1985) in a sample of British women (Yeomans, Leitch, & Mobini, 2008). Similarly, Meule, Lutz, et al. (2012) found the RS unrelated to the BIS-11 in a German sample, and van Koningsbruggen et al. (2013) found no correlation between concern for dieting and the BIS-11 (overall score) in their Dutch sample. (However, they did find a low but significant correlation of concern for dieting with the BIS subscale attentional impulsiveness.) Thus, although these findings suggest that general impulsiveness is not the core of the problem we are discussing, the role of impulsiveness in eating regulation is certainly in need of further clarification.

One area of research that could be helpful in disentangling impulsive compared to goal-directed overeating concerns treatment effects of a go/no-go task training. The no-go training is usually seen as a method of strengthening inhibitory control, such as counterregulating the impulse to take fatty food (e.g., Houben & Jansen, 2011; Veling & Aarts, 2009; Veling et al., 2011). However, the no-go training does not only improve inhibitory control, it also results in a devaluation of stimuli used in the no-go training. Thus, a study in which heavy drinkers were trained with a go/no-go task found a significant decrease in implicit affect toward beer as well as a decrease in beer consumption (Houben, Nederkoorn, Wiers, & Jansen, 2011). In a further study with heavy drinkers, Houben, Havermans, Nederkoorn, and Jansen (2012) demonstrated that the decrease in positive affect rather than the response inhibition mediated the impact of the no-go training on beer consumption, suggesting the modulation of reward value of drinking rather than strengthening inhibitory control.

Veling, Holland, and van Knippenberg (2008) have provided a theoretical explanation for the impact of the no-go training on affect. They have suggested that the no-go training with a positively valenced stimulus results in a response conflict between an approach tendency and subsequent behavioral inhibition that is resolved by spontaneously tagging negative affect to the approach eliciting stimulus. "This negative affect would make the stimulus temporarily less desirable, and hence decrease the response tendency" (Veling et al., 2008, p. 1014). Thus, even though the effect of the no-go training in reducing food consumption is likely to be partially mediated through improvements in impulse control, it is also appears to reduce reward value and thus weakens the goal of eating enjoyment (see also Veling & Aarts, 2009).

So where does this leave us? We know that both impulsive and goal-directed behavior play a role in inducing diet-violations and unhealthy eating in restrained eaters. However, at present, we have insufficient information to estimate the relative contribution of and the possible interaction between these two processes to the difficulties restrained eaters have in regulating their food intake and controlling their body-weight in a food-rich environment.

Planning Interventions

One important aim in trying to understand the mechanism of dieting success and failure is to design effective interventions that help people with weight problems to control their weight. One implication of the research reviewed so far is to train unsuccessful restrained eaters to become successful, another implication is to use environmental cues to help unsuccessful restrained eaters to resist food-temptations by reminding them of their dieting goal. In the following, we present findings of research that pursued these alternative routes.

Training Unsuccessful Restrained Eaters to Become Successful

If the success of successful restrained eaters in regulating their weight is solely based on the fact that for them temptations activate dieting thoughts, then unsuccessful restrained eaters should become more successful if one could somehow teach them to activate dieting thoughts in situations of temptation. One way to achieve this is by inducing them to form the implementation intention to think of dieting when confronted with temptations. Implementation intentions are behavioral plans that specify the when, where, and how of what one will do to reach a certain goal. Implementation intentions follow the format of if-then plans that create a strong link between a specified situation and the goal-directed response making people automatically select the specific response when entering the specified situation (Gollwitzer, 1999). While implementation intentions are traditionally employed to activate a specific behavior in the critical situation (e.g., to eat an apple when you feel like having a snack; Adriaanse, de Ridder, & de Wit, 2009), van Koningsbruggen, Stroebe, Papies, and Aarts (2011) extended the use of this technique to activate a goal rather than a specific behavior, that should then allow participants to select a suitable goal-directed behavior from a variety of available behavioral options. Thus, van Koningsbruggen et al. employed implementation intentions to remind their participants to think of dieting when confronted with the temptation to eat certain high-calorie, palatable food items. While the induction of this kind of implementation intention should increase the self-control of unsuccessful restrained eaters, it should have no effect for successful restrained eaters, because for them, temptations would activate dieting thoughts automatically anyway.

Van Koningsbruggen, Stroebe, Papies, and Aarts (2011) conducted two studies to test this hypothesis. Whereas Study 1 was designed to test whether forming implementation intentions to "think of dieting" when tempted would indeed create a strong temptation-weight control goal association, Study 2 tested whether this planning strategy would effectively enhance the self-control of dieters in daily life. In both studies, participants were either instructed to form this implementation intention for five palatable foods (e.g., chocolate cookies, pizza) or they did not receive instructions to form implementation intentions.

Study 1 assessed the impact of this implementation intention on the accessibility of weight control concepts. Participants were given a word completion test that contained word fragments as well as a number of complete words, some of which served as food primes. The word fragments were chosen in a way that they could either be completed as words related or unrelated to weight control. To measure the temptation-weight control goal association, five of the weight control-related word fragments were preceded by food words from the implementation intention (e.g., chocolate, pizza). Consistent with predictions, the formation of implementation intentions significantly increased weight control-related word completions in unsuccessful restrained eaters to the level of successful restrained eaters (see Figure 5). Successful restrained eaters completed a high number of weight control-related words, even without implementation intentions. Inducing them to form implementation intentions did not increase this number further. This latter finding is consistent with the assumption that temptations automatically facilitate dieting thoughts for successful restrained eaters. The induction of implementation intentions had no effect for normal eaters.

Study 2 assessed whether the induction of implementation intentions would also be effective in enhancing the self-control of unsuccessful restrained eaters. In addition to the "think-of-dieting" implementation intention and the no-treatment control condition, van Koningsbruggen, Stroebe, Papies, and Aarts (2011) included a second control condition, in which participants were instructed to form an implementation intention, that would not activate the dieting goal. This condition was added to ascertain that effects were due to the activation of the dieting goal. In this condition, participants were instructed to think of "not-eating" when exposed to tempting food cues. Although "not-eating" when exposed to tempting food represents a means to an end, van Koningsbruggen et al. expected that it would not be helpful in resisting the temptation, because it would keep their attention fixed on the food. This should keep hedonic thoughts about food highly accessible.

Participants were contacted by e-mail 15 days after the first session and were asked to report how much and how often they had consumed each of the palatable food items during the last 15 days. As with the word completion test, the formation of the implementation intention to think of dieting only affected the unsuccessful restrained eaters (see Figure 6), who reported to have consumed significantly less of the palatable foods after having formed an implementation intention than they did without having formed implementation intentions.[7] Successful restrained eaters reported to have consumed less of the food items even without having formed an implementation intention. Forming this implementation did not reduce their consumption further. Normal eaters were not influenced by the induction of an implementation intention. As expected, the control implementation intention to think of not-eating had no effect.

Concurrently with—but independently of—van Koningsbruggen, Stroebe, Papies, and Aarts (2011), Kroese, Adriaanse, Evers, and De Ridder (2011) conducted a similar study which replicated the findings of van Koningsbruggen et al. They also found that the implementation intention to think of dieting when exposed to food temptations was only effective for unsuccessful dieters. Successful dieters were able to control their eating of tempting food items even without the induction of implementation intentions.

Environmental Interventions to Reestablish Weight Control as Focal Goal

One implication of the goal conflict model is to use environmental cues to remind unsuccessful restrained eaters of their weight control goal. As we have seen in the research reported earlier, the fragile balance between weight control and eating enjoyment is easily disturbed by exposure to palatable food and the hedonic thoughts with which restrained eaters respond to such exposure. As a result, weight control thoughts are being inhibited. However, according to our goal conflict model (see Figure 1), exposure to dieting cues should help to maintain or reestablish the weight control goal. This hypothesis was tested by Papies and colleagues in two field experiments (Papies & Hamstra, 2010; Papies & Veling, in press).

Papies and Hamstra (2010) made use of the custom in Dutch butcher shops to have trays of tasty but fatty sausage and meatballs on their counter for customers to taste. As diet prime, they used a poster that announced a weekly recipe that was "good for a slim figure." This poster was displayed clearly visible at the shop door for half the days of the study, whereas no poster was fixed to the door during the other days. When customers entered the shop they were greeted by the smell of grilled chicken that was continuously wafting through the store from a grill oven at the back. The dependent measure was the number of snacks each customer took from the tray. These were registered by the experimenter, who was behind the counter apparently helping the shop assistants. After customers had paid, they were asked to fill in the concern for dieting scale. On the days without the dieting cue at the door, the number of snacks eaten by restrained and normal eaters replicated the pattern observed in the studies involving food-exposure reported in the previous section, namely that restrained eaters ate more snacks than normal eaters. However, on the days with the dieting cue clearly visible at the door, restrained eaters did not eat more than normal eaters, and they ate significantly less than in the

[7] Veling, van Koningsbruggen, Stroebe, and Aarts (2012) conducted a field study that induced implementation intentions to think of dieting in individuals who wanted to lose weight. They found that participants who had formed an implementation intention lost significantly more weight than individuals who had not formed an implementation intention.

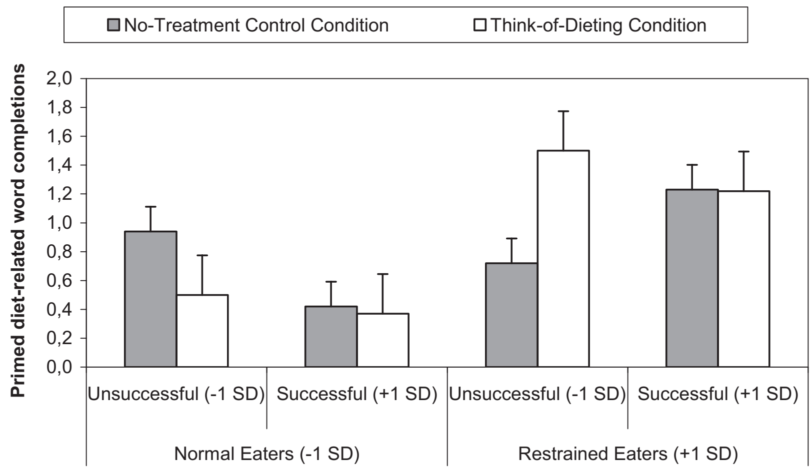

Figure 5. The impact of implementation intentions on the cognitive accessibility of dieting thoughts. Error bars indicate the standard error of the mean. Adapted from "Implementation Intentions as Goal Primes: Boosting Self-Control in Tempting Environments," by G. M. van Koningsbruggen, W. Stroebe, E. K. Papies, and H. Aarts, 2011, *European Journal of Social Psychology, 41,* p. 554. Copyright 2011 by Wiley.

control condition, where no diet prime was present. Thus, priming the goal of weight control with a simple environmental cue reduced the amount of snacks eaten by restrained eaters to that of normal eaters. Normal eaters were not influenced by the dieting cue.[8]

This pattern of findings was replicated by Papies and Veling (in press) in a study conducted in a small café-style restaurant. The daily specials announced by a plasticized sheet displayed on the table consisted of three different main dish salads (with fish, meat, or vegetarian). In the diet-prime condition, the description of the salads was supplemented by the phrases "low in calories," "calorie conscious," and "Are you also watching your weight?" printed on the margins around the main text of the offer. In the control condition, these diet-related words were not added. In a pilot study, all the dishes offered in the restaurant had been rated according to their perceived calorie content. Dishes such as salad or steamed fish were perceived to be relatively low in calories, whereas hamburgers or fried pork were perceived as high in calories. The experimenter noted the food choices ordered by customers and also administered the concern for dieting scale at the time customers were ready to pay the bill. When food choices were categorized on the basis of the ratings established in the pilot study, it emerged that the diet primes affected food choice of restrained but not of normal eaters. Restrained eaters made significantly more low-calorie choices in the diet prime condition than without diet primes. Normal eaters were not affected by the prime.

One might have expected that that food choice in this study would be moderated by the restrained eater's score on the measure of successful dieting: Since successful restrained eaters should think of dieting when exposed to temptations, one might expect that they would be more likely to choose the low-calorie option even in the control condition. However, there is also evidence that successful restrained eaters engage in a more flexible control of their dieting than do unsuccessful restrained eaters (Meule, Westenhöfer, & Kübler, 2011). Restrained eaters with flexible control of eating behavior do not react with overeating to a high-calorie preload (Westenhoefer et al., 1994). They seem to follow a more long-term strategy in their dieting and to make up for indulgence by eating less the following day. It seems therefore plausible that successful restrained eaters might suspend their eating control goal in order to allow themselves to enjoy their food on occasions when they are out eating.

The findings of these two studies suggest that environmental diet primes can help restrained eaters to resist the temptation of palatable but calorific food. In terms of our goal conflict model, the dieting primes helped restrained eaters to maintain or reestablish their weight control goal and prevent the eating enjoyment goal from becoming dominant. The problem is that to be effective, the environmental dieting prime has to be delivered in close temporal proximity (i.e., before or during) to the exposure to the tempting food stimuli.

Conclusions

After starting our review of theories and evidence concerning the self-regulation of food consumption with the comparison of normal weight and overweight individuals, we focused on eating restraint as an important underlying dimension. This led us to distinguishing three types of individuals—namely, normal eaters (i.e., individuals with low scores on the RS), unsuccessful restrained eaters, and successful restrained eaters. Because normal eaters neither react overly hedonically to palatable food stimuli nor feel the need to diet, exposure to palatable food does not affect the accessibility of their weight control thoughts nor their eating behavior. In fact, they are unlikely to entertain thoughts about weight control, because they experience no difficulty in regulating their calorie intake.

[8] Due to an oversight, the measure of dieting success was not given to participants of this study.

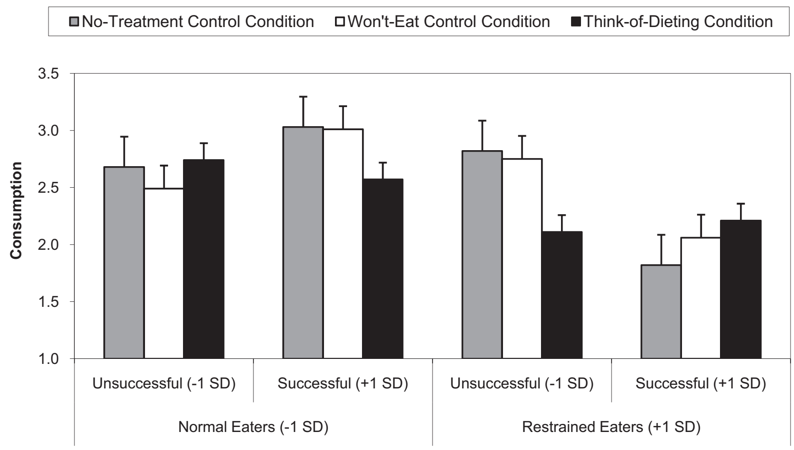

Figure 6. The impact of implementation intentions on eating behavior. Error bars indicate the standard error of the mean. Adapted from "Implementation Intentions as Goal Primes: Boosting Self-Control in Tempting Environments," by G. M. van Koningsbruggen, W. Stroebe, E. K. Papies, and H. Aarts, 2011, *European Journal of Social Psychology, 41,* p. 555. Copyright 2011 by Wiley.

There is some debate in the literature whether restrained eaters were once normal eaters, who ruined their equilibrium by unnecessarily trying to reduce their body weight through dieting (e.g., Polivy & Herman, 1992) or whether restrained eaters began to diet because, due to their enjoyment of palatable food combined with their inefficient metabolism, they began to gain unwanted weight (for a discussion, see Stroebe, 2008). Depending on the position one takes on this issue, one has to give opposing recommendations regarding dieting to individuals with weight problems. However, since one of the main arguments in support of the "undieting" movement that opposes dieting as strategy of weight regulation (e.g., Polivy & Herman, 1992) was that dieting does not work, their position is weakened by the fact that some chronic dieters are successful in regulating their weight.

In presenting and discussing our goal conflict model of eating, we have attempted to demonstrate that this new model cannot only accommodate most of the research findings accumulated by earlier research programs, but has also stimulated novel research that supported the model. Since goals are frequently activated by external factors the individual is typically not aware of, the goal conflict model also offers a theoretical underpinning for externality theory. Most of the external eating-relevant factors studied in the context of this program were likely to prime the eating enjoyment goal (e.g., taste, food salience).

We would also argue that the methodology borrowed from experimental research on cognition and behavior that we, and others have used in eating research, offers a promising approach to disentangle the cognitive, affective, and motivational processes that influence the self-regulation of food intake. Although the taste test and preload paradigm originally developed by Schachter et al. (1968) more than half a century ago has provided important insights into eating regulation, it also has serious shortcomings. Most importantly, it does not allow one to study the processes that determine the amount people eat.

It is a truism that obesity rates have been increasing rapidly in most developed and some developing countries. One reason is certainly that most of these countries provide food-rich environments that stimulate indulgence. As we have attempted to demonstrate, it is mainly the unsuccessful restrained eaters who are affected by exposure to palatable food. A better understanding of successful restrained eaters might improve interventions aimed at helping individuals with weight problems to improve their self-regulation. The development of strategies that teach unsuccessful restrained eaters to become successful is therefore an important task for future research.

However, although teaching unsuccessful restrained eaters strategies for planning how to resist such food temptations is certainly one way to go, large-scale environmental changes are also needed to stimulate healthy, low-calorie eating and prevent further increases in the prevalence of overweight and obesity (see also Hill & Peters, 1998; Visscher & Seidell, 2001). As we, and others, have argued, the abundance of attractive, high-calorie food in our food-rich environments contributes to overeating and thus to overweight (for a review, see Brownell, 2002; Stroebe, 2008). The research reviewed in this article has identified the psychological mechanisms by which such food cues influence eating behavior, especially among consumers who are struggling with their weight already, and it once again confirms that our food rich environment plays a major role in public health.

The research conducted in the context of the goal conflict model indicates that overweight can best be targeted by curbing the influence of attractive food cues in our living environment. Although it may not be feasible to reduce the abundance of tasty-looking, high-fat food, simple diet reminders, as in the field experiments described above, seem to be effective in facilitating self-regulation among motivated individuals. In addition, diet reminders could have the format of clear information about the calories contained in a food item, and on the percentage of one's daily intake that would be covered by eating the food. This may be particularly important for situations in which people typically overeat, such as in restaurants (Papies & Veling, in press). Indeed, research has shown that simple calorie information often surprises consumers in restaurants, as they have the tendency to underestimate the energy content of menu items. Thus, such information can influence choices in tempting settings (Burton, Creyer, Kees, & Huggins, 2006). However, this research area would benefit from much more systematic research to examine the impact of such simple and low-cost intervention strategies on different types of consumers, in interplay with their health goals and personal motivation to eat healthily. In addition, once a health-conscious dieter decides against a good-looking, high-calorie food, there needs to be similarly priced, healthy alternatives available to support the choice. This has clear implications for policy making regarding cafeteria vending machines, and other purchase locations where people easily overeat on high-fat snacks (see also Faith, Fontaine, Baskin, & Allison, 2007).

Although such comprehensive efforts to preserve and improve public health require political courage and will be unpopular with the food and restaurant industry, the rising costs of obesity and the wide-spread failures of weight control in our food-rich environment suggests that ultimately such measures will be inevitable to fight the current obesity epidemic (see also Story, Kaphingst, Robinson-O'Brien, & Glanz, 2008; Swinburn et al., 2011). In addition, marketing studies indicate that many consumers are prepared to pay extra for products supporting their dieting efforts, such as smaller portion-packages, making such consumers' health goals profitable for food producers (see Wansink, 2004). Based on the available research findings, we would argue that public health efforts to curb the impact of attractive food cues can be effective to make weight regulation in food-rich environments more successful. Because psychological research come a long way in identifying the mechanisms contributing to dieting failures, it can also inform us on strategies to create dieting success.

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Received December 9, 2011
Revision received September 19, 2012
Accepted September 24, 2012 ■