



As Pleasure Unfolds: Hedonic Responses to Tempting Food

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Abstract

Why do chronic dieters often violate their dieting goals? One possibility is that they experience stronger hedonic responses to tempting food than normal eaters. Here, we scrutinized hedonic processing in dieters and normal eaters (a) by manipulating food pre-exposure and (b) by assessing both immediate and delayed hedonic responses to tempting food with an adapted affect misattribution procedure. Without food pre-exposure, dieters showed less positive hedonic responses than normal eaters (Study 1). When pre-exposed to tempting food stimuli, however, dieters exhibited more positive delayed hedonic responses than normal eaters (Studies 1 and 2). Furthermore, delayed hedonic responding was meaningfully related to self-reported power of food and state cravings (Study 2). These findings suggest that dieters experience difficulties in down-regulating hedonic affect when in a “hot” state and that self-regulation research may benefit from a greater emphasis on temporal dynamics rather than static differences.

[144 Words]

Keywords: Self-Regulation, Hedonic Processes, Affect Regulation, Eating, Dietary Restraint

As Pleasure Unfolds: Hedonic Responses to Tempting Food

With the prevalence of overweight and obesity constantly on the rise, dieting has become the most important strategy to control weight in food-rich environments (Kruger, Galuska, Serdula, & Jones, 2004). Although chronic dieters, also referred to as restrained eaters (Herman & Polivy, 1980), are generally highly motivated to restrict food intake in order to control body weight, only few succeed in losing weight and in maintaining weight losses over significant periods of time (Mann et al., 2007; Stroebe, 2008). Precisely why dieters often fail to meet their dieting goals, however, has been the subject of continuous debate.

The Hedonic Response Hypothesis

One recent approach to this important matter proposes that eating is often driven by the automatic hedonic processing of food cues rather than by the homeostatic regulation of hunger per se (Lowe & Butryn, 2007; Pinel, Assanand, & Lehman, 2000). Specifically, dieters may experience stronger hedonic responses to highly palatable food cues. These hedonic responses are assumed to be responsible for attentional biases to tempting food cues (Papies, Stroebe, & Aarts, 2008), the emergence of food cravings and intrusive thoughts (Kavanagh, Andrade, & May, 2005; Papies, Stroebe, & Aarts, 2007), and the temporary inhibition of the long-term dieting goal (for a model, see Stroebe, Mensink, Aarts, Schut, & Kruglanski, 2008).

Central to this line of reasoning is the assumption that dieters show more positive hedonic responses to tempting food cues than normal eaters. However, previous research using explicit measures has often failed to find a difference in the self-reported evaluation of palatable food stimuli (Fedoroff, Polivy, & Herman, 1997; Stroebe et al., 2008) or has even found a devaluation of highly palatable food among dieters (e.g., Papies, Stroebe, & Aarts, 2008). It has been argued that hedonic reactions, due to their spontaneous, automatic nature may be better captured with the help of indirect measures (e.g., Hofmann, Friese, & Strack,

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3 2009b). However, consistent with the self-report data mentioned above, research using
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5 indirect measures has yielded only inconclusive evidence for the hedonic response hypothesis,
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7 with two studies reporting more positive hedonic reactions among dieters (Hoefling & Strack,
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9 2008; Veenstra & de Jong, in press), one study finding no difference between dieters and
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11 normal eaters (Roefs, Herman, Macleod, Smulders, & Jansen, 2005), and two studies finding
12
13 more negative hedonic reactions to palatable food among dieters (Papies, Stroebe, & Aarts,
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15 2009, Experiment 1, personal communication, May 4, 2010; Roefs & Jansen, 2002). How
16
17 should we understand these seemingly divergent hedonic response findings?
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20 21 22 A Two-Factor Approach to Hedonic Processing 23

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25 In the present article, we argue that the assumption of a static difference between
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27 dieters and normal eaters that has guided previous research is too simple. We propose that, to
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29 understand hedonic responses in eating behavior—and probably other domains of self-
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31 regulation as well—we need to take into account the dynamic interplay of two crucial factors:
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33 pre-exposure and the time-course of hedonic responses. Pre-exposure concerns the (often
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35 disruptive) influence of the immediate stimulus environment on self-regulatory processes
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37 (e.g., Metcalfe & Mischel, 1999). In the eating domain for instance, it has been found that
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39 dieters are more likely to overeat after they have been pre-exposed to the sight, smell, or taste
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41 of tempting food cues (Fedoroff et al., 1997; Fedoroff, Polivy, & Herman, 2003; Herman &
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43 Mack, 1975; Jansen & van den Hout, 1991; Rogers & Hill, 1989). Research examining the
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45 potential causes of this overeating effect show that pre-exposure to tempting food words
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47 increases attentional bias for tempting food (Papies et al., 2008) and temporarily inhibits
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49 access to the dieting goal (Stroebe et al., 2008). These findings suggest that dieters may show
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51 different hedonic responses depending on whether they have been brought into a “hot state”
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53 by the presence of tempting food primes or not.¹
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The second crucial factor is the time-course of the hedonic response. Previous research
using indirect measures has exclusively focused on immediate hedonic reactions to stimulus

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3 exposure. However, by just looking at the immediate hedonic response, an important piece of
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5 information is missing, namely how the mental apparatus *deals* with hedonic affect *over time*.
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8 Recent neuroscientific research suggests that evaluation is a fast and dynamic process that
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10 includes multiple iterative processing cycles even within the first second upon stimulus
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12 exposure (Cunningham, Zelazo, Packer, & Van Bavel, 2007). Iterative hedonic processing
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14 may lead to a maintenance or even to an amplification of hedonic responses given that
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16 attention is continuously allocated to the affective information and that no regulatory process
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18 is recruited (Kavanagh et al., 2005; Van Dillen & Koole, 2007). Conversely, hedonic
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20 responses may be down-regulated over time through the re-allocation of attention and through
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22 mechanisms of affect regulation which allow the psychological system to disengage from a
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24 tempting episode (Hofmann, Friese, & Roefs, 2009a).
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29 Study 1

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31 To test the proposed two-factor model, we assessed dieters' and normal eaters'
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33 immediate as well as delayed hedonic responses to tempting food stimuli as a function of pre-
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35 exposure. We hypothesized that, without pre-exposure, dieters' dieting goal may be dominant
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37 (Stroebe et al., 2008) and successfully bias information processing, including the devaluation
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39 of goal-incompatible temptations (Aarts, Custers, & Holland, 2007; Myrseth, Fishbach, &
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41 Trope, 2009; Veling & Aarts, 2009). After pre-exposure to tempting food, however, dieters
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43 may become increasingly sensitive to the hedonic aspects of tempting food. As a
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45 consequence, they may have difficulties in down-regulating positive hedonic affect and
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47 exhibit prolonged hedonic processing over time when compared to normal eaters.
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53 Furthermore, we assumed that this pattern of effects is specific for food stimuli and does not
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55 generalize to food-unrelated control stimuli.
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57 *Method*

58 *Participants and Procedure*

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3 Participants were 80 students from Utrecht University (46 female, 34 male; $M_{age} =$
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5 21.75 years, $SD_{age} = 2.33$), who received either course credit or monetary compensation
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7 (approx. \$5). They were assigned randomly to the food pre-exposure or the no pre-exposure
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9 condition. Afterwards, we unobtrusively measured immediate and delayed hedonic responses
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11 to tempting food with a modified version of the affect misattribution procedure (AMP; Payne,
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13 Cheng, Govorun, & Stewart, 2005). Finally, participants filled out the restraint scale.
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17 *Materials and Procedure*

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20 *Food Pre-Exposure Manipulation.* A lexical decision task was used to implement food
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22 pre-exposure experimentally as in Papies et al. (2008). In each trial of the task, participants
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24 were presented with a word or non-word target stimulus and they had to indicate quickly via
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26 keypress whether the presented stimulus was a word or a non-word. Participants in the pre-
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28 exposure condition ($n = 39$) were presented with 15 palatable food words (e.g., pizza,
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30 chocolate, cake), 15 neutral words (e.g., book), and 30 non-words. Participants in the no pre-
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32 exposure condition ($n = 41$) were presented with 30 neutral words and 30 non-words.
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34 Presentation order of stimuli was randomized across the 60 trials of the task.
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39 *Hedonic Response over Time.* Building on the AMP (Payne et al., 2005), we
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41 developed a new procedure to capture immediate versus delayed hedonic responses to
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43 tempting food stimuli (see Hofmann et al., 2009a, for a first application to assess general
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45 affect regulatory capacity). In the standard trial of the task, a prime stimulus was presented for
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47 100 ms, followed by an interstimulus interval (ISI) of 100 ms (a blank screen), followed by
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49 the presentation of a Chinese pictograph for 200 ms, followed by a mask which remained
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51 until the participant responded with a pleasantness judgment of the pictograph (see Figure S1
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53 in the supporting material available on-line). The standard trial employing such a short ISI is
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55 typically used in order to measure immediate affective reactions to the primes (misattributed
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57 to the pictograph), with a higher proportion of pleasant judgments indicating a more positive
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59 hedonic response (Payne et al., 2005). We added a second trial type in which the ISI was
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3 increased to 1,000 ms while keeping all other aspects of the task constant (see supplementary
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5 Figure S1). Comparing responses to identical stimuli at the short versus the long ISI informs
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7 us about how immediately activated affect unfolds over time. Specifically, a decrease in
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9 positive responses from the short to the long ISI is indicative of a down-regulation of
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11 immediate affect over time.
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15 The task consisted of 90 trials presented in random order. As primes, we used 15
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17 palatable food pictures selected from a pilot test ($N = 24$) and included 15 positive and 15
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19 negative food-irrelevant stimuli from the International Affective Picture System (Lang,
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21 Bradley, & Cuthbert, 2005). To allow for a specificity analysis (see below), food and positive
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23 control stimuli were matched according to 9-point scale ratings of valence ($M_{food} = 6.31$; $SD =$
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25 0.32 ; $M_{positive} = 6.32$; $SD = 0.31$) and arousal ($M_{food} = 5.41$; $SD = 0.40$; $M_{positive} = 5.31$; $SD =$
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27 0.39). Each stimulus was shown twice in each ISI condition and always paired with a new
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29 pictograph. As in Payne, Burkley, and Stokes (2008), participants responded to the pictograph
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31 with the index and middle fingers of both hands placed on 4 keys labeled -2 (*very*
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33 *unpleasant*), -1 (*slightly unpleasant*), +1 (*slightly pleasant*), and +2 (*very pleasant*). For data
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35 analysis, we excluded responses below 150 ms and above 3500 ms upon presentation of the
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37 pictograph.
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44 *Restraint Scale.* Dietary restraint was assessed with the Concern for Dieting subscale
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46 of the Revised Restraint Scale (Herman & Polivy, 1980). The mean sum score across the 6
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48 items with a response scale from 0 to 3 was 6.60 ($SD = 3.40$; $\alpha = .74$).
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50 51 *Results and Discussion*

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53 To simplify interpretation, responses in the AMP were recoded to a 1 to 4 scale with
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55 higher scores indicating more positive responses. A GLM analysis on hedonic responses with
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57 stimulus type (food vs. matched positive control stimuli), ISI (100 ms vs. 1,000 ms) as within-
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59 subjects factors, food pre-exposure (yes vs. no) as between-subjects factor, and dietary
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restraint as a continuous predictor (with means for dieters and normal eaters estimated at +1

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3 and -1 *SDs*, respectively) revealed two significant interactions: a three-way interaction
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5 between ISI, pre-exposure, and restraint, $F(1, 76) = 4.14, p = .045, \eta_p^2 = .05$, which was
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7 qualified by a four-way interaction between stimulus type, ISI, pre-exposure, and restraint,
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9 $F(1, 76) = 5.51, p = .022, \eta_p^2 = .07$. To decompose these two interactions, we investigated the
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11 effects of ISI and restraint separately for food and positive control primes and separately for
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13 the no pre-exposure and the food pre-exposure condition.
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18 Regarding food stimuli, in the no pre-exposure condition there was only a main effect
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20 of restraint, $F(1, 39) = 7.88, p = .008, \eta_p^2 = .17$. As can be seen from Figure 1 (left panel),
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22 dieters harbor less positive hedonic reactions to palatable food than normal eaters when not
23
24 pre-exposed. In the pre-exposure condition, however, there was a significant interaction
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26 between ISI and restraint, $F(1, 37) = 6.56, p = .015, \eta_p^2 = .15$, and no main effects. Figure 1
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28 shows that hedonic responses of dieters (+1 *SD*) and normal (-1 *SD*) eaters did not differ at
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30 the short ISI of 100 ms, $t(37) = .42, p = .673, \eta_p^2 = .005$. However, dieters' hedonic responses
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32 were significantly larger than those of normal eaters at the long ISI, $t(37) = 2.15, p = .038, \eta_p^2 = .11$. This dissociation of the delayed response was due to a significant decline in hedonic
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34 responding for normal eaters over time, $t(37) = -2.79, p = .008, \eta_p^2 = .17$. In contrast, dieters
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36 maintained high levels of positive responding over time, $t(37) = 0.74, p = .46, \eta_p^2 = .02$.
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39 Regarding positive control stimuli, there was neither a significant main effect of ISI or
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41 restraint, nor was there a significant interaction between ISI and restraint in either condition,
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43 all $F_s < 1.05$ (see Figure 1, right panel), indicating that the present findings are specific to
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45 food stimuli.
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54 Viewed in concert, the results from Study 1 suggest that, without pre-exposure to
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56 food, dieters appear to devalue palatable food primes effectively even at very short time
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58 frames, indicating implicit self-control as the default (Fishbach, Friedman, & Kruglanski,
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60 2003). When pre-exposed to palatable food, however, dieters show elevated hedonic

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3 responses that persist over time whereas normal eaters show signs of down-regulation over
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5 time. Thus, dieters' exposure to tempting food invokes a "hot" state during which they
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7 become increasingly sensitive – and vulnerable – to the hedonic aspects of food.
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10 Study 2

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12 The aim of Study 2 was to examine more closely the time-pattern that emerged under
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14 food pre-exposure in Study 1. Specifically, we wanted to investigate whether the observed
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16 difference between dieters' and normal eaters' hedonic responses generalizes further across
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18 time. We therefore included a third ISI of 1,500 ms in the modified AMP. Moreover, we
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20 wanted to investigate whether the assessment of delayed hedonic responses has explanatory
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22 power beyond its link with dietary restraint. Specifically, we examined whether delayed
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24 hedonic responding can be meaningfully linked to self-reported urges toward palatable food.
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29 Method

30 *Participants*

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32 Participants were 48 students from Utrecht University (27 female, 21 male; $M_{age} =$
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34 20.96 years, $SD_{age} = 3.85$), who received either course credit or monetary compensation
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36 (approx. \$5). Two participants were identified as outliers in boxplots and excluded from
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38 further analyses, one of them scored outside the normal range on the restraint measure ($SD >$
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40 2.9), and one reported not to have eaten for more than 18 hours ($SD > 4.1$).
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45 *Materials and Procedure*

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47 All participants were pre-exposed to food cues through the lexical decision task from
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49 Study 1. Afterwards, their hedonic responses to tempting food, matched positive control
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51 pictures, and negative pictures were assessed with the modified AMP. However, in Study 2,
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53 we added a third ISI of 1,500ms to the AMP in order to trace hedonic responding further over
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55 time, resulting in a total of 135 trials. Participants then filled out the restraint scale ($M = 6.45$;
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57 $\alpha = .75$). They also completed the Power of Food Scale (PFS; Lowe et al., 2009 $\alpha = .87$; e.g.,
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59 "If I see or smell a food I like, I get a powerful urge to have some"), a recently proposed
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3 measure of the sensitivity to tempting food cues in the environment, as well as the State Food
4 Cravings Questionnaire (FCQ-S; Cepeda-Benito, Gleaves, Williams, & Erath, 2000; $\alpha = .96$;
5 e.g., “If I had tasty food right now, it would be hard to stop eating.”) with the five subscales
6 “intense desire to eat” ($\alpha = .95$), “anticipation of positive reinforcement” ($\alpha = .90$),
7 “anticipation of relief from negative feelings” ($\alpha = .88$), lack of control over eating” ($\alpha = .84$),
8 and “craving as a physiological state” ($\alpha = .87$). The PFS and the FCQ-S have both been
9 shown to predict problematic eating behavior in field and laboratory settings (Cepeda-Benito
10 et al., 2000; Lowe & Butryn, 2007; Vander Wal, Johnston, & Dhurandhar, 2007).

21 *Results and Discussion*

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24 A GLM analysis revealed a significant interaction among stimulus type, ISI, and
25 dietary restraint, $F(2, 88) = 4.47, p = .014, \eta_p^2 = .09$. To unravel this interaction, we
26 investigated the effects of ISI and restraint on hedonic reactions separately for food and
27 positive control primes.
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34 Regarding food primes, a significant interaction between ISI and restraint emerged,
35 $F(2, 88) = 3.29, p = .042, \eta_p^2 = .07$, while there were no significant main effects. As can be
36 seen from Figure 2, dieters and normal eaters did not differ in their hedonic response at the
37 short ISI of 100 ms, $t(44) = -.12, p = .908, \eta_p^2 = .001$. However, dieters’ hedonic responses
38 were significantly larger than those of normal eaters at the delayed ISIs of 1,000 ms, $t(44) =$
39 $2.22, p = .032, \eta_p^2 = .10$, and 1,500 ms, $t(44) = 2.84, p = .007, \eta_p^2 = .16$. Analogous to Study
40 1, this dissociation of delayed responses when pre-exposed to tempting food was due to a
41 significant decline in hedonic responding for normal eaters from the 100 ms ISI to the 1,000
42 ms ISI, $t(44) = 3.16, p = .003$, and to the 1,500 ms ISI, $t(44) = 2.63, p = .012$, respectively. In
43 contrast, and replicating the results from Study 1, dieters maintained high levels of positive
44 responding over time when comparing the short to the two delayed ISIs, $t(44) = 0.35, p = .73$,
45 and $t(44) = 0.43, p = .67$, respectively. Regarding positive control primes, there was neither a
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3 significant main effect of ISI, nor restraint (both F s < 1), nor was there a significant
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5 interaction between ISI and restraint, $F(2, 88) = 1.45, p = .24$, indicating again that the present
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7 findings are specific to food stimuli.
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10 Next, we correlated hedonic food responses in the AMP with self-reported power of
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12 food and the state food cravings total scale and subscales separately for the three different
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14 ISIs. As can be seen from Table 1, correlations generally increased from the short to the
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16 longest ISI such that elevated positive responses to tempting food at the 1,500 ms ISI were
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18 substantially associated with a higher self-reported power of food, stronger desire to eat,
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20 stronger positive reinforcement from eating, positive relief from eating, and less control over
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22 eating.
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27 To investigate whether late hedonic responding (ISI = 1,500 ms) can partially explain
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29 the relationship between dietary restraint and power of food in our sample, $r = .445, p = .002$,
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31 we conducted a mediation analysis as recommended by Preacher and Hayes (2004). Results
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33 showed that the combined effect of restraint on delayed hedonic responses, $\beta = .35, p = .016$,
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35 and of hedonic responses on power of food scores, $\beta = .51, p = .002$, was significant, $\beta = .16$,
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37 $p < .05$, establishing mediation (MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002). A
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39 similar analysis involving FCQ-S (total) scores as dependent variable also showed that the
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41 combined product of the two significant direct effects ($\beta = .45 \times \beta = .43$) was reliable, $\beta = .19$,
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43 $p < .05$, indicating mediation. These analyses provide an intriguing link between dietary
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45 restraint and subjective experiences of urges and desires. They directly support our
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47 assumption that a failure to down-regulate hedonic affect over time may be one of the primary
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49 reasons underlying the propensity to overeat when tempted.
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55 General Discussion

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57 The present findings provide novel insights into when and why dieters may have
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59 difficulties to resist the allure of tempting food. Study 1 showed that without pre-exposure,
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dieters exhibited less positive hedonic responses than normal eaters indicating successful

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3 devaluation of tempting food at both short and long inter-stimulus intervals. In contrast, when
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5 pre-exposed to palatable food stimuli, dieters showed continued elevated hedonic responses,
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7 and differed markedly from normal eaters who showed down-regulation over time. Study 2
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9 replicated this finding and, by extending the interstimulus interval, demonstrated that the
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11 observed discrepancy remains stable for at least a certain amount of time. These results show
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13 that dieters are able to effectively regulate their hedonic responses to food as a result of
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15 having the goal to diet, but that pre-exposure to food evokes a “hot” state in which the down-
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17 regulation of hedonic responses is substantially impaired.
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22 These findings are consistent with a goal-conflict model of eating (Stroebe et al.,
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24 2008). According to this model, restrained eaters’ dieting goal successfully biases information
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26 processing, leading to a devaluation of goal-incompatible food. However, when a “hot” state
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28 is induced through the repeated exposure to tempting food, the dieting goal is inhibited and
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30 hedonic processing prevails. In contrast to dieters, normal eaters are not chronically biased by
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32 a dieting goal and thus appear to be hedonically drawn toward tempting food objects under
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34 normal conditions. However, when pre-exposed to palatable food stimuli normal eaters, in
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36 contrast to dieters, showed reduced hedonic responding over time. This noteworthy effect
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38 may be part of a functional mechanism to disengage from stimuli that have already had a
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40 repeated influence so as to keep the organism open to the flexible pursuit of potential
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42 alternative goals (Jostmann & Koole, 2009).
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48 As our correlational and mediation analyses from Study 2 imply, dieters’ failure to
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50 down-regulate hedonic affect when tempted may be the key mechanism in the development of
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52 more “elaborated” food cravings and desires (Kavanagh et al., 2005) and may pave the way
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54 for unhealthy eating behavior. Our findings thus accord well with the recently proposed
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56 notion of “hedonic hunger” (Lowe & Butryn, 2007) by providing experimental evidence that
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58 it is precisely this prolonged responsiveness to the pleasurable aspects of food that may pose
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60 dieters at risk of unhealthy eating in present day’s food-rich environments.

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3 The present findings also support the notion of relative automatic, implicit forms of
4 self-control through the devaluation and/or inhibition of tempting stimuli (e.g., Fishbach et al.,
5 2003; Fishbach & Shah, 2006; Hofmann, Deutsch, Lancaster, & Banaji, 2010). Results in the
6 no pre-exposure condition suggest that, under default conditions, dieters can successfully
7 counteract temptation through devaluation, even at an early interstimulus interval. However,
8 the observed pattern in the food pre-exposure condition indicates that this regulatory
9 mechanism may be substantially weakened through the repeated confrontation with tempting
10 cues, rendering dieters increasingly vulnerable to the hedonic aspects of food. This clearly fits
11 the everyday observation that chronic dieters are often strong, but not invincible. Future
12 research may help to further elucidate the boundaries under which otherwise beneficial
13 mechanisms may be offset by specific circumstances or stimulus constellations.
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29 Finally, our results may help to reconsolidate previous research into the hedonic
30 response hypothesis by incorporating situational factors such as pre-exposure and temporal
31 dynamics that might escape the currently prevailing research focus on immediate automatic
32 responses. Taking such a dynamical and context-dependent perspective, future self-regulation
33 research from domains such as drug abuse, sexual risk-taking, aggression, and emotion
34 regulation may likewise profit from a closer look on how immediate affect unfolds over time.
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References

- 1
2
3
4
5
6 Aarts, H., Custers, R., & Holland, R. W. (2007). The nonconscious cessation of goal pursuit:
7
8 when goals and negative affect are coactivated. *Journal of Personality and Social*
9
10 *Psychology, 92*, 165-178.
11
- 12 Cepeda-Benito, A., Gleaves, D. H., Williams, T. L., & Erath, S. A. (2000). The development
13
14 and validation of the State and Trait Food-Cravings Questionnaires. *Behavior*
15
16 *Therapy, 31*, pp.
17
- 18
19
20 Cunningham, W. A., Zelazo, P. D., Packer, D. J., & Van Bavel, J. J. (2007). The iterative
21
22 reprocessing model: A multilevel framework for attitudes and evaluation. *Social*
23
24 *Cognition, 25*, 736-760.
25
- 26
27 Fedoroff, I. C., Polivy, J., & Herman, C. P. (1997). The effect of pre-exposure to food cues on
28
29 the eating behavior of restrained and unrestrained eaters. *Appetite, 28*, 33-47.
30
- 31 Fedoroff, I. C., Polivy, J., & Herman, C. P. (2003). The specificity of restrained versus
32
33 unrestrained eaters' response to food cues: general desire to eat, or craving for the cued
34
35 food? *Appetite, 41*, 7-13.
36
37
- 38
39 Fishbach, A., Friedman, R. S., & Kruglanski, A. W. (2003). Leading us not unto temptation:
40
41 Momentary allurements elicit overriding goal activation. *Journal of Personality and*
42
43 *Social Psychology, 84*, 296-309.
44
- 45
46 Fishbach, A., & Shah, J. Y. (2006). Self-control in action: Implicit dispositions toward goals
47
48 and away from temptations. *Journal of Personality and Social Psychology, 90*, 820-
49
50 832.
51
- 52
53 Herman, C. P., & Mack, D. (1975). Restrained and unrestrained eating. *Journal of*
54
55 *Personality, 43*, 647-660.
56
- 57
58 Herman, C. P., & Polivy, J. (1980). Restrained eating. In A. J. Stunkard (Ed.), *Obesity* (pp.
59
60 208-225). Philadelphia: Saunders.

- 1
2
3 Hoefling, A., & Strack, F. (2008). The tempting effect of forbidden foods. High calorie
4 content evokes conflicting implicit and explicit evaluations in restrained eaters.
5
6 *Appetite*, *51*, 681-689.
7
8
9
- 10 Hofmann, W., Deutsch, R., Lancaster, K., & Banaji, M. R. (2010). Cooling the heat of
11 temptation: Mental self-control and the automatic evaluation of tempting stimuli.
12
13 *European Journal of Social Psychology*, *40*, 17-25.
14
15
16
- 17 Hofmann, W., Friese, M., & Roefs, A. (2009a). Three ways to resist temptation: The
18 independent contributions of executive attention, inhibitory control, and affect
19 regulation to the impulse control of eating behavior. *Journal of Experimental Social*
20 *Psychology*, *45*, 431-435.
21
22
23
24
25
26
- 27 Hofmann, W., Friese, M., & Strack, F. (2009b). Impulse and self-control from a dual-systems
28 perspective. *Perspectives on Psychological Science*, *4*, 162-176.
29
30
31
- 32 Jansen, A., & van den Hout, M. (1991). On being led into temptation: "Counterregulation" of
33 dieters after smelling a "preload". *Addictive Behaviors*, *16*, 247-253.
34
35
36
- 37 Jostmann, N. B., & Koole, S. L. (2009). When persistence is futile: A functional analysis of
38 action orientation and goal disengagement. In G. B. Moskowitz & H. Grant (Eds.),
39 *The psychology of goals* (pp. 337-361). New York, NY: Guilford Press.
40
41
42
- 43 Kavanagh, D. J., Andrade, J., & May, J. (2005). Imaginary relish and exquisite torture: The
44 Elaborated Intrusion theory of desire. *Psychological Review*, *112*, 446-467.
45
46
47
- 48 Kruger, J., Galuska, D. A., Serdula, M. K., & Jones, D. A. (2004). Attempting to lose weight:
49 Specific practices among U.S. adults. *American Journal of Preventive Medicine*, *26*,
50 402-406.
51
52
53
54
- 55 Lang, P. J., Bradley, M. M., & Cuthbert, B. N. (2005). *International affective picture system*
56 *(IAPS): Affective ratings of pictures and instruction manual*. Gainesville, FL:
57 University of Florida.
58
59
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4
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46
47
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49
50
51
52
53
54
55
56
57
58
59
60
- Lowe, M. R., & Butryn, M. L. (2007). Hedonic hunger: A new dimension of appetite?
Physiology & Behavior, 91, 432-439.
- Lowe, M. R., Butryn, M. L., Didie, E. R., Annunziato, R. A., Thomas, J. G., Crerand, C. E., et al. (2009). The Power of Food Scale. A new measure of the psychological influence of the food environment. *Appetite, 53*, pp.
- MacKinnon, D. P., Lockwood, C. M., Hoffman, J. M., West, S. G., & Sheets, V. (2002). A comparison of methods to test mediation and other intervening variable effects. *Psychological Methods, 7*, 83-104.
- Mann, T., Tomiyama, A. J., Westling, E., Lew, A.-M., Samuels, B., & Chatman, J. (2007). Medicare's search for effective obesity treatments: Diets are not the answer. *American Psychologist, 62*, pp.
- Metcalfe, J., & Mischel, W. (1999). A hot/cool system analysis of delay of gratification: Dynamics of willpower. *Psychological Review, 106*, 3-19.
- Myrseth, K. O. R., Fishbach, A., & Trope, Y. (2009). Counteractive self-control: When making temptation available makes temptation less tempting. *Psychological Science, 20*, 159-163.
- Papies, E., Stroebe, W., & Aarts, H. (2007). Pleasure in the mind: Restrained eating and spontaneous hedonic thoughts about food. *Journal of Experimental Social Psychology, 43*, 810-817.
- Papies, E., Stroebe, W., & Aarts, H. (2009). Who likes it more? Restrained eaters' implicit attitudes towards food. *Appetite, 53*, 279-287.
- Papies, E. K., Stroebe, W., & Aarts, H. (2008). The allure of forbidden food: On the role of attention in self-regulation. *Journal of Experimental Social Psychology, 44*, 1283-1292.

- 1
2
3 Payne, B. K., Burkley, M. A., & Stokes, M. B. (2008). Why do implicit and explicit attitude
4 tests diverge? The role of structural fit. *Journal of Personality and Social Psychology*,
5
6 94, 16-31.
7
8
9
10 Payne, B. K., Cheng, C. M., Govorun, O., & Stewart, B. D. (2005). An inkblot for attitudes:
11 Affect misattribution as implicit measurement. *Journal of Personality and Social*
12
13 *Psychology*, 89, 277-293.
14
15
16
17 Pinel, J. P. J., Assanand, S., & Lehman, D. R. (2000). Hunger, eating, and ill health. *American*
18
19 *Psychologist*, 55, 1105-1116.
20
21
22 Preacher, K. J., & Hayes, A. F. (2004). SPSS and SAS procedures for estimating indirect
23 effects in simple mediation models. *Behavior Research and Methods, Instruments, &*
24
25 *Computers*, 36, 717-731.
26
27
28
29 Roefs, A., Herman, C. P., Macleod, C. M., Smulders, F. T., & Jansen, A. (2005). At first
30 sight: how do restrained eaters evaluate high-fat palatable foods? *Appetite*, 44, 103-
31
32 114.
33
34
35
36 Roefs, A., & Jansen, A. (2002). Implicit and explicit attitudes toward high-fat foods in
37 obesity. *J Abnorm Psychol*, 111, 517-521.
38
39
40
41 Rogers, P. J., & Hill, A. J. (1989). Breakdown of dietary restraint following mere exposure to
42 food stimuli: Interrelationships between restraint, hunger, salivation, and food intake.
43
44 *Addictive Behaviors*, 14, 387-397.
45
46
47
48 Stroebe, W. (2008). *Dieting, overweight, and obesity: Self-regulation in a food-rich*
49
50 *environment*. Washington: APA.
51
52
53 Stroebe, W., Mensink, W., Aarts, H., Schut, H., & Kruglanski, A. (2008). Why dieters fail:
54 Testing the goal conflict model of eating. *Journal of Experimental Social Psychology*,
55
56 44, 26-36.
57
58
59
60 Van Dillen, L. F., & Koole, S. L. (2007). Clearing the mind: A working memory model of
distraction from negative mood. *Emotion*, 7, 715-723.

- 1
2
3 Vander Wal, J. S., Johnston, K. A., & Dhurandhar, N. V. (2007). Psychometric properties of
4
5 the State and Trait Food Cravings Questionnaires among overweight and obese
6
7 persons. *Eating Behaviors*, .8, pp.
8
9
- 10 Veenstra, E. M., & de Jong, P. J. (in press). Restrained eaters show enhanced automatic
11
12 approach tendencies towards food. *Appetite*.
13
14
- 15 Veenstra, E. M., de Jong, P. J., Koster, E. H. W., & Roefs, A. (2010). Attentional avoidance
16
17 of high-fat food in unsuccessful dieters. *Journal of Behavior Therapy and*
18
19 *Experimental Psychiatry*, 41, 282-288.
20
21
- 22 Veling, H., & Aarts, H. (2009). Putting behavior on hold decreases reward value of need-
23
24 instrumental objects outside of awareness. *Journal of Experimental Social Psychology*,
25
26 45, 1020-1023.
27
28
29
30
31
32
33
34
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Footnotes

¹ Such a conditional view may help to explain some of the inconsistencies reported earlier. For instance, whereas the studies cited as reporting more negative evaluations of food by dieters did not involve a pre-exposure to food, Höfling and Strack (2008), noted in their methods section that, before completing the implicit measure in their study “all subjects dealt with other food items (pictures) in another irrelevant task” (p. 684), involving the visual presentation of palatable food stimuli during a judgment task (A. Höfling, personal communication, May 4, 2010). In a similar vein, Veenstra and de Jong (in press) note that “an exogenous cueing task was administered (before the rest of the tasks)”, involving the presentation of high-fat food pictures and an explicit assessment of state cravings (see Veenstra, de Jong, Koster, & Roefs, 2010, for details). In both studies, these presentations may have acted as a pre-exposure manipulation. Thus, the degree of pre-exposure to palatable food may at least partially account for empirically observed variations in the difference between dieters’ and normal eaters’ hedonic responses.

² Including gender in GLM analyses as a further factor did not affect any of the statistical conclusions drawn, neither in Study 1 nor Study 2.

Table 1. *Correlations between hedonic responses to tempting food stimuli in the AMP and self-report measures in Study 2*

	Hedonic responses to tempting food (AMP)		
	Short ISI (100 ms)	Long ISI (1,000 ms)	Long ISI (1,500 ms)
Power of food (PFS)	0.16	<i>0.26</i>	0.47
Food cravings questionnaire (FCQ-S)	0.17	0.29	0.43
Desire to eat	0.10	0.16	0.31
Positive reinforcement	0.27	<i>0.28</i>	0.43
Positive relief from eating	0.14	0.34	0.38
Lack of control	0.19	0.31	0.50
Craving as physiological state	0.06	0.18	<i>0.26</i>

Note. $N = 46$. AMP = affect misattribution procedure; ISI = interstimulus interval.

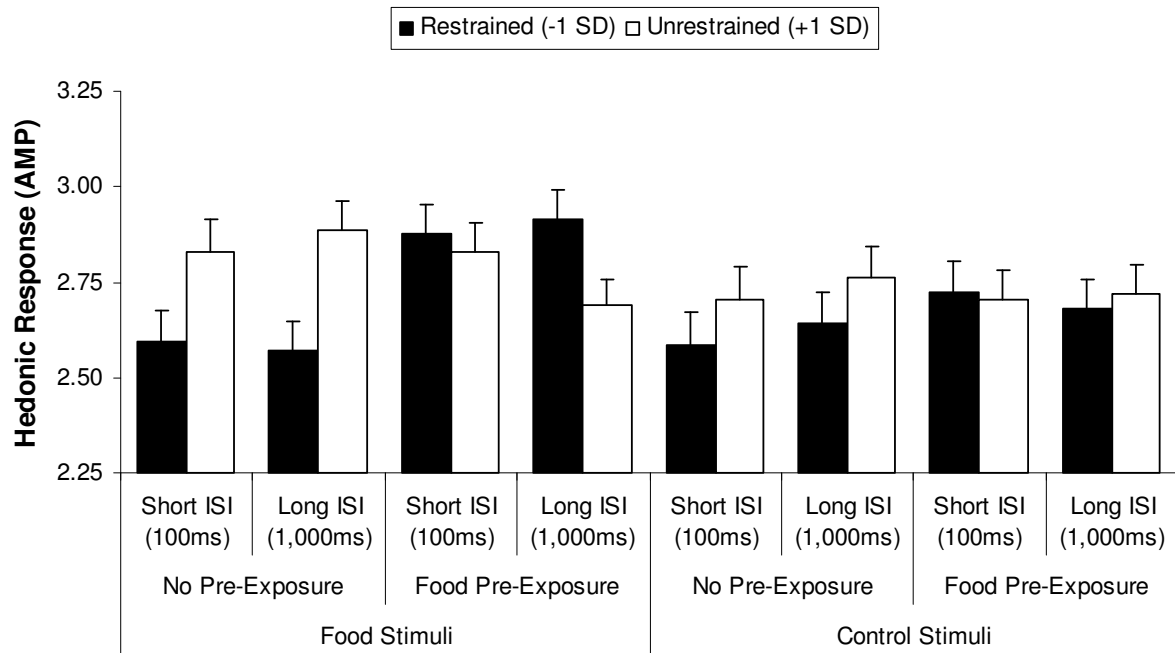
Correlations printed in bold are significant at $p < .05$ (two-sided). Correlations in italics are marginally significant at $p < .10$ (two-sided).

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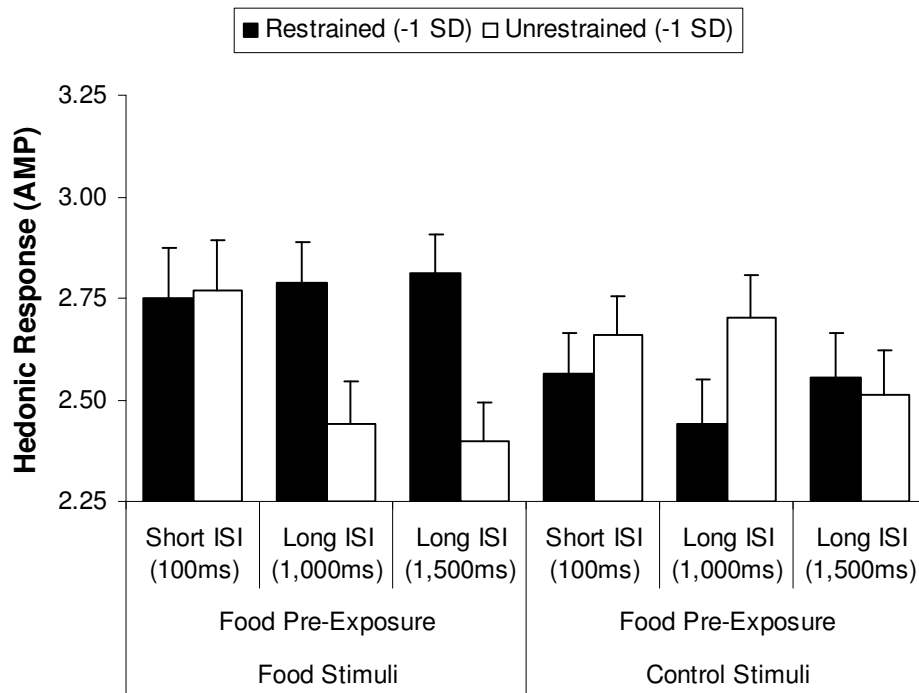
Figure Captions

Figure 1. Hedonic responses to tempting food and matched positive control stimuli in Study 1 as a function of food pre-exposure (yes vs. no), interstimulus interval (short vs. long), and dietary restraint (dieters vs. normal eaters, +1 *SD* vs. -1 *SD* of the mean of the dietary restraint scale, respectively). Error bars reflect the standard error of the mean.

Figure 2. Hedonic responses to tempting food stimuli and matched positive control stimuli in Study 2 under pre-exposure as a function of interstimulus interval (100 ms, 1,000 ms, 1,500 ms), and dietary restraint (dieters vs. normal eaters, +1 *SD* vs. -1 *SD* of the mean of the dietary restraint scale, respectively). Error bars reflect the standard error of the mean.



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