PLEASURE AS A SUBSTITUTE FOR SIZE: HOW SENSORY IMAGERY CAN MAKE
PEOPLE HAPPIER WITH SMALLER FOOD PORTIONS

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In today's research on overeating, pleasure is seen as the enemy that consumers need to sacrifice for health's sake. Contrary to this view, the authors show that sensory pleasure can make people prefer smaller food portions and be good for business. In four experiments, they asked American and French adults and children to imagine vividly the taste, smell and oro-haptic sensations of three hedonic foods, prior to choosing a portion size of another hedonic food. Compared to a control condition, this "sensory imagery" intervention led non-sated people to choose smaller portions, expect more eating enjoyment, and be willing to pay more for their (smaller) portion. This occurred because it made people evaluate portions based on expected sensory pleasure, which actually peaks at the first bite, rather than on expected hunger satiation. In contrast, health-based interventions led people to choose a smaller portion than the one they expected to enjoy most—a hedonic cost for them and an economic cost for food marketers. Overall, focusing on sensory pleasure can benefit consumers, businesses, and public health.

Key words: food consumption, health, portion size, nutrition, mental imagery, hedonic consumption.
“A wise person does not simply choose the largest amount of food but the most pleasing food.”

Epicurus (341-270 BC), Letter to Menoeceus

In most fast-food restaurants, and on an increasing number of other consumption occasions, customers ordering a beverage or dessert also need to choose between different portions sizes. Most food portions are now much larger than the USDA recommended serving size, contributing to overeating, obesity and food waste (Hall et al. 2009; Ledikwe et al. 2005; Nestle 2003; Rolls et al. 2007; Zlatevska et al. 2014), so the question is how can we encourage people to choose—and actually prefer—smaller food portions?

Existing research in health and consumer science recommends an array of solutions aimed at encouraging people to trade off the expected enjoyment from eating large portions of hedonic foods for better health (Belei et al. 2012; Raghunathan et al. 2006; Shiv and Fedorikhin 1999). Unfortunately, health-based solutions come at a hedonic cost for the consumers who forego the larger portions that they expect to enjoy most (Patterson et al. 2001) and an economic cost for food marketers by turning consumers away from larger and typically more profitable portions (Dobson and Gerstner 2010; Giuliani et al. 2013).

Another strategy to reduce overeating is to satiate the consumer’s desire to eat, for example through simulated repeated consumption or choice of food (Larson et al. 2014; Morewedge et al. 2010). However, simulated satiation reduces eating enjoyment and willingness to pay for food, and is therefore bad for business.

In short, there is no obvious way to make people prefer smaller food portions, that is, to make them expect to enjoy them more, and be willing to pay at least as much for them as for the larger portions they would otherwise have chosen.
This research explores ways to encourage consumers who have already chosen a drink or
dessert to choose smaller portion sizes at no hedonic cost to themselves or economic cost to
companies who make the food. To reach that aim, we challenge the generally-held assumption
that sensory pleasure is the enemy of healthy eating and develop an innovative intervention –
multisensory mental imagery – which consists of vividly imagining the multisensory pleasure
(taste, smell, texture) of three hedonic foods prior to choosing the size of another hedonic food. In
a series of experiments, multisensory imagery made non-sated children and adults in France and
in the US choose smaller portions of chocolate cake, brownies or soft drinks compared with a
control condition. We also show that, unlike health appeal, multisensory imagery increases the
expected eating enjoyment for small (but not large) portions and increases willingness to pay for
smaller sized portions. By prompting people to choose smaller portions of hedonic foods that
they actually enjoy most, multisensory imagery also improves the calibration between expected
and actual eating enjoyment. In testing the boundary conditions of this intervention, we find that
multisensory imagery backfires and leads to larger portions consumption when consumers are
sated and when they are dieting.

Our findings that pleasure can achieve a “greater good” – for consumer enjoyment, business,
and health – contribute to the debate on the sustainability of the food industry and its ability to
grow without contributing to the obesity epidemic (Chandon and Wansink 2012b; Ludwig and
Nestle 2008). This is particularly relevant for fast food, which is associated with overeating
(Currie et al. 2010) and less ability to savor pleasurable experiences (House et al. 2014). Our
results extend the research on ‘mindful’ eating (Kidwell et al. 2008; Papies et al. 2012), which
has focused on impulsive eating but has neglected portion size choice. They also advance our
understanding of the behavioral consequences of simulated eating, showing that it can increase—
and not just decrease (Larson et al. 2014; Morewedge et al. 2010)—pleasure expectations.
Overall, our results align with the movement advocating a paradigm shift from “food as health” to “food as well-being”, and calling for a more holistic and positive role for pleasure in food (Block et al. 2011).

**CONCEPTUAL BACKGROUND: MULTISENSORY PLEASURE AND PORTION SIZE**

Although the obesity epidemic is largely driven by ever-increasing food portion sizes, public policy efforts to fight obesity, but also research on overeating, have largely focused on what people choose to eat instead of how much people choose to eat (Chandon and Wansink 2012a). In particular, the effects of sensory pleasure on portion size preferences once people have decided what they want to eat are not well known.

*Portion Size Preferences: The Role of Hunger, Health, and Sensory Pleasure*

When choosing between a small or large brownie or between a small, medium, large, or extra-large soft drink, leaving aside price considerations, consumers are influenced by at least three expectations: (1) “Will this portion satiate my hunger?” (2) “How will it impact my health and weight?” and (3) “How pleasurable will it be?”

Hunger and expectations about hunger satiation are the number one driver of food portion choice (Brunstrom 2014). In several studies, it was found that people’s expectations of food’s satiating power were highly correlated with their selection of portions size, suggesting that portion size choice is governed primarily by expected hunger satiation (Brunstrom 2014; Brunstrom and Rogers 2009; Brunstrom and Shakeshaft 2009). This explains why hunger leads people to choose larger portion sizes (Herman and Polivy 1983). However, hunger satiation is certainly not the only factor influencing portion size choice. In fact, in a recent review paper by Herman and Polivy (2014) argues that the importance of hunger is often overestimated, as food
decisions (including portion size choices) are also strongly influenced by normative and affective factors.

Except for dieters, concerns about health and weight are less important drivers of food choices than expected hunger satiation (Glanz et al. 1998; van Strien et al. 1986). Still, prompting people to think about their health and weight can reduce food intake (Giuliani et al. 2013), although the evidence regarding its effects on portion size choice is circumstantial (Ledikwe et al. 2005). For example, we know that providing calorie and nutrition information can reduce the calorie count of food ordered in fast-food restaurants, but we do not know how much of this reduction comes from choosing smaller portions as opposed to choosing different types of food (Bollinger et al. 2011; Harnack and French 2008).

The effects of sensory pleasure expectations on portion size choice are not well known. Most food ads, especially those for fast-food restaurants, promise that consuming more food will bring more pleasure (Harris et al. 2010), and this assumption is commonly made in the literature on supersizing (e.g., Dobson and Gerstner 2010). However, no research has actually measured how much pleasure people expect to derive from eating a small, medium, or large portion of the same hedonic food. This is a crucial oversight, because – at least post-intake – more food does not mean more pleasure. In fact, the first few mouthfuls of a palatable food are the most pleasurable; sensory pleasure declines with each additional mouthful among adults, children and infants alike, and for all foods (Mennella and Beauchamp 1999; Rolls et al. 1981), particularly for hedonic foods (Sorensen et al. 2003). This phenomenon, called sensory-specific satiation, is clearly distinct from hunger satiation. Although both contribute to overall eating enjoyment, sensory enjoyment peaks during the first mouthfuls before satiation of hunger (Romer et al. 2006). Sensory-specific satiation is important because it is the last mouthful, not the first, which most strongly influences the overall evaluation of a meal (Rode et al. 2007; van Kleef et al. 2013). For
example, Garbinsky et al. (2014) found that people enjoy the fifteenth cracker less than the fifth one. For this reason, people asked to eat 15 crackers (vs. only 5) experienced less enjoyment, and wanted to wait longer before tasting the crackers again. In other words, sensory-specific satiation does not just mean that later bites are enjoyed less than the first ones (i.e., marginally diminishing pleasure); it means that consumption quantity can actually reduce overall eating enjoyment.

To summarize, existing research suggests that hunger will prompt people to prefer larger portions, whereas a focus on health or body weight will prompt them to choose smaller portions but expect to enjoy them less. Focusing on sensory pleasure should lead people to prefer smaller portions (because they provide the most pleasurable sensory experience), but the association between sensory pleasure expectations and choice of portion size remains unknown.

Research conducted on the effects of focusing on sensory pleasure (e.g., through mindful eating) has several important limitations. We know that training people to eat mindfully (i.e., to pay more attention to taste, emotions and bodily sensations while eating in order to better recognize and analyze one’s impulsive reactions to food) decreases ad libitum eating (Kristeller and Wolever 2010; Poothullil 2002) and can lead people to choose healthier foods (Kidwell et al. 2008; Papies et al. 2012). However, the effects of mindful eating on expected overall eating enjoyment and pre-intake portion size preferences are not known. Studying portion size choices is important, because once people choose a food portion, they tend to eat all of it even if they are not hungry anymore (for a review, see Zlatevska et al. 2014). Moreover, even the shortest mindful eating training can take up to 45 minutes and requires concentration to be applied to the 200 food decisions that consumers typically make each day (Wansink and Chandon 2014). In the following section, we describe a short intervention which applies mindful eating techniques to simulated (vs. actual) consumption and explain how it increases preferences for smaller portions.
Hypotheses: Sensory Imagery, Portion Size Preferences and Pleasure Expectations

Our intervention, “Multisensory mental imagery” consists in showing photos of three familiar hedonic foods (e.g., vanilla ice cream) and encouraging consumers to vividly imagine the multisensory pleasure (aroma, taste, and texture in mouth) that they would experience by consuming them. It is a deliberate form of imagery (Krishna and Schwarz 2014) designed to mentally simulate the multisensory hedonic experience of eating indulgent food and to be applicable in a restaurant setting (e.g., through imagery-rich descriptions in menu boards) or in a school setting.

Because it focuses people on sensory pleasure, multisensory imagery should increase the relative importance of expectations about sensory pleasure over those about hunger satiation (or those about weight gain among dieters) in driving portion size choice. This is consistent with a stream of research which shows that taking an experiential perspective (through imagery or feelings) changes the criteria used when evaluating and choosing products (Holbrook and Hirschman 1982; McGill and Anand 1989). For example, affective priming (say, by showing photos of babies) increases the importance of affective over quantitative attributes such as the number of objects in driving evaluation (Hsee and Rottenstreich 2004). Likewise, vividly imagining the consumption of a product leads people to choose products that provide more affective satisfaction (Shiv and Huber 2000).

Further, multisensory imagery should be particularly effective in retrieving expectations of sensory pleasure for different food portion sizes. There is strong evidence that vividly imagining eating emulates the mental processes (emotions, cognition, sensations) engaged in actual eating (Barsalou 2008; Elder and Krishna 2012; Krishna and Schwarz 2014). By emulating these mental processes, mental imagery increases how much people rely on their past experience when making decisions. It not only helps people reconstruct their past experiences, but it also helps
people anticipate more vividly and more accurately their future experiences (Moulton and Kosslyn 2009). For these reasons, multisensory imagery should help people better anticipate that smaller portions will maximize sensory pleasure. Because everyone, including children, has had the experience of sensory-specific satiation since early infancy (Mennella and Beauchamp 1999), the effects of mental imagery should not be limited by age or food expertise.

Our proposed mechanism is therefore that multisensory imagery puts a stronger emphasis on expected sensory pleasure over other considerations (such as hunger satiation) when choosing portion sizes. This should prompt most people to choose smaller portions as well as increase their expectations of enjoying these smaller portions (i.e. they would choose smaller portions because they expect these portions to maximize pleasure). Multisensory imagery should therefore also have a positive effect on willingness to pay, despite the choice of smaller portions. In contrast, health appeals can also prompt the choice of smaller portions but as a result of a trade-off between enjoyment and health, thereby reducing the chances that people choose the portion expected to maximize pleasure. Finally, sensory imagery should reduce the chances that people choose portions based on expectations of hunger satiation, that are ultimately too large from a pure pleasure standpoint. In other words, sensory imagery should also increase the calibration between expected and experienced pleasure.

We want to emphasize that multisensory imagery is qualitatively different from recent eating simulation interventions and leads to different predictions. In particular, repeated eating simulation (Larson et al. 2014; Morewedge et al. 2010) consists in asking participant to imagine eating one M&M 30 times or asking them to make 60 repeated choices and ratings of snacks, whereas our intervention consists of imagining the multisensory enjoyment (taste, smell, texture in mouth) of three hedonic foods only. More importantly, repeated eating simulation reduces the overall desire for food and willingness to pay for it, even for a very small quantity (e.g. one
cheese cube), because it satiates the consumer’s desire. In contrast, sensory imagery should increase preference and willingness to pay for a small portion.

The Moderating Role of Hunger and Dieting

Our research objective is to examine how to encourage people to order smaller portions of hedonic food when they have already decided to eat such food, which most likely happens when they are hungry and if they are not on a diet. There are obviously cases where multisensory imagery will be inefficient, and may even backfire. First, when people are already sated (i.e. not hungry at all), they naturally prefer small portions (they do not need to satiate hunger). In this case, relying on expected hunger satiation -the default criterion of portion choice (Brunstrom 2014)- naturally leads them to choose small portions, whereas emphasizing sensory pleasure in already sated people should be inefficient and should even backfire, i.e. preferring larger portions compared to a control condition.

Second, a chronic dieting tendency is another important moderator of the effects of sensory imagery. Dieters (like sated people) naturally choose smaller food portions, although they do it because they are concerned about their health and weight. When people are chronic dieters, focusing on pleasure is likely to disrupt their dieting commitment and lead them to choose larger portions. This is consistent with research by Fedoroff et al. (1997), who found that asking people to write down their thoughts about eating a pizza increased pizza consumption among dieters but not among normal eaters. Sensory imagery should therefore backfire for dieters, leading them to choose larger portions than in the control condition.

Study Overview

We tested these predictions in four experimental studies involving diverse populations: French and American, adults, young adults, and children. In all studies, the main task was to choose among different portion sizes of a chocolate cake (and an indulgent drink in Study 1). All
portions were presented to participants and were visibly cut from the same cake, ruling out any inferences that smaller portions might be of higher quality. The first experiment, run in a school, demonstrated the basic effect on portion size choice among French children. The second study replicated the effect with US adult consumers, allowing us to measure willingness to pay and the relative importance of sensory pleasure and hunger satiation expectations in the control and the sensory imagery conditions. In the third study, we compared the effects of sensory imagery, health imagery, and a control condition on portion choice, expected (pre-consumption) pleasure, and actual (post consumption) pleasure among dieting and non-dieting French women. In a final study, we compared the effectiveness of a simple menu description intervention vs. calorie and fat labeling in preferences of US adults for smaller portions.

**STUDY 1: EFFECTS OF SENSORY IMAGERY ON THE PORTION SIZE CHOICES OF 5-YEAR OLDS**

In study 1, we tested whether sensory imagery of three chocolaty foods would make hungry (i.e. non-sated) four- and five-year-old children choose smaller portions of brownie and smaller glasses of soft drink, using both hypothetical and actual choices. We conducted this study among young children from a middle-class French public school to rule out two alternative explanations: 1) that small portions are associated with higher sensory quality because they are often served in high-end restaurants; 2) that sensory imagery primes dieting goals (Trope and Fishbach 2000). Children of this age and background are unlikely to have experienced high-end restaurants or to have dieting goals. This age group also allowed us to test our intervention at a time when children start to form their own perceptions of food (Rozin 1990).

**Method**
Following discussions with parents, we selected the Brossard brand of packaged brownie cake and the Oasis brand of sweetened tropical fruit soft drink because they were both familiar and appealing to children. We cut six different sizes of brownie ranging from 0.5 oz. (containing 60 calories, about as much as in one Oreo cookie) to 3.2 oz. (410 calories, about as much as a Starbucks’ regular brownie). We prepared five amounts of soft drink ranging from 0.4 cup (40 calories) to 3.4 cups (350 calories).

Forty-two children (52% female) aged 4 or 5 from two pre-school classes in France participated in this study (with the authorization of their parents and the school board). None of the children suffered from an eating disorder or obesity. The study took place between 10AM and 11:15 AM over two days, in order to ensure that none of the children were sated during the study and to ensure minimal variance in hunger. Children were randomly assigned to either a food or non-food (control) sensory imagery condition and participated in the experiment in groups of four.

In the food sensory imagery condition, children saw photos of three hedonic foods (chocolate cereal, chocolate waffle, chocolate candies). After each picture, the experimenter showed them a photo of a child highlighting the receptors of the five senses. They were then asked to cover their eyes with their hands and to imagine the multisensory features of each of the three foods (e.g., the sound made by the cereals when eaten, the sensation when chocolate melts in the mouth, the smell of the waffle, etc.). To rule out alternative explanations such as that the intervention improved children’s mood or calmed them down, the children in the control condition went through a similar procedure but were shown three photos of children playing at the beach, playing with dead leaves, and making a snowman. Just like the children in the food sensory condition, they were reminded about the five senses and, after covering their eyes, were asked to imagine the multisensory features of the non-food scenes (e.g., the sound of walking on dead
leaves, the taste of a snowflake on the tongue, the warmth of the sun on their skin, etc.). In both conditions, the intervention lasted approximately 5 minutes.

We measured portion size choices first with a hypothetical choice for a projected self (Gripshover and Markman 2013). The children were given drawings of a little girl or a little boy, were told that the drawing represented them, and were asked to write their name on the poster. They were then asked to choose one of five stickers representing portions of cake of different sizes and one of five stickers representing glasses of soft drink of different sizes and to place them in each hand of their self-character (see Figure 1 for examples of the drawings with stickers).

We then measured actual portion size choices. The children were taken one by one into a separate room with the six sizes of chocolate brownie and the five glasses of soft drink shown in Figure 1. They were asked to choose the portion of cake and drink that they would be served for their afternoon snack. Eventually, all the children actually received the same age-appropriate portion. After choosing, the children were asked whether they thought that the chocolate cake and the juice were “not good”, “pretty good”, or “very good”.

Results and Discussion

We analyzed children’s choices with four ordered logit regressions, with portion size as the dependent variable and imagery condition and gender as independent variables. No participant was excluded from analysis. We chose ordered logit because the sticker sizes cannot be converted into an actual size, but the results were identical when using a linear regression and

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1 Two children had difficulties with the tasks because of health issues but including or excluding them did not affect the results. We controlled for gender (and body mass index, when available) in all the studies because of their strong influence on food decisions. In order to facilitate reading comprehension, we only report their effects in the very few cases when they moderated the effect of sensory imagery.
when estimating a single ordered logit random effect regression accounting for the fact that each child made four choices.

The results revealed that children chose smaller portions in the food sensory imagery condition than in the control condition across all four replications: cake stickers (resp. $M=3.2$ vs. $M=4.1$, $z=-2.3$, $p=.02$), drink stickers (resp. $M=3.6$ vs. $M=4.4$, $z=-2.1$, $p=.04$), real cake (resp. $M=3.2$ vs. $M=5.2$, $z=-3.6$, $p<.001$), and real drink (resp. $M=3.2$ vs. $M=4.4$, $z=-2.8$, $p=.005$). The random-effect regression further found that sensory imagery was equally effective for the hypothetical and real choices ($p>.24$) and for the foods and beverage ($p>.5$). Finally, almost all the children expected the chocolate cake and the drink to taste “very good” whether in the food or the non-food sensory imagery condition (respectively 95% vs. 81% for the cake, $\chi^2(1)=.70$, $p=.4$ and 100% vs. 90% for the drink, $\chi^2(1)=.42$, $p=.5$).

Overall, study 1 showed that a brief intervention by school teachers can have sizeable effects on children’s choice of food portions, without requiring adults to restrict children’s options. Food sensory imagery led non-sated children to choose smaller portions of hedonic foods and drinks. The effect held whether the target food shared common sensory characteristics with the imagined foods (chocolate cake) or not (soft drink), and whether the choice was hypothetical or not. The effects were as strong for the last choice as for the first choice, and showed no evidence of compensation from the first choice to the later ones. Because children in both experimental conditions were engaged in mental imagery about pleasurable activities, the results of study 1 cannot be attributed to differences in mood or mental resources. Still, another study was necessary to replicate these results with adults and to examine the hypothesized roles of expectations about sensory pleasure and hunger satiation. Study 2 addresses these limitations.
STUDY 2: EFFECTS OF SENSORY IMAGERY, HUNGER, AND EXPECTATIONS ABOUT SENSORY PLEASURE AND HUNGER SATIATION ON ADULTS’ PORTION SIZE CHOICES AND WILLINGNESS TO PAY

Just like the children in study 1, we expected that sensory imagery would make non-sated adults choose smaller portions of hedonic food. We also expected that it would increase their willingness to pay for their smaller portions. Study 2 also allowed us to test the moderating role of hunger, as well as our hypothesis that sensory imagery will backfire when people are sated, and to test the mechanism of the effect by measuring expectations about sensory pleasure and hunger satiation for each portion size one week before the intervention.

Specifically, we posit that the portion providing the most expected sensory pleasure will be smaller than the portion that best satiates hunger. And that sensory imagery will increase the relative weight of sensory pleasure expectations over hunger satiation expectations in driving portion size choice.

Method

After pre-testing to select a photo of a slice of delicious-looking yet familiar chocolate cake, we created five other portion sizes with Photoshop to obtain six different portion sizes seemingly cut from the same chocolate cake (See Figure 1). For the first phase of the study, we recruited 100 participants on Amazon Mechanical Turk (60% female, mean age=34) and showed them the six portion sizes in increasing order. We asked them to rate (from 1 to 9) how much they agreed that each portion was ‘just right’ in terms of hunger satiation, i.e., to choose a high rating if the size was just right and a lower rating if it was too small or too large. This ensured that the participants would realize that being satiated means being comfortably full rather than “stuffed”. Specifically, expected hunger satiation was measured with three items on a scale ranging from 1
(not at all) to 9 (absolutely): “this portion would be just right for me to feel comfortably full for
dessert”, “this portion would be just right for me to be satiated for dessert” and “this portion
would be just right to satisfy my appetite for dessert.” To allow comparisons, we used exactly the
same format for the ratings of sensory pleasure expectation, which was measured with three
items: “this portion would be just right for me to have a pleasurable sensory experience”, “this
portion would be just right for me to enjoy the taste of this cake” and “this portion would be just
right for me to savor the cake”. The order of the questions on expected hunger satiation and on
expected sensory pleasure was counterbalanced across participants.

One week later, we re-contacted all the participants to take part in the main study; seventy-nine participants replied. These participants were not statistically different from those who did not reply in terms of age, gender and food ratings ($p$’s $> .5$).

We first asked participants how hungry they felt (from 1=“not hungry at all” to 9=“extremely
hungry”) and when was the last time they ate. In the sensory imagery condition, we showed three
pictures of hedonic desserts (a strawberry pie, vanilla ice-cream, and chocolate mousse) and
asked the participants to imagine as vividly as possible the taste, smell and texture in mouth of
each dessert. In the control condition (nonfood sensory imagery), we showed pictures of three
comfortable armchairs and asked the participants to imagine as vividly as possible how they
would feel if they sat on each chair.

Participants were then shown the same six portions of chocolate cake as in the first part of the
study. We asked them to choose one portion and indicate the probability of choosing each
portion, from 1=highly unlikely to 9=highly likely. We then showed them again the portion that
they had chosen and asked them to state the maximum price they would be willing to pay to
purchase this portion.
Finally, as a manipulation check, we asked participants whether they evaluated portion sizes based on expected sensory pleasure or based on expected hunger satiation with three bipolar scales: “I was thinking of the cake’s tastiness” vs. “I was wondering whether the portion would satisfy my appetite”, “I was thinking of eating this cake as a sensory experience” vs. “I was wondering whether the portion would make me comfortably full”, and “I was thinking of savoring the cake” vs. “I was wondering whether the portion would make me feel pleasantly satiated”. We also asked participants whether they were thinking about their health or weight when evaluating the portions of chocolate cake. At the end of the study, we asked about participants’ height and weight in order to compute their body mass index.

Results

Among the seventy-nine participants who participated in the pre-study and the main study, we excluded four participants who failed to pass attention checks and six participants who had not eaten for a full day before the study. These exclusion criteria were applied to all studies to avoid too strong heterogeneity in hunger level among participants categorized as non-sated. Participants’ average hunger in the main study was 4.01 (on a 1 to 9 scale) with a large standard deviation (2.40). We used spotlight analyses (Fitzsimons 2008; Irwin and McClelland 2001) to observe the effects of our manipulations in sated (one standard deviation below the average level of hunger, M=1.61 on the 1-9 hunger scale) and non-sated (one standard deviation above the mean, M=6.41) participants.

As a manipulation check, we verified that compared to the control condition, sensory imagery led people to evaluate the portions based on their expected sensory enjoyment rather than on expected hunger satiation (M = 4.89 in control vs. M = 3.63 in sensory, t(67)=-2.17, p=.03, on a 0-10 scale, where a lower number indicated evaluation based on sensory enjoyment and a higher number indicated evaluation based on hunger satiation). This effect was not moderated by actual
hunger ($t<1$). Furthermore, there were no differences between the control and sensory imagery condition in terms of how much participants thought about their health and weight when evaluating the portions ($t<1$).

**Portion Choice and Willingness to Pay.** We analyzed portion size choice with an ordered logit model with the imagery condition, hunger, their interaction, gender and BMI as independent variables. There was no main effect of sensory imagery on portion choice ($z=.15$, $p=.90$), but a positive main effect of hunger ($z=2.30$, $p=.02$), and more importantly, a strong interaction of sensory imagery and hunger ($z=-2.65$, $p=.008$). As predicted, hunger was a strong predictor of choice in the control condition ($z=3.91$, $p<.001$) but not at all in the sensory imagery condition ($z=-.03$, $p>.9$). As predicted, sensory imagery made non-sated participants choose smaller portions compared to control (resp. $M=3.55$ vs. $M=4.28$, $z=-2.16$, $p=.03$; see Figure 2). However, sensory imagery made sated participants choose larger portions ($M = 3.75$ vs. $M=2.91$, $z=2.01$, $p=.05$). Analyzing the choice probability data yielded similar results.

A regression of willingness to pay on hunger and imagery condition revealed a main effect of hunger ($t(65)=3.35$, $p=.001$) but, more interestingly, a strong main effect of sensory imagery ($t(65)=3.26$, $p=.002$) with no interaction effect with hunger ($t<1$, $p>.4$). As shown in Figure 2, sensory imagery made hungry participants still willing to pay directionally more than participants in the control condition ($M=$$4.85$ vs. $M=$$3.98$, $t(65)=1.47$, $p=.14$), even though they had chosen significantly smaller portions, thus considerably increasing willingness to pay (WTP) per quantity unit. Among sated participants, sensory imagery increased willingness to pay for the (larger) chosen portion, compared with control (resp. $M=3.87$; $M=2.38$, $t(65)=2.88$, $p=.005$).

**The Role of Sensory Pleasure and Hunger Satiation Expectations.** As shown in Figure 3, there was an inverted U shape between portion size and both types of expectations: Participants
judged average portions more highly than the smallest portion, which was not large enough (especially in terms of hunger satiation), and more highly than the largest portion, which was too large (especially in terms of sensory pleasure). Overall, smaller portions were rated more favorably in terms of sensory pleasure than hunger satiation ($t(99) = 6.56, p < .001$; $t(99) = 6.68, p < .001$; $t(99) = 2.84, p = .005$ for the three smallest portions, respectively). It was the opposite for the larger portions four and five, which were rated more favorably in terms of hunger satiation than in terms of “sensory pleasure” ($t(99) = -2.47, p = .01$; $t(99) = -2.76, p = .01$). Finally, the largest portion was rated similarly low in both perspectives ($t(99) = -1.04, p = .30$).

As another test, we computed for each participant which portion size received the highest rating from both perspectives. Across participants, the optimal portion was smaller in the sensory pleasure perspective ($M = 3.32$) than in the hunger satiation perspective ($M = 3.98$; $t(99) = -4.94, p < .001$). These results combined suggest that people focusing on sensory pleasure (vs. hunger satiation) rate smaller portions more favorably and larger portions less favorably.

But is the respective importance of these ratings for portion choice influenced by multisensory imagery? To examine this issue, we regressed the choice probability data for each portion (from the main study) on a binary variable measuring the effects of the intervention (sensory imagery vs. control), a continuous measure of hunger (measured just before the intervention), a continuous measure of expected sensory pleasure and hunger satiation (measured in the first phase), and all two-way interactions. The regression (which controlled for the panel structure of the data) showed a significant positive main effects of sensory pleasure expectations ($z = 4.33, p < .001$) and hunger satiation expectations ($z = 12.7, p < .001$) on choice probabilities. Hunger had a negative interaction effect with sensory expectations ($z = -2.08, p = .04$) and a positive interaction effect with hunger satiation expectations ($z = 2.57, p = .01$): hungry people valued the expected pleasure of the food less and its satiating properties more, explaining why
hungry people chose larger portions. More importantly, the interaction of the multisensory imagery intervention and of sensory pleasure expectations was positive and statistically significant \((z=2.25, p=.03)\). Expected sensory pleasure had a strong and positive impact on portion size choice in the sensory imagery condition \((z=4.67, p<.001)\), but a weaker and not statistically significant impact in the control condition \((z=1.12, p=.26)\). This explains why multisensory imagery made (hungry) people choose smaller portions. The other effects were not statistically significant \((p’s>.63)\).

**Discussion**

The key finding from study 2 was that multisensory food imagery made hungry (i.e. non-sated) consumers choose smaller portions, yet willing to pay more for these smaller portions than consumers in the control condition were willing to pay for the larger portions that they had chosen. This means that food multisensory imagery can be a win-win for hungry consumers, who choose smaller portions with no hedonic cost, and for marketers, who can charge at least as much for less food. Conversely, sensory imagery made sated consumers prefer larger portions (and—unsurprisingly—willing to pay more for them). This is less of a public health concern than it might appear, because in study 2 (as in all the studies in this research) we only examined portion size choice conditional on having decided to eat the food (i.e., no food at all is not an option). In reality, many sated consumers would probably choose not to eat at all, regardless of the intervention.

Study 2 also provides evidence about the underlying mechanism linking sensory imagery with preference for smaller portions. First, it measured people’s expectations and found that the optimal portion was smaller from a sensory pleasure perspective than from a hunger satiation perspective. Second, it showed that enhancing sensory imagery increased the influence of sensory pleasure expectations on portion size choice probability. This suggests that asking people to
imagine the multisensory sensations of eating hedonic foods makes them more likely to rely on their own expectations of pleasure (rather than on the normally more important expectations of hunger satiation) when choosing portion sizes.

Study 2 has some limitations. First, it did not directly test the effects of multisensory food imagery on the overall enjoyment expected from each portion size, and thus did not test the hypothesis that sensory imagery increases the expected enjoyment from eating smaller (but not larger) portions. Second, it did not measure actual (post-intake) eating enjoyment. Third, it did not examine the hypothesized moderating effects of dieting because there were too few dieters in the sample. These limitations are addressed in the following study, in which we also compare the effectiveness of our intervention with that of health imagery.

**STUDY 3: EFFECTS OF SENSORY AND HEALTH IMAGERY ON EXPECTED AND ACTUAL EATING ENJOYMENT FOR ADULT DIETERS AND NORMAL EATERS**

We posit that both sensory imagery and health imagery (imagining the effects of hedonic foods on one’s health and weight) will prompt non-sated consumers to choose smaller portions of cake compared with a control condition. We predict that health imagery will prompt consideration of a tradeoff between pleasure and health, leading consumers to choose a smaller portion than the one they expect to be most enjoyable, whereas sensory imagery increases the expected enjoyment from smaller portions. By prompting people to choose the smaller portions that actually provide higher eating enjoyment, sensory imagery should also reduce the gap between expected eating enjoyment (measured in a group of “forecasters”) and actual eating enjoyment (measured in a group of “experiencers”), improving the calibration of enjoyment.
expectations. Conversely, we expect sensory imagery to backfire among dieters, making them choose larger portions than the ones they would have otherwise chosen.

**Method**

We recruited 367 young French women (mean age=22) in exchange for €8. We used a 3 (food sensory imagery, health imagery, control) x 4 (forecasters, experiencers of small portions, experiencers of medium portions, experiencers of large portions) between-subject design. We chose this population because it is generally more receptive than men to health appeals and more likely to diet (Rolls et al. 1991), allowing us to better test our hypotheses.

The study took place between 10.30 AM and 12AM, or between 3PM and 6:30PM (the time of day had no significance on the results). Participants were asked to refrain from eating for at least one hour before. During the pre-study screening, participants who said that they were not hungry were not included in the study (but were compensated for showing up).

At the center of the room where participants took the tests, we displayed five portions of the same brownie as in Study 1, in order of size labeled 1 to 5. The five portions contained, respectively, 70, 140, 210, 280, and 350 calories (but no calorie information was made available). After looking at the portions, participants sat in front of a computer near them, reported their hunger (on a scale ranging from 1=not hungry at all to 9=extremely hungry), and when they had eaten for the last time. Participants assigned to the sensory imagery condition were then shown on a computer screen photos of vanilla ice-cream, strawberry tart, and chocolate mousse and were asked to imagine their taste, smell and texture in mouth as vividly as possible. Following the procedure used by Giuliani et al. (2013), participants in the health imagery condition looked at the same three photos and were asked to imagine their negative impact on their health and body. Participants in the control condition saw three comfortable office chairs and were asked to imagine sitting on them.
We asked participants assigned to the “forecaster” condition to choose one of the five portions of brownies and told them that they would be able to take their chosen portion with them at the end of the study. We also measured expected enjoyment by asking them to rate how enjoyable it would be to eat each of the five portions on scales ranging from 1 (not at all) to 10 (very much). We chose this measure because it captured the overall evaluation brought by sensory pleasure and hunger satiation.

Participants assigned to the three “experiencer” conditions were asked to eat entirely either the smallest (portion 1), the medium (portion 3) or the largest (portion 5). Only two “experiencers” were unable to finish their portion but excluding them from the analyses did not affect the results. We then asked them to rate how much they had enjoyed eating the brownie on the same scale used by forecasters. Finally, we measured dieting tendency with the Dutch Eating Behavior Questionnaire (van Strien et al. 1986) and asked participants to provide their height and weight in order to compute their body mass index.

Results

We excluded 11 participants because of an error when cutting the portions on one day, 7 participants who said that they were so full that they could not eat anything (despite the pre-screen test), and 6 participants who had not eaten at all in the 24 hours before the study. The final sample of 343 participants had an average dieting score of 2.8 (s.d. =.95) on a scale ranging from 1 to 5, with a fairly even distribution between normal eaters and dieters. The average hunger rating was 5.2 on a 1-9 point scale, with a small standard deviation of 1.3, indicating that our pre-screen test and our exclusion criteria succeeded in selecting a sample of only non-sated participants.

Expected Enjoyment. We analyzed expected eating enjoyment with a regression which, like all the models used, accounted for the panel structure of the data. The independent variables were
a contrast-coded binary variable measuring the effects of food sensory imagery (vs. control), a
contrast-coded binary variable measuring the effects of health imagery (vs. control), and
continuous measures of dieting tendencies, hunger, and body mass index. In order to test our
hypothesis, we analyzed expected enjoyment separately for small portions (portions 1 and 2) and
for large portions\(^2\) (4 and 5). The results are plotted in Figure 4.

Consistent with the results of study 2, portion size had an inverted U shape effect on expected
eating enjoyment, with average portions rated higher than extreme ones. As hypothesized,
sensory imagery increased expected eating enjoyment for the smaller two portions \((z=2.25,\ p=.02)\) but not for the larger two portions \((z=.21,\ p=.8)\). In contrast, health imagery had no effect
on expected eating enjoyment, regardless of portion size \((p’s>.6)\). Hunger did not influence the
expected enjoyment of smaller portions \((p>.7)\) but increased the expected enjoyment of larger
portions \((z=4.51,\ p<.001)\). Further, both sensory imagery and health imagery decreased the
influence of hunger on expected enjoyment for larger portions \((respectively \ z=-2.49,\ p=.01\ \text{and}\ \ z=-1.96,\ p=.05)\). This is consistent with Study 2, even though all participants in Study 3 were
hungry, with little variance in hunger level. None of the other effects was statistically significant
\((p’s>.4)\).

---Insert Figure 4 about here---

*Actual Eating Enjoyment.* As shown in Figure 4, portion size had a monotonically negative
effect on the actual eating enjoyment reported by the experiencers. We therefore regressed actual
eating enjoyment on portion size (using a linear coding), the same two binary variables capturing
the interventions, dieting tendencies, hunger, and body mass index. Actual eating enjoyment
sharply decreased with portion size \((t(240)=-4.68,\ p<.001)\). The only other significant effect was

\(^2\) As expected because of their countervailing effects on small and large portions, there were no differences across
experimental conditions when analyzing all portion sizes together \((p’s>.15)\).
hunger, which increased actual eating enjoyment (t(240)=5.05, p<.001). None of the other effects was statistically significant (p's>.1). In particular, actual eating enjoyment, unlike expected eating enjoyment, was unaffected by the sensory and health imagery interventions.

These results show a poor calibration in the control condition between expected and actual eating enjoyment with respect to portion size (inverted U shape for expectations, linear decrease for actual enjoyment). Specifically, participants in the control condition erroneously expected portion 3 to be more enjoyable than portion 1 (M=6.78 vs. M=5.59, z=1.93; p=.05) and failed to predict that portion 5 would be significantly less enjoyable than portion 1 (M=4.56; z=-1.50; p=.13). Sensory imagery was able to reduce the gap between actual and expected eating enjoyment. Participants in the sensory imagery condition expected to be indifferent between portions 1 and 3 (M=6.11 vs. M=6.45, z=.53, p=.6) and correctly expected to prefer portion 1 over portion 5 (M=4.42, z=-2.56, p=.003). In the health imagery condition, participants expected to be indifferent between portion 1 and 3 (M=5.25; M=5.83; z=.90; p=.5) and failed to predict that portion 1 would be significantly more enjoyable than portion 5 (M=4.12; z=-1.57; p=.12).

**Portion Size Choice.** We now turn to the analysis of portion choices in order to understand (a) how they were influenced by sensory and health imagery and (b) whether they were driven by expected eating enjoyment or something else. As in Study 2, we analyzed portion size choice via an ordinal logit model and use the same independent variables as for enjoyment expectations. The results are plotted in Figure 5.

---Insert Figure 5 about here---

There was no significant main effect of sensory imagery (p>.6) and of dieting (z=-1.09, p=.27) but a strongly significant interaction between them (z=2.85, p=.004). As hypothesized, dieting tendencies predicted portion choice in the control condition (z=-2.30, p=.02), but not in the sensory imagery condition (z=.05, p=.6). Further, as predicted, a spotlight analysis revealed
that sensory imagery led normal eaters (one standard deviation below the mean dieting score) to choose smaller portions than in the control condition (M=2.17 vs. M=2.85; z=-2.23, p=.02), which is consistent with the results of studies 1 and 2. Sensory imagery backfired among dieters (one standard deviation above the mean), leading to them choosing marginally larger portions (resp. M=2.48; M=1.92; z=1.77, p=.08), even though dieting tendencies had no sizeable effect on expected enjoyment.

Despite having no effect on enjoyment either, health imagery (vs. control) made all participants choose smaller portions (M=1.90 vs. M=2.40; z=-2.27, p=.02), with no reliable interaction effect with dieting tendencies (z=1.72, p=.09). Hunger made participants choose larger portions (z=3.71, p<.001) but it did not interact with any of the two interventions (p’s>.19), probably because of the limited variation in hunger in Study 3. The effects of body mass index were not statistically significant (p’s>.10).

Is Choice based on Expected Enjoyment? We now test our hypothesis that sensory imagery made normal eaters choose a smaller portion because they expected it to maximize enjoyment, whereas health imagery made participants choose smaller portions despite expecting them to be less enjoyable (i.e. a tradeoff between health and expected enjoyment). We used McFadden’s conditional logit model with a binary variable indicating whether the portion had been chosen or not as the dependent variable. The independent variables were the expected enjoyment for each portion, a binary variable capturing the effects of sensory imagery (vs. control), another for sensory imagery (vs. health imagery), and continuous measures of dieting, hunger, and BMI.

Overall, expected enjoyment was strongly predictive of choice (z=6.41, p<.001). Still, there was a significant three-way interaction between expected enjoyment, dieting and sensory imagery vs. control (z=-2.30, p=.02) and another significant three-way interaction between expected enjoyment, dieting and sensory vs. health imagery (z=-2.87, p=.004). Among normal
eaters, expected enjoyment predicted portion size choice better in the sensory imagery condition (odds ratio=8.19) than in the control condition (odds ratio=1.59) or in the health imagery condition (odds ratio=0.54). In the sensory imagery condition, the portion chosen by normal eaters ($M=2.2$) was the same as the portion that they expected to enjoy the most ($M=2.2$, computed as the portion size with the highest expected enjoyment, averaged across participants). In the control condition, however, normal eaters chose a smaller portion than the one predicted to be most enjoyable ($M=2.8$ for the chosen portion vs. $M=3.1$ for the portion with the highest expected enjoyment). The gap was even larger in the health imagery condition ($M=1.9$ for the chosen portion vs. $M=2.6$ for the portion with the highest expected enjoyment).

Among dieters, there were no differences across imagery conditions, suggesting that the backfiring effect on portion size choice was unrelated to expected enjoyment.

**Discussion**

Study 3 showed that both sensory imagery and health imagery made normal non-sated eaters choose smaller portions, compared to nonfood sensory imagery. However, sensory imagery backfired for dieters, making them choose marginally larger portions, consistent with our hypothesis that it made participants choose based on sensory pleasure rather than concerns about body weight (the primary driver of choice among dieters in a control condition). Among normal eaters, sensory imagery increased expected enjoyment of smaller (but not larger) portions, whereas health imagery did not modify enjoyment expectations. Furthermore, sensory imagery made normal eaters more likely to choose the portion they expected to enjoy most. In contrast, participants in the health imagery condition (and, to a smaller extent, in the control condition) were likely to choose a smaller portion than the one they expected to enjoy most. Finally, study 2 showed that actual eating enjoyment was the highest for the smallest portion, regardless of all
interventions. By increasing the chance that this portion was chosen, sensory imagery improved the calibration of eating enjoyment expectations.

Study 3 provided further evidence that sensory imagery leads people to choose smaller portion because they expect to enjoy eating them more. This underlines that the effects of sensory imagery are different from those of repeated consumption simulation (Larson et al. 2014; Morewedge et al. 2010), which leads to reduced desire even for small food portions.

In the final study, we examine the managerial relevance of our results for restaurants, school or workplace cafeteria by examining the effects of a simple way to trigger multisensory imagery: vivid menu descriptions (Elder and Krishna 2010; Tuorila et al. 1994). We also compare the effectiveness of vivid menu descriptions to that of nutrition labeling, a much debated intervention aimed at nudging people to choose smaller food portions (Howlett et al. 2009).

**STUDY 4 - SENSORY INFORMATION AND PORTION CHOICE**

**Method**

One hundred and ninety American online panelists (Amazon Mechanical Turk, mean age=37, 60% female) were assigned to one of three between-subject conditions: multisensory labeling, nutrition labeling, and control (non-sensory label). We first asked participants how hungry they felt (from 1, not hungry at all, to 9, extremely hungry) and when was the last time they ate. All participants were shown the six photos of different portions of the same chocolate cake used in Study 2 (see Figure 1). In the control condition, the cake was simply described as “a chocolate cake”. In the nutrition labeling condition, we added information about the calorie and fat content of each portion, ranging from 80 calories and 3g of fat to 570 calories and 23g of fat. In the multisensory labeling condition, we added the following description: “the chocolate has a smell of roasted coffee, a bitter-sweet balance taste, with natural aromas of honey and vanilla, and a
light aftertaste of blackberry.” Subsequently, we asked participants which portion of cake they would like to eat. On the next page, we reminded participants of the portion size that they had chosen and asked them the maximum price they would be willing to pay for it.

Results and Discussion

We excluded thirteen participants who failed to pass attention checks and eleven participants who reported not having eaten since the day before the study, yielding a total of 166 valid participants. Participants’ average hunger was 3.69 (on a 1-9 scale) with a standard deviation of 2.10. We considered participants as “sated” at one standard deviation below the average level of hunger (M=1.59), and as “hungry” at one standard deviation above the average level of hunger (M=5.79).

We first analyzed the impact of product information and hunger on portion choice with an ordered logit model. The independent variables were a binary variable capturing the effects of multisensory information (vs. control), another capturing the effects of nutrition information (vs. control), hunger, gender, and body mass index. The results are reported in Figure 6.

![Insert Figure 6 about here—](image)

There was no significant main effect of multisensory information (vs. control) on portion choice (z=-.43, p=.7), but a positive main effect of hunger (z=2.71, p=.007) and more importantly, a significant interaction of hunger and multisensory information (z=-3.05, p=.002). As predicted, hunger was a significant predictor of choice in the control condition (z=3.86, p<.001) but not in the multisensory information condition (z=.30, p=.8). As in previous studies, multisensory information made non-sated participants choose smaller portions (M=3.64 vs. M=4.75, z=-2.58, p=.01) but made sated participants choose larger portions, (M=3.53 vs. M=2.66, z=1.92, p=.054). Health information made all participants choose smaller portions (M=2.91 vs. M=3.71, z=-2.39, p=.02), although this effect was stronger when participants were
hungry (interaction effect: $z=-3.21$, $p=.001$). Unlike in all other studies, multisensory information interacted with BMI ($z=1.95$, $p=.05$) and had a stronger effect on low BMI than on high BMI participants.

Regression analyses of willingness to pay with the same independent variables revealed a strong main effect of multisensory information ($t(156)=4.434$, $p<.001$), a marginal effect of hunger ($t(156)=1.85$, $p=.07$), and a marginal interaction between the two ($t(156)=-1.71$, $p=.09$). As in Study 2, providing rich sensory information (versus control) marginally increased how much hungry people were willing to pay for their chosen portion (resp. $M=4.37$ vs. $M=3.24$, $t(156)=1.76$, $p=.08$) despite having chosen a significantly smaller portion. Sensory information (versus control) also increased how much sated people were willing to pay for their (larger) chosen portion (resp. $M=4.36$ vs. $M=2.68$, $t(156)=4.31$, $p<.001$). The main effect and interaction effects of nutrition information on willingness to pay were not statistically significant ($p$'s $>.3$). However, additional analyses showed that multisensory information increased willingness to pay compared with health information ($t(156)=3.78$; $p<.001$), and this effect was not moderated by hunger ($p>.2$).

In study 4, as in study 2, providing rich and vivid multisensory information made hungry consumers choose a smaller portion; yet they were willing to pay an even higher price than in the control condition or in the health information condition. It could be argued that the results of study 4 can be explained by the fact that multisensory information increased the perceived quality of the cake. In the absence of price information, however, quality perception should have led people to choose a larger (not smaller) portion of cake. Overall, study 4 shows that a simple vivid description of the multisensory experiences of eating a cake can suffice to lead hungry people choose a smaller portion yet be willing to pay more for it. Finally, although nutrition information led everybody to choose a smaller portion, it made people willing to pay a lower price than they
were willing to pay for similarly small portions in the multisensory labeling condition. Given that margins are typically smaller for smaller portion sizes (Dobson and Gerstner 2010), nutrition information would achieve the same public health goal of portion control, but at the expense of the restaurant’s profitability.

**GENERAL DISCUSSION**

Attempts to counteract the widespread supersizing of hedonic food portions urge people to choose health over eating enjoyment (e.g., Giuliani et al. 2013) or seek to satiate people’s desire for food (Larson et al. 2014; Morewedge et al. 2010). Unfortunately, both strategies are undermined by the sheer volume of food marketing claims that large portions are pleasurable and satiating, and the fact that they are directly opposed to the business goals of food manufacturers and distributors who make more money with supersized portions.

In this research, we have shown that it is possible to make regular hungry eaters choose less food, pay more for it, and expect to enjoy it more—a triple win for consumers, marketers and public health. We have built on the fact, contrary to common belief, that larger portions are not necessarily more pleasurable than smaller ones (Garbinsky et al. 2014; Rode et al. 2007; van Kleef et al. 2013) because sensory enjoyment peaks at the first mouthfuls and declines with each additional mouthful (Rolls et al. 1981). Drawing on mental imagery research (Barsalou 1999; Krishna and Schwarz 2014; Moulton and Kosslyn 2009), we created a new intervention aimed at enhancing the multisensory food imagery of consumers before they choose their portion size, whereby consumers vividly imagine the pleasant multisensory features of three hedonic foods, prior to choosing a portion size of another hedonic food. Alternatively, multisensory imagery can be enhanced by vivid multisensory product descriptions.
Across four studies, we have shown that sensory imagery makes typical consumers (i.e., people who are neither sated nor dieting) choose smaller portions, regardless of their cultural background (French in Studies 1 and 3, Americans in studies 2 and 4) and generations (children in Study 1, young adults in Study 3, adults in Studies 2 and 4). Remarkably, we found that multisensory imagery increases the willingness to pay (Studies 2 and 4), the enjoyment expected from eating smaller portions (Study 3), as well as the actual eating enjoyment (Study 3) because it led people to choose the smaller portions that provide the best eating experience. By doing so, it reduces the gap between the expectation and actual enjoyment which often leads people to choose portions that are larger than those that provide the most enjoyment.

Evidence of the underlying mechanism is provided in Studies 2 and 3. Study 2 showed that people recognize that smaller portions are best from a pure sensory pleasure perspective, although larger portions are better for hunger satiation. It found that multisensory imagery increases the relative influence of sensory pleasure over hunger satiation. These results were confirmed in Study 3 which found that multisensory imagery increased the overall eating enjoyment (based on both pleasure and hunger satiation) expected from eating small portions, but not large portions.

As a benchmark, we examined the effect of both health imagery (“imagine vividly the negative impact on your health and body”) and nutrition labeling (information about calories and fat content). On the positive side, both interventions led to the choice of smaller portions, even for dieters and sated consumers. On the negative side, however, these choices were hedonically costly because health appeals led people to sacrifice pleasure and choose portions that were smaller than the ones that they expected to enjoy the most. This can be problematic because restrained eaters typically fail to follow dieting rules, and when they do, they overeat to the point
where it negates the benefits of their sacrifices (Bublitz et al. 2010; Fedoroff et al. 1997; Stroebe et al. 2013).

There are boundary conditions to the effects of sensory imagery. By increasing the importance of sensory pleasure, and decreasing the importance of hunger or dieting tendencies as drivers of choice, sensory imagery backfires among sated consumers and dieters who would have otherwise chosen small portions. However, because sated consumers are less likely to want to eat in the first place, this is unlikely to be a significant problem from a public health perspective. Regarding the boomerang effect among dieters, it could be argued that focusing on sensory pleasure may be more effective on the long run compared to cognitive restraint, although more research is needed.

Implications for Future Research

Our research leaves some questions open. First, the focus in this research was on portion size choice conditional on people having decided to eat. It would be important to examine the effects of multisensory food imagery on consumption incidence (when to eat) and food choice (what to eat). This would indicate whether multisensory imagery interventions are only warranted when people have already decided to eat (e.g., while waiting at a restaurant or sitting down at the family table) or if they can also be used in situations when people have not yet decided what and when to eat (e.g., in supermarkets).

Further, we focused on hedonic but calorie-dense food because of their negative impact on health. From a theoretical perspective, we would expect multisensory imagery to have a lower effect on staple foods like bread or rice, which exhibit less sensory-specific satiation (Sorensen et al. 2003). From a managerial perspective, it would be useful to test our interventions for a variety of food and when people pay for their food. This is particularly important because the higher perceived value of larger portions is one of the main reasons why people supersize (Vermeer et
al. 2010). Similarly, it would be interesting to explore the impact of multisensory imagery on nonfood experiential consumption (e.g., music). In many cases, pleasure diminishes with repetition, yet people generally fail to predict this hedonic adaptation effect (Wang et al. 2009).

It would be also interesting to further explore the dimensions and consequences of multisensory imagery. First, by examining the non-sensory aesthetic and symbolic dimensions of eating pleasure, such as the pleasure derived from beautifully-presented dishes and tables (Hoyer and Stokburger-Sauer 2012; Zellner et al. 2014) or from learning about the food’s origin and preparation (Korsmeyer 1999). Another way would be to examine other consequences of multisensory imagery. For example, it is possible that training children to focus on the multisensory experiences of eating may encourage them to approach novel foods or to learn to appreciate the hedonic value of eating fruit and vegetables (Hong et al. 2011).

Further research is also necessary to better understand the mechanisms underlying the effects of multisensory imaging. Sensory mental imagery is a pleasurable activity in itself, which may satiate the reward-seeking system (which is different from mere satiation from eating), leading to less impulsive decisions about portion size. It would also be interesting to study whether multisensory imagery may be activating self-control goals (Trope and Fishbach 2000). Although this process is inconsistent with our findings of increased pleasure expectations for smaller portions and the stronger effect of multisensory imagery for normal eaters (who are less likely than dieters to experience self-control dilemmas), it would be important to know more about the interplay of sensory imagery and eating goals.

To conclude, our results question a rich cultural and philosophical tradition that considers sensory pleasure as immoral and taste as an impoverished sense responsible for bodily intemperance (Coveney 2006; Korsmeyer 1999). Alba and Williams (2013) observe that this tradition is perpetuated in modern research in consumer behavior, for example when food choices
are framed as vices or virtues. Our findings suggest that it is time to stop caricaturing eating
enjoyment as the simple fulfillment of visceral impulses and to rehabilitate eating pleasures, as in
countries such as France, Italy, Japan and South Korea, which also have the lowest prevalence of
obesity and eating disorders (Rozin et al. 2003; Rozin et al. 2011).
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FIGURE 1

STIMULI FOR STUDY 1 (TOP) AND STUDIES 2 AND 4 (BOTTOM)
FIGURE 2

STUDY 2: PORTION SIZE CHOICE AND WILLINGNESS TO PAY FOR CHOSEN PORTION

Portion Size Choice

WTP for Chosen Portion Size

- Multisensory Imagery
- Control
STUDY 2: PRE-INTERVENTION EVALUATIONS OF PORTIONS BASED ON EXPECTED SENSORY PLEASURE AND HUNGER SATIATION

FIGURE 3

"Just right for sensory pleasure"

"Just right for satiation"
FIGURE 4

STUDY 3: EFFECTS OF SENSORY IMAGERY AND HEALTH IMAGERY ON EXPECTED AND ACTUAL EATING ENJOYMENT

Eating Enjoyment (1-10 scale)

- Actual enjoyment (all conditions)
- Expected enjoyment (sensory imagery condition)
- Expected enjoyment (control condition)
- Expected enjoyment (health imagery condition)

Portion 1 Portion 2 Portion 3 Portion 4 Portion 5
FIGURE 5

STUDY 3: EFFECTS OF SENSORY AND HEALTH IMAGERY ON PORTION SIZES CHOSEN BY DIETERS AND NORMAL EATERS
FIGURE 6

STUDY 4: PORTION SIZE CHOICE AND WILLINGNESS TO PAY FOR CHOSEN PORTION

[Diagram showing the relationship between Portion Size Choice and WTP for Chosen Portion Size under different conditions: Multisensory Information, Control, Nutrition Information.]