

Effects of Temptation and Weight on Hedonics and Motivation to Eat in Women

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Objective: The aim of the present study was to examine the extent to which food temptation influences liking, the hedonics of food, and wanting, the motivation to eat, and whether this effect differed between normal-weight and overweight women.

Methods and Procedures: Ninety-seven normal-weight and overweight women participated in a randomized experiment, which used a two-by-two design with food temptation and body weight as independent variables. ANOVAs tested the effect of these factors on wanting and liking.

Results: The most important finding of this study was that food temptation had a significant effect on wanting, but not on liking. Wanting was mainly influenced by temptation; however, this effect was moderated by weight. Interestingly, temptation caused a decrease in wanting, but only in normal-weight women. This effect of temptation could not be explained by a change in affect after manipulation or a difference in hunger before the start of the experiment.

Discussion: A possible explanation for the finding that normal-weight women showed a decline in wanting after the confrontation with highly palatable food may be that normal-weight women are protected by a higher sensory-specific satiety. Moreover, it is possible that in these women goals regarding, for example, weight maintenance are more easily evoked, which may remind them of the positive consequences of not yielding into temptation.

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INTRODUCTION

It is generally known that modern society is currently confronted with an increasing number of obese adults and children, a problem that ranks high on the list of the World Health Organization's top 10 of global health problems (1). One of the causes of weight gain is the increase in energy intake. Berridge (2,3) has suggested that two reward systems with separate neurological substrates each play an independent role in the regulation of food intake. On the one hand, food intake is influenced by "liking" the taste of food, which refers to the hedonic preferences for food or, in other words, the pleasantness of food, and is regulated by opioid neurotransmission (2). On the other hand, food intake is driven by "wanting" food, which refers to appetite or the motivational value of food and is influenced by dopaminergic changes (4). It has been demonstrated that liking and wanting are not strongly correlated and are regulated by, at least partly, separate processes (e.g., ref. 5), which may change differently over time (6).

Knowing the factors that influence these two reward systems may be important in explaining when and why people overeat. Previous research has demonstrated that wanting increases when the individual is deprived (5,7), is confronted with a new food for which he/she has not yet worked for (8), or when a higher variety of food is present (9), whereas it decreases when

the costs to obtain access to the palatable food grow (10,11) and after repeated presentation of the same food item (9). Another important variable may be weight. Researchers have found that, compared with normal-weight women, overweight women are more sensitive to the rewarding aspects of food (12) and are more motivated to work for food (13).

Liking seems to be influenced by other variables. Some previous research results can even be interpreted as that liking might be less state- and context-dependent than wanting. For example, Epstein *et al.* (5) found that food deprivation increased the motivation to eat but not the hedonics of food. Also regarding weight, no differences have been found between obese and nonobese women in liking with respect to specific tastes and aromas (14,15), and snack foods (13); however, it must be said that the results for the liking of fat remain less clear (16). On the other hand, previous research has also demonstrated that some factors indeed influence liking; repeated exposure to food, such as chocolate, tends to decrease the liking for that specific food item (e.g., refs. 17,18).

The present experiment aims to contribute to research into the factors effecting hedonics and motivation to eat by examining whether the confrontation with temptation has an effect on liking and wanting and whether its potential influence differs between women with normal weight and women with

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overweight. This is important, because on a daily basis and in many different places people are confronted with highly palatable food that are very rewarding to eat, but not very helpful in attaining goals, such as remaining slim and healthy. In our western society, it is very hard to avoid these constant temptations. Examining the effect of food temptation on liking and wanting may shed light on the question why some individuals are more prone to yield to temptation whereas others are not. There is very little data that test whether seeing palatable food cues alone causes a change in hedonics and motivation to eat. Moreover, it has not yet been examined whether this effect may differ between normal-weight and overweight people. Interestingly, previous research has demonstrated that exposure to highly pleasurable food triggers higher desire to eat (19,20) and increased consumption of food (21), suggesting that the reward systems may indeed play a role in the response to temptation.

We hypothesize that a main effect of temptation will be primarily found for wanting and not for liking, because wanting is more sensitive for external influences. In accordance with results showing that obese people have a higher motivation to eat (13), but not an increased pleasure for food (14,15), we predict that the same result will be found for women who are overweight, but not (yet) obese. In comparison with normal-weight women, overweight women will have an increased wanting, but a similar liking. Moreover, we predict that weight plays a moderating role in the relationship between temptation and wanting. As overweight individuals have a fundamentally higher motivation to eat, the hypothesis is that they will have a stronger reaction to temptation than normal-weight women; in other words, we expect to find an interaction effect between temptation and weight regarding wanting.

METHODS AND PROCEDURES

Participants

Participants were 101 female psychology students of the Utrecht University in the Netherlands. They were told that the aim of the present study was to examine their opinion on products, but they were unaware of the actual purpose of the study. They received one experimental credit or €3 for their participation. Exclusion criteria were being pregnant, having a history of eating disorders, currently suffering from a medical condition, being a top-class athlete, or being an extreme restrained eater. Two students were excluded because of their high score on the Restraint Scale (22; cutoff score of 30, see Measurements) and one student was excluded because she was underweight (BMI (kg/m²) <18), which resulted in a sample of 98 participants with a mean age of 21.2 (s.d. = 1.4, range 18–25). They were divided in a normal-weight group (BMI = 18–25, $M = 21.6$, s.d. = 1.7, $n = 66$) and an overweight group (BMI = >25–30, $M = 27.6$, s.d. = 1.9, $n = 32$).

Procedure

Two weeks before the start of the experiment, potential participants were asked to fill in a short questionnaire, which contained the [Q2] Restraint Scale (see Measurements), questions referring to the exclusion criteria, and to body weight, height, age, and prescribed restrictions concerning food/drinks. In addition, they were asked in this questionnaire to indicate on a 10-point Likert scale (ranging from 1 = not at all to 10 = very much) to what extent they liked several types of fruit (apples, oranges, bananas), vegetables (carrots, cucumber, cherry, tomatoes) and snacks (chips, chocolate, wine gums) in order

to determine their favorite snack and favorite fruit or vegetable. This latter information was used for the wanting measure, which will be described later. Participants had to rate their liking of at least one product in every category at least a 7 on the 10-point scale. All potential participants met this criterion.

With the selected 98 participants, an appointment was made by telephone or e-mail and they were asked to eat normally, but to refrain from eating at least 2 h before the start of the experiment. One person had eaten half-an-hour before the start and was therefore excluded, which resulted in a final sample of 97 women. Arriving at the laboratory, participants from the normal-weight group as well as the overweight group were randomly assigned by the computer to the temptation condition or the no temptation condition. A two-by-two experimental design was used with body weight (normal weight vs. overweight) and food temptation (control vs. temptation) as independent variables.

Participants were tested individually in a 12 m² room. Temptation was manipulated by bringing the participants into a room, decorated with posters depicting popular fattening food items. In addition, an array of tempting snacks (marshmallows, slices of cake, salted cookies, and chocolate chip cookies) was used to create a highly tempting situation. The large bowls of snacks were placed within reach and the participants were asked to evaluate the snacks on their presentation, smell, and appearance to make them even more aware of the temptations. The researcher left aside whether or not the participant could taste and consume the snacks. During this part of the experiment, the researcher left the room for 10 min to give the participant the opportunity to secretly taste and eat the snacks as well. Only a few participants asked whether they were allowed to consume the food. They were told that they could decide for themselves whether they would eat the snacks. Afterward, we measured the amount of food eaten from the bowls. Participants who had eaten from the snacks were excluded from the analyses, because tasting and eating the snacks could have an effect on wanting and liking. It appeared that none of participants had to be excluded.

In the no temptation condition, the participants followed the same procedure. A neutral room was created containing neutral objects to ensure that the participants were not confronted with any temptation whatsoever. During the 10 min when the researcher left the room, the participants were asked to give their opinion about neutral magazines (e.g., garden magazine, house and kitchen magazine), which did not contain any type of temptation. As in the temptation condition, they answered questions regarding the magazines' presentation and appearance.

After manipulation, first wanting and then liking was assessed. The experiment ended with the measurement of several control variables. Participants' height and body weight were measured, and they were asked whether they had taken any snacks during manipulation. Afterward, participants were debriefed, thanked, and reimbursed for their participation. On average, the duration of the experiment was 30 min.

Measurements

Liking. We assessed liking by rating the participants' hedonic responses to three sucrose-in-water solutions: 0% sugar solution, 20% sugar solution, and 40% sugar solution. Participants were asked to drink 15 ml of the solution, to taste it and to swallow it, and to rate its pleasantness by answering on a five-point Likert scale (ranging from 1 = I do not like this at all to 3 = neutral to 5 = I like this very much) to what extent they liked the solution. The solutions were presented randomly and the participants were asked to rinse with some still water before tasting the next solution.

Wanting. In order to measure wanting, we used the forced-choice questionnaire developed by Goldfield *et al.* (23). First of all, a training questionnaire, with money as a reinforcer, was filled in to familiarize the participants with this measurement instrument. The

questionnaire consisted of 16 trials. In each trial, the participant was asked to make a choice to work to obtain either 100 g of their most favorable snack or 100 g of their most favorable vegetable/fruit, rated in the short questionnaire 2 weeks before the experiment. The amount of work (i.e., button presses on a counter connected to a computer) required to obtain the snack food increased with each choice, but the work required to obtain the healthy alternative remained fixed on all choices. The snack food choice began at 20 button presses on the first trial and increased with 20 presses on subsequent trials with a maximum of 320 presses on the last trial. The healthy alternative choice started and stayed at 20 button presses on each trial. Following Goldfield *et al.* (23), the participants were asked to carry out one of their choices after the completion of the questionnaire in order to encourage valid responses. They chose 1 of 16 numbers from a small box, each number representing one trial. Then, they carried out the choice they had made on that particular trial. For example, if the participant pulled number 6, she would be asked to carry out her circled choice for item number 6, which would be either 120 button presses to obtain her favorite snack or 20 button presses to obtain her favorite fruit/vegetable. After the end of the experiment, participants received their favorite snack food or healthy food for which they had been working. They did not consume the food at the laboratory, but they took it with them. The participants' score on this wanting measure was assessed by computing a percentage of the choices in which the participants chose their favorite snack food.

Restraint status. Participants' restraint status was assessed with a Dutch translation of the Restraint Scale (22), which consists of 10 items measured on a five-point Likert scale (Cronbach's $\alpha = 0.75$). Participants with a score of ≥ 30 were excluded from this experiment.

Hunger. Before the start of the experiment and right after the end of the experiment, participants were asked the question "At this moment, how hungry are you?". They could answer on a five-point Likert scale ranging from 1 = not at all to 5 = very much.

Affect. In order to examine whether potential effects of food temptation on liking and wanting are caused by a change in affect, we measured participants' positive and negative affect before and after the manipulation by using a short, six-item version of the Positive and Negative Affect Scale (24). Participants were asked to indicate on a five-point Likert scale (ranging from 1 = not at all to 5 = extremely) to what

extent they felt alert, happy, excited, irritable, distressed, and upset at that particular moment.

Statistical analyses

Two separate ANOVAs were used to analyze the differences in liking and wanting between the women in the four experimental conditions. Main effects of food temptation (temptation vs. control) and body weight (normal weight vs. overweight) as well as the interaction effect between these two variables were examined. Control variables were included in the analyses as covariates when they showed a significant association with the dependent variables, in other words, with liking or wanting. Zero-order Pearson correlations were used to determine these associations. As the sample included more normal-weight women than overweight women, we corrected for unequal cell sizes while analyzing.

RESULTS

Descriptive statistics

Table 1 displays the differences between the four experimental groups. No significant differences were found regarding the two baseline variables age and restraint status. Nevertheless, it appeared that normal-weight participants ($M = 23.3$, $s.d. = 5.0$, $n = 65$) showed higher restraint eating than overweight participants ($M = 21.0$, $s.d. = 4.8$, $n = 32$), which was confirmed by an independent-samples *t*-test ($t(95) = 2.16$, $P = 0.03$). Therefore, restraint status was included in the analyses as a covariate.

Not surprisingly, the overweight groups had a significantly higher body weight than the normal-weight groups. Furthermore, the overweight group randomized to temptation was hungrier before the start of the experiment than their normal-weight counterparts. Therefore, hunger was also included as a covariate in the analyses. Another reason for including this variable in the analyses was that it significantly and positively associated with wanting (see **Table 2**). Logically, participants who were hungrier were also more motivated to obtain their favorite snack. None of the other control variables correlated significantly with liking or wanting.

Table 1 Raw means and standard deviations of the variables for the four experimental groups ($N = 97$)

	Group 1: normal weight, no temptation ($n = 36$)	Group 2: overweight, no temptation ($n = 16$)	Group 3: normal weight, temptation ($n = 29$)	Group 4: overweight, temptation ($n = 16$)	$F(3, 96)^a$
Baseline					
Age	20.9 (1.2)	21.6 (1.7)	21.4 (1.3)	20.6 (1.4)	2.40
BMI (kg/m^2) ^b	21.7 (1.5) _a	27.6 (1.7) _b	21.4 (1.9) _a	27.6 (2.1) _b	83.12**
Restraint status	23.4 (5.1)	21.2 (4.3)	23.3 (4.9)	20.7 (5.3)	1.56
Hunger before	3.2 (0.9) _a	3.0 (1.2) _a	2.7 (1.1) _{a,b}	3.7 (0.7) _{a,c}	3.71*
Outcomes					
Hunger after	3.2 (0.9)	3.2 (1.2)	3.1 (0.9)	3.9 (1.0)	
Change in NA	-0.09 (0.32)	0.02 (0.28)	-0.09 (0.27)	-0.10 (0.23)	
Change in PA	-0.06 (0.32)	0.02 (0.33)	-0.01 (0.17)	0.02 (0.51)	
Liking	2.6 (0.6)	2.8 (0.7)	2.7 (0.5)	2.9 (0.5)	
Wanting	52.4 (27.1)	49.2 (20.5)	27.2 (17.9)	47.3 (24.8)	

NA, negative affect; PA, positive affect.

^aThese are the univariate *F*s calculated by ANOVA. Row means with dissimilar subscripts are significantly different from each other. ^bIn order to calculate BMI, weight and height scores were used that were measured by the researcher at the end of the experiment. * $P < 0.05$. ** $P < 0.01$.

Table 2 Zero-order Pearson correlations between the variables (N= 97)

	1	2	3	4	5
1. Liking	—				
2. Wanting	0.14	—			
3. BMI	0.13	0.10	—		
4. Restraint status	-0.07	0.01	-0.16	—	
5. Hunger before	-0.08	0.24*	0.09	-0.12	—
6. Hunger after	0.01	0.12	0.12	-0.01	0.67**

* $P < 0.05$. ** $P < 0.01$.

One-way ANOVA showed that temptation did not influence participants' affect; no significant differences were found for the four groups regarding change in negative affect ($F(3, 93) = 0.72, P = 0.54$) or positive affect ($F(3, 93) = 0.40, P = 0.75$). Neither did we find differences between the temptation group and the control group with respect to a change in negative affect ($m = -0.10$ (s.d. = 0.25) vs. $m = -0.06$ (s.d. = 0.31), $F(1, 95) = 0.44, P = 0.51$) and positive affect ($m = 0.00$ (s.d. = 0.33) vs. $m = -0.04$ (s.d. = 0.32), $F(1, 95) = 0.34, P = 0.56$).

Liking

Regarding liking, a main effect of weight was found ($F(1, 91) = 4.95, P = 0.03, \eta_p^2 = 0.05$). Overweight women generally evaluated sugar solutions as more positive (raw $M = 2.9$, s.d. = 0.1) than normal-weight women (raw $M = 2.6$, s.d. = 0.1). As expected, no significant main effect was found for temptation ($F(1, 91) = 0.31, P = 0.58$). Finally, we also did not find a significant interaction effect ($F(1, 91) = 0.07, P = 0.79$). It appeared that the amount of hunger before the start of the experiment did not influence the hedonic responses to sweet solutions ($F(1, 91) = 1.42, P = 0.24$) and neither did restraint status ($F(1, 91) = 0.07, P = 0.79$). The model explained 7% of the variance in liking.

Wanting

In the second ANOVA, liking was included as an additional covariate. The analysis did not show a significant main effect of weight ($F(1, 90) = 0.79, P = 0.38$). We found a significant main effect of temptation ($F(1, 90) = 13.61, P < 0.001, \eta_p^2 = 0.13$). Striking is that women who were confronted with food temptation were less motivated (raw $M = 37.2$, s.d. = 3.6) to obtain their favorite snack than women in the neutral condition (raw $M = 50.8$, s.d. = 3.5). Finally, a significant interaction effect was found ($F(1, 90) = 5.39, P = 0.02, \eta_p^2 = 0.05$). Post hoc analysis revealed that, in the normal-weight group, wanting did significantly decrease after temptation ($F(1, 94) = 17.86, P < 0.001$), but no such significant difference was found for the overweight group ($F(1, 94) = 0.06, P = 0.81$). In other words, only women with normal weight were less motivated to work for the favorite snack when they were confronted with food temptation. No effect of temptation was found for overweight women. Regarding the covariates, it appeared that the amount of hunger before the start of the experiment did not have a significant

effect ($F(1, 90) = 3.02, P = 0.09$), neither did restraint status ($F(1, 90) = 0.17, P = 0.69$) nor liking ($F(1, 90) = 2.92, P = 0.09$). The model explained 23% of the variance in wanting.

DISCUSSION

The aim of the present experimental study was to examine whether food temptation affects hedonics and motivation to eat in normal-weight and overweight women. Understanding the differences in responses of the two reward systems may help to understand why some individuals yield to temptation and overeat, which may eventually contribute to becoming overweight. Consistent with our hypothesis, we found that temptation did not influence liking, but that it did have a significant effect on wanting. Interestingly, when confronted with palatable, tempting food the motivation to eat decreased, but only for normal-weight women; overweight women did not show a change in motivation after temptation. This suggests that different mechanisms play a role in the effect of temptation in normal-weight and overweight women.

A possible explanation for the unexpected result that wanting decreased after confrontation with temptation can be found in the direction of the phenomenon of sensory-specific satiety, a well-established finding in children (8,25), adults, and animals (for recent reviews, see refs. 26,27). When a certain food is eaten, its pleasantness and the motivation to eat more of that food decrease gradually, even though the stomach is not yet full (28). An individual is still motivated to eat other food items, so he/she is not satiated *per se*, but only satiated to the sensory properties of the specific food that has been consumed. Previous research has shown that sensory-specific satiety not only occurs after food consumption, but also after the sight of food (9). It seems plausible that the confrontation with highly palatable food cues alone can cause a decrease in wanting via the mechanism of sensory-specific satiety. Interestingly, our research demonstrated that only normal-weight women were less motivated to work to gain access to their most favorite snack when being confronted with temptation. Overweight women remained having a higher wanting. It is possible that normal-weight women have a more strongly developed sensory-specific satiety system, which may protect them against overeating. Recent research has found no differences in sensory-specific satiety between normal-weight and obese people when foods are consumed (29,30). However, regarding the confrontation with food temptation without actually tasting and eating the foods, an interesting study by Epstein *et al.* (31) indeed showed that the salivation response in obese women habituated slower to the repeated presentation of food cues than it did in nonobese women, indicating that their wanting decreased more slowly after confrontation with palatable food. It will be interesting to examine whether the same is true for overweight women.

Recent research by Fishbach *et al.* (32,33) may direct to another possible explanation. They found that the confrontation with temptations, such as palatable food, may automatically and effortlessly help people to remember their long-term priorities, such as maintaining a normal weight and remaining

healthy (32–34). The idea that temptations might be adaptive is also found in other research domains that demonstrated that environmental cues can trigger goals (35) and concordantly elicit goal-directed behavior (e.g., refs. 36–38). It is possible that in normal-weight women goals are more easily evoked, goals that remind them of the positive consequences of not yielding into temptation, which may eventually protect them against the undermining consequences of daily temptations. Of course, it may be that normal-weight women have more health goals than overweight women to begin with, which confounds the relationship between weight and wanting and undermines this potential explanation. Nevertheless, we excluded extreme restraint eaters from the sample and, moreover, we found no significant association between BMI and restraint eating. In other words, we think that this potential explanation is worth investigating. Future research is necessary to examine both hypothetical explanations for the finding that normal-weight women are less motivated to eat after temptation than overweight women.

Another finding of the present study was that not food temptation but weight had a significant effect on liking. Overweight women rated the sweet tastes as more pleasant than normal-weight women. In the literature, there is no longer a strong debate about the question of whether overweight and obese people have a fundamentally higher pleasure in tastes and food products than normal-weight individuals. Although some previous research has demonstrated that moderately obese individuals liked sweet tastes better than normal-weight individuals (39), many other researchers did not find any differences in palatability of specific tastes (14,15) and snack foods (13) between obese and nonobese people. The results of the present study showed that overweight women had a higher pleasure for sweet tastes, but this effect was very small.

Although the lack of effect of temptation on liking was in accordance with our hypothesis, it is important to note that it is possible that this nonfinding may be (partly) due to the fact that the foods used for the manipulation differed from the one used for the measurement of liking. It may be interesting to examine whether the same results are found when hedonics are assessed of the palatable foods that are also used in the exposure condition.

A limitation of the present study is the fact that we only included highly educated, young women, so we are not able to make any conclusions about the influence of temptation on liking and wanting in other populations varying in gender, age, and educational level. Trying to replicate described findings in other samples is a necessary line of research for the future. For example, it will be very interesting and important to examine whether the same results will be found for normal-weight and overweight men.

To conclude, this experiment showed that food temptation and body weight are important factors in explaining the motivation to eat in women. The main finding of the present study was that food temptation did not influence liking, but that it did have an effect on wanting, however, in the opposite direction than expected. The confrontation with palatable

food caused a decrease in the motivation to work for a favorite snack, but only in normal-weight women. Wanting did not decline in overweight women. It seems that varying mechanisms are responsible for the effect of food temptation on the motivation to eat snack food in normal-weight and overweight women.

DISCLOSURE

The authors declared no conflict of interest.

[Q3]

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