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Taming Temptation: Visual Perspective Impacts Consumption and Willingness to Pay For Unhealthy Foods

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Abstract

While thinking about food is a ubiquitous facet of daily life, the perils of imaginary eating are well documented; food-related mental imagery elevates both cravings and consumption. Given the serious health issues that often arise from over-eating and obesity, identifying strategies that can be employed to combat the link between imagination and consumption is therefore of considerable theoretical and practical importance. Here we explored the possibility that a fundamental property of mental imagery — the visual perspective from which an event is viewed — may alter the appraisal of unhealthy foods. Specifically, because it is accompanied by attenuated sensorimotor activity, third-person (cf. first-person) imagery was expected to weaken the link between imagination and consumption. The results of three studies supported this prediction showing that third-person (cf. first-person) simulations decreased the mental representation, actual consumption, and willingness to pay for desirable items. Driving these effects was the natural reduction of sensory components furnished by third-person imagery. Together, these findings suggest that adoption of a third-person vantage point during mental imagery may be a viable and effective tactic for curbing consumption in everyday life.

Keywords: mental imagery, visual perspective, self-control, eating, embodiment

Taming Temptation: Visual Perspective Impacts the Consumption of and Willingness to Pay for Unhealthy Foods

With people spending excessively on products and services that promise to tame temptation and trim waistlines, the weight loss industry is big business. Despite considerable financial outlay, however, obesity remains on the rise with associated medical costs in the U.S. alone approximating $150 billion dollars per annum (Flegal, Carroll, Kit, & Ogden, 2012). The problem is quite straightforward — dietary control is increasingly challenging in an enticing calorific landscape. Not only are unhealthy items bigger, tastier and more accessible than ever before, so too media portrayals serve to reinforce the desirability of burgers over broccoli and indulgence over restraint (Hill & Peters, 1998; Moore & Lee, 2012; Story & Faulkner, 1990). What then, if anything, can be done at a practical level to address this pressing societal issue?

Corroborating the popular adage that out of sight is out of mind, self-control (i.e., dietary restraint) is enhanced when food cues are diminished or removed entirely from view (Maas, de Ridder, de Vet, & de Wit, 2012; Mischel, Ebbesen, & Zeiss, 1972). Regrettably, however, temptation is not confined to the physical environment, but extends also to the mental world (Kavanagh, Andrade, & May, 2005; Tiffany & Drobes, 1990). Indeed, imaginary gustatory experiences exert considerable influence on eating behavior. According to Elaborated Intrusion Theory, internal (e.g., hunger) and external (e.g., advertisements) food cues trigger detailed mental simulations that elevate cravings and undermine dietary resolve (Kavanagh et al., 2005; Kemps & Tiggermann, 2010; Papies, 2013; Tiggermann & Kemps, 2005). The pathway from simulation to consumption rests on the fact that mental imagery is facilitated by reactivation of the sensorimotor systems that support perception and action (Fadiga & Craighero, 2004; Ganis, Thompson, & Kosslyn, 2004; Grezes & Decety, 2001; Jeannerod, 2001; Moulton & Kosslyn, 2009). With outcomes akin to those that accompany actual eating (e.g., salivation, reward), imaginary

consumption provides an embodied preview of prospective gustatory pleasures (Andrade, May, & Kavanagh, 2012; Siep, Roefs, Roebroeck, Havermans, Bonte, & Jansen, 2009; Wooley & Wooley, 1973) and makes salient any discrepancy between one's current (unsatisfied without a cookie) and potential (satisfied with a cookie) states. Little wonder, therefore, that devouring an imaginary cookie often precipitates ingestion of the real thing.

Reflecting the perils of imaginary eating, strategies have been identified that seek to remediate the impact of mental simulation on subsequent consumption. For the most part these psychological tactics rely on either disrupting mental imagery altogether (e.g., via the imposition of concurrent visuospatial load) or encouraging excessive imaginary ingestion (i.e., repeated intake of desired items) such that habituation occurs and consumption is reduced (Kemps & Tiggermann, 2010; Morewedge, Huh, & Vosgerau, 2010). While the efficacy of these approaches attests to the crucial influence of simulated sensations on consumption, manipulating the imagination in these ways is a difficult prerequisite for dietary control. Whether white bears or chocolate brownies, attempts at thought suppression tend to promote rather than prevent such musings (Wegner, Schneider, Carter & White, 1987) and, outside the constraints of a laboratory, it is unlikely that most individuals would take the time (or have the necessary resolve) to imagine eating an entire chocolate cake before helping themselves to a single slice. It may be possible, however, to circumvent these complications by capitalizing on a property of the mental world that naturally influences the concrete sensorimotor activities that accompany a simulation — the visual perspective from which an imaginary event is viewed (Christian, Miles, Parkinson, & Macrae, 2013; Libby & Eibach, 2011; Nigro & Neisser, 1983).

When simulating an experience, one of two vantage points can be adopted: a first-person perspective (1PP) in which people visualize events through their own eyes, as if they are looking outward on the world; or a third-person perspective (3PP) whereby they see themselves embedded in an event, as if from an external point of view (Christian et al., 2013; Libby & Eibach, 2011;

Nigro & Neisser, 1983). Critically, these vantage points highlight different properties of an imaginary experience. Whereas third-person simulations focus on the overarching purpose of an event and provide access to propositional self-knowledge (e.g., goals/values), first-person constructions emphasize concrete details and are accompanied by pronounced neural (e.g., modality-specific activity), physiological (e.g., salivation) and affective (e.g., pleasure, pain) reactions (Christian, Parkinson, Macrae, Miles, & Wheatley, 2015; Holmes & Mathews, 2010; Libby, Valenti, Hines, Eibach, 2014; McIssac & Eich, 2002; Nigro & Neisser, 1983). Put simply, first-person simulations are more embodied than their third-person equivalents (Christian et al., 2015; Macrae, Sunder Raj, Best, Christian, & Miles, 2013; Miles, Christian, Masilamani, Volpi, & Macrae, 2014).

These vantage-point differences in mental imagery likely have important implications for behavior, especially when simulating events with powerful sensory components (e.g., eating ice cream) that are counter to highly valued goals (e.g., losing weight). Specifically, as they are closer in character to the veridical event, imaginary eating experiences that are generated from a first-person (cf. third-person) point of view should elevate both the appeal and consumption of imagined items. Of course, if true, this would only be problematic if people routinely imagine eating unhealthy (cf. healthy) items and tend to do so from a first-person (cf. third-person) perspective. For this reason, a preliminary investigation probed the characteristics of everyday food-related imagery.

Survey data[1] from 265 participants confirmed that individuals estimate that they imagine eating prior to consumption approximately 37% of the time and that it is substantially more common for them to imagine eating unhealthy than healthy items (60.8% vs. 33.5%, respectively, of food related imagery) items. Of particular relevance to the current investigation, 86% of participants reported that they usually adopt a 1PP during imaginary eating. Interestingly, those who reported adopting a 1PP also state that imagery precedes consumption more often than those

[1] Full methods and results are available in Supplementary Materials.

who report a 3PP (38.7% vs 27.6%). Consistent with these findings, we propose that via the propensity to imagine eating unhealthy items through their own eyes, people may unwittingly increase motivation for, and consumption of, the foods in question. From an applied perspective, this suggests that adopting a 3PP during mental imagery may be a tactic through which the often-problematic link between imagination and consumption can be weakened. Accordingly, we explored this possibility in the current research. Experiments 1 and 2 investigated the consequences of vantage point on the mental representation, appraisal, and consumption of food. Experiment 3 examined whether visual perspective influenced participants' willingness to pay for tempting (cf. non-tempting) desserts via the sensory components that accompany mental simulations.

Experiment 1

An extensive body of evidence explicating consumption related self-control failures emphasizes the key role of hedonic temptation and reward sensitivity (Davis, Patte, Levitan, Reid, Tweed, & Curtis, 2007; Herman & Polivy, 2008; Krishna, 2012; Sorensen, Moller, Flint, Martens, & Raben, 2003). Whether in the marketing or self-regulation domain, the literature is clear, our kryptonite is the palatability of to-be-consumed items. What this work suggests is that the most effective strategies for weight management are not to strengthen resolve, but rather to weaken sensory temptations. Along these lines, recent work posits that first-person (cf. third-person) simulations confer stronger sensorimotor representations of simulated events (Christian et al., 2015; Macrae et al., 2013; Miles et al., 2014; Libby & Eibach, 2011). Given that the reduction in sensory information accompanying third-person simulation could play a crucial role in consumption, our first study sought to identify the effects of vantage point on the mental representation of imaginary foods. Specifically, if first-person simulations are really imbued with more sensorimotor information, this should be evident in the quantity and/or quality of the imaginary physical sensations that accompany first-person (cf. third-person) imagery. To investigate this possibility,

participants were required to imagine eating an unhealthy food from either a first- or third-person perspective and then to report the content of their simulations, including the physical sensations imagined and the vividness of these experiences.

Method

Participants

One hundred and twenty-four participants were recruited online using Amazon's Mechanical Turk (www.mturk.com, see supplementary materials for procedure). Five participants were excluded due to incomplete responses on the questionnaire. Thirteen participants failed the manipulation check (reported the wrong visual perspective for their imagery) and were also excluded from the analysis. Data analysis was performed on the remaining 106 participants (M_{age} = 32.3 years, *SD* = 11.2 years; 62 females).

Materials and Procedure

A short questionnaire[2] was constructed to investigate the fundamental characteristics of food-related mental imagery associated with each visual perspective. After reading a brief description of the two visual perspectives, participants were asked to describe each vantage point in their own words to ensure understanding of the task. Participants were then asked to imagine eating a 'freshly baked cookie' from either a first- or third-person perspective (condition was assigned randomly). Using a free-response format, participants described their imagery and then reported the visual perspective they had adopted. Next, forced-choice (i.e., yes vs. no) questions probed the experiential details of the imagery experience. Separately, participants were asked if they had imagined the taste, smell, appearance and temperature of the cookie. If they responded 'yes' to

[2] All questionnaire items are included in methods and results sections for all of the studies presented in this paper, no items were excluded.

imagining any given sensation, follow-up questions about the vividness and the temptation associated with the sensation were presented using a slider-bar scale with appropriate anchors (i.e., not very vivid/tempting, very vivid/tempting). Additionally, participants who reported tasting the imaginary cookie were asked to report how good it tasted (i.e., not very good, very good). For judgments of temperature, participants were only asked to rate the vividness of the experience. Participants also reported how much they generally liked cookies as well as their age and sex.

Results

Descriptions

Participants' descriptions of their mental imagery experience were coded[3] for content with respect to three categories: physical sensations (e.g., taste, touch), fine-grained details (e.g., descriptions of the cookie), and peripheral details (e.g., extraneous elements of the environment/scene imagined, see McIssac & Eich, 2002 for coding guidelines). Independent samples *t*-tests revealed significant differences between imagery conditions in content related to physical sensations, $t(76.8) = 4.44$, $p < .001$, $d = 0.91$, fine details, $t(80.8) = 3.27$, $p = .002$, $d = 0.67$, and peripheral aspects of the simulation, $t(67.7) = -2.20$, $p = .03$, $d = 0.43$. These differences were such that first-person simulations were characterized by more fine details about the cookie itself and the physical sensations that accompanied imaginary consumption. In contrast, third-person simulations were richer in peripheral details (see Table 1).

To further explore differences in the representation of physical sensations, participants' descriptions were coded according to the frequency with which details pertaining to taste, touch, sight and smell were reported.[4] Independent samples *t*-tests revealed significant differences in the number of times participants mentioned words related to taste, $t(82.5) = 3.61$, $p = .001$, $d = 0.74$,

[3] Two individuals separately coded participants' descriptions. Any discrepancies in coding were resolved by a third coder, blind to the experimental condition. Full agreement was achieved.
[4] No participants reported sensations related to sound.

touch, $t(59.2) = 5.04$, $p < .001$, $d = 1.04$, smell, $t(61.7) = 2.23$, $p = .03$, $d = 0.47$, and sight, $t(85.2) = -2.29$, $p = .024$, $d = 0.46$, as a function of vantage point. Specifically, first-person imagery was associated with heightened sensory representations of taste, smell and touch relative to third-person simulations. Interestingly, the opposite pattern was true for sight such that participants in the third-person condition were more likely to describe what they could see in their mind's eye than those in the first-person imagery condition (see Table 1).

Forced Choice and Follow-up Questions About Each Sensation

Consistent with the open-ended descriptions, chi-square tests of independence revealed a relationship between visual perspective (i.e., first vs. third) and the tendency to simulate physical sensations. In particular, taste, $\chi^2(1) = 4.76$, $p = .03$, and temperature, $\chi^2(1) = 4.77$, $p = .03$, were more likely to be simulated from a 1PP (taste: 96% of participants, temperature: 84%) than 3PP (83%, 65% respectively). The number of participants who reported imagining the smell, $\chi^2(1) = 0.12$, $p = .73$ (1PP = 61.2%, 3PP = 57.9%), and appearance, $\chi^2(1) = 0.87$, $p = .35$ (1PP = 100%, 3PP = 98%), of the cookie did not differ as a function of visual-imagery condition.

To compare the quality of the sensory information as a function of visual perspective, independent samples *t*-tests were conducted on the follow-up questions for each modality. Cronbach's alpha scores indicated that ratings of vividness and temptation[5] within each modality were highly consistent (taste, $\alpha = .72$; sight, $\alpha = .77$; smell, $\alpha = .92$), such that composite scores for each of the modalities were used for analysis. Results revealed significant differences in the quality of smell, $t(57.5) = 2.38$, $p = .02$, $d = 0.60$, and temperature, $t(63.2) = 3.24$, $p = .002$, $d = .76$, such that first-person imagery was associated with richer experiential qualities than third-person imagery (see Table 1). No significant differences were found between first- and third-person imagery as far as the quality of the taste, $t(91) = 0.97$, $p = .33$, or the visual aspects, $t(103) = 0.82$, $p = .41$, of the

[5] The composite score for taste also included the question about how good participants imagined the cookie tasted.

imaginary experiences were concerned for those participants that reported 'yes' to imagining the sensation (see Table 1). Additionally, the two groups did not differ with respect to their age, sex or liking of cookies in general.

[Insert Table 1]

Discussion

In line with previous work (Christian et al., 2015; Libby & Eibach, 2011; McIssac & Eich, 2002), these findings confirm that first-person imagery is represented with more concrete experiential detail than third-person imagery. In particular, when simulations entail eating an unhealthy food item, first-person imagery is more likely to incorporate sensations such as taste and temperature than third-person imagery. Further, when such sensory information is imagined from a third-person perspective, it tends to be of a lower quality than the equivalent representations associated with first-person imagery. This study demonstrates that the mental representation of unhealthy foods systematically differs as a function of imagery perspective. Considering the relationship between mental elaboration and consumption (Kavanagh et al., 2005; Kemps & Tiggermann, 2010; Tiggermann & Kemps, 2005), these findings may have important implications for eating behavior. Specifically, consumption may be influenced by the vantage point from which imaginary experiences are generated (i.e., first-person > third-person).

Experiment 2

Having established that visual perspective does indeed influence the hedonic sensory information incorporated in a mental simulation, our second study investigated whether or not first-person imagery (adorned with a richer sensory experience) actually promotes consumption relative to third-person imagery. Subsequent to imagining eating chocolate candies from either a first- or third-person perspective, participants completed a short questionnaire assessing basic properties of

their experiences and current level of desire for the confectionery. Participants then took part in an alleged taste-test that required them to eat and evaluate the candies. We expected consumption of the candies to be greater following first- than third-person imagery and taste-test evaluations to reflect this difference. In addition, data from a no-imagery control condition were also collected to establish the directionality of the predicted effects. Given that third-person simulation strips imagery of key sensory components, while first-person simulation highlights such information, we expected the no-imagery control condition to fall between these two conditions (i.e., 1PP > Control > 3PP). This prediction stems from the knowledge that at least some of the participants in the no-imagery control were likely to spontaneously imagine eating the candy and those who did were most likely to do so from a first-person perspective (see preliminary findings).

Method

Participants and Design

Ninety-one undergraduates[6] (M_{age} = 20.9 years, SD = 2.3 years; 50 females) completed the experiment in exchange for course credit. The study had a single factor (Condition: no-imagery control, first-person imagery or third-person imagery) between-participants design and was reviewed and approved by the School of Psychology, University of Aberdeen Ethics Committee.

Materials and Procedure

Participants arrived at the laboratory individually and were greeted by a female experimenter. Participants in the control condition were told that they were taking part in a pilot study to establish baseline preferences for chocolate candies to be used in a study that would be

[6] A priori sample size was estimated using G*Power. Effect size was based on that of a previous behavioral study (η_p^2 = .12; Miles et al., 2014) investigating first- and third-person imagery and is consistent in size across conceptually similar studies (Macrae et al., 2014). To achieve 80% power with one covariate a sample size of 60 was required. An additional 30 (control) participants were tested to establish the directionality of the observed effects.

conducted at a later date. Participants in the imagery conditions (first- or third-person) were told that the study was investigating whether or not imagining eating a food could influence the way it actually tasted. Further, these participants were informed that they had been randomly allocated to the 'imagine' group, so they would be required to imagine eating chocolate candies prior to taking part in a taste-test. In reality, all participants in the imagery conditions mentally simulated eating chocolate candies prior to the taste test. Importantly, however, the visual perspective utilized during the mental imagery was manipulated between these participants. In total, 1/3rd of participants imagined eating candies from a 1PP, 1/3rd imagined eating candies from a 3PP and 1/3rd did not partake in any imagery at all.

Participants in all three conditions were initially shown a photograph of a bowl containing Smarties (similar to M and M's) and asked to report how much they liked them (1 = I really do not like, 7 = I really like). This served to establish a baseline of liking for the candies, which was used in subsequent analysis to control for variation in participants' preferences and consumption (Morewedge et al., 2010). The experimenter then removed the photo. Those in the imagery conditions were informed that they would be required to imagine that a bowl of candies (like the one in the picture they had just been shown) was sitting on the table in front of them and that they were eating candies from the bowl. At this point participants were given a description of a specific visual perspective (i.e., first- or third-person perspective) and were instructed to adopt that viewpoint during the imaginary task. Once the experimenter ensured understanding, participants were blindfolded to enhance the vividness of their imaginary experiences. Participants were given unlimited time to complete the simulation, but were asked to indicate to the experimenter when they started and finished to enable the duration of their imaginary experiences to be recorded. Upon completion of the imagery task, participants filled out a brief questionnaire assessing the valence and vividness of their simulation as well as their current level of desire for the candies. Participants responded by placing a mark on an analogue scale (16cm line) anchored with appropriate endpoints.

Next, all participants (regardless of condition) completed the 'taste-test'. The experimenter placed a bowl of approximately 41g (M = 41.2 g, SD = 1.0 g) of chocolate candies in front of the participants and told them: "For the taste-test you are welcome to eat as much or as little as you'd like, just be sure that afterwards you are able to fill out a detailed questionnaire about the taste and properties of the candies." Participants informed the experimenter, who was behind a partition during the taste-test, when they had finished trying the Smarties. The bowl was then removed and the participants were given a short questionnaire to complete in order to assess the candies they had just eaten. Items on the questionnaire (analogue scale, 16cm lines) probed the taste, appearance, sweetness, crunchiness, and likelihood to purchase the candies along with participants' level of hunger after the taste-test. Finally, participants were debriefed and dismissed and the bowl of candies was weighed to establish how much had been eaten.

Results

Liking as a Covariate

Participants reports of how much they liked the candies in the photo had a significant effect on reported imagery valence, $F(1,58) = 23.73$, $p < .001$, $\eta_p^2 = 0.29$, desire, $F(1,87) = 13.94$, $p < .001$, $\eta_p^2 = 0.14$, the amount of chocolate eaten during the taste-test, $F(1,87) = 5.87$, $p = .02$, $\eta_p^2 = 0.06$, and overall 'taste-test score', $F(1,87) = 16.68$, $p < .001$, $\eta_p^2 = 0.16$. As such, liking was included as a covariate in the following analyses[7] (see Morewedge et al., 2010).

Desire

After controlling for pre-imagery ratings of liking, analysis revealed a marginally significant effect of condition on reported desire for the candies, $F(1,87) = 2.76$, $p = .07$, $\eta_p^2 = .06$ (see Figure

[7] Conducting the analysis without controlling for reported liking yields the exact same pattern of results for the effect of condition on chocolate eating and post taste-test ratings (p's < .05). The effect of perspective on desire fails to reach significance, although directionally the results are consistent.

1a). Planned contrasts revealed a significant linear trend for desire as a function of condition (p = .032).

Chocolate Consumed

Analysis of covariance (ANCOVA) revealed a significant effect of condition on the amount of candy eaten during the taste-test, $F(1,87) = 4.46$, $p = .014$, $\eta_p^2 = 0.09$ (see Figure 1b). Pairwise comparisons (Bonferroni corrected) revealed significant differences between first- and third-person imagery in the amount of chocolate consumed, $p = .012$, 95% $CI_{difference}$ [-1.08, -11.36].[8] Although failing to reach significance, numerically participants ate fewer candies following third-person imagery compared to the no imagery control condition, $p = .17$, 95% $CI_{difference}$ [-1.14, 9.7]. No differences between the control condition and first-person imagery condition, $p = 1$, 95% $CI_{difference}$ [-3.22, 7.09] were observed. Planned contrasts also revealed a significant linear trend for the amount of candy eaten as a function of condition ($p = .004$).[9]

Post-consumption Ratings

The items on the taste-test questionnaire (i.e., overall taste, appearance, sweetness, crunchiness and likelihood to purchase) were averaged to create a single score for each participant (Cronbach's α = .72). Analysis revealed a significant effect of condition on ratings of how the candies tasted, $F(1,87) = 6.03$, $p = .004$, $\eta_p^2 = 0.12$ (see Figure 1c). Pairwise comparisons revealed that the candies were evaluated more favorably following first- than third-person imagery, $p = .035$, 95% $CI_{difference}$ [0.06, 2.4], and first-person compared to control, $p = .005$, 95% $CI_{difference}$ [0.38,

[8] Although no participants refused to eat any candy, two participants in the first-person condition ate all of the candies in the bowl. Analyses excluding these participants yielded the exact same pattern of results. In addition, the amount of candies eaten was non-normally distributed, with skewness of 1.96 (SE = 0.25) and kurtosis of 4.17 (SE = 0.50), however analysis conducted on the log-transformed data also yielded an identical pattern of results. Therefore, for completeness and ease of interpretation, the raw untransformed data with no exclusions are reported.

[9] Two additional analyses using the Process SPSS application (Hayes, 2013) were undertaken to determine if reports of desire for the candies or vividness of imagery mediated the relationship between visual perspective and food intake. Bootstrapped 95% confidence intervals from 5000 samples spanned zero suggesting that the indirect effect of perspective on consumption via craving was not significant.

2.73]. There was no difference between the control and third-person imagery condition, $p = 1$, 95% $CI_{difference}$ [-1.56, 0.91]. Again, planned contrasts revealed a significant linear trend for the post-consumption ratings of the candy as a function of condition ($p = .012$).

[Insert Figure 1]

Imagery Only Measures

No differences were observed on the valence and vividness of the simulated experiences, the amount of time participants spent imagining the candies or reported hunger.

Discussion

The results of this study are striking, revealing that the visual perspective from which an imaginary event is viewed has the potential to change the amount of an unhealthy food item that is consumed. Specifically, adopting a third-person imagery perspective before eating reduced the number of candies that participants consumed during an alleged taste test. While a growing body of evidence has attested to differences in the construal of first- and third-person simulations (Libby & Eibach, 2011), and the online sensorimotor activities that accompany events imagined from different points of view (Christian et al., 2015; Miles et al., 2014) the potential for these differences to shape behavior has not been well explored (see Libby et al., 2007). As such, the current work furnishes one of the first demonstrations that the visual perspective utilized to simulate an event actually impacts subsequent behavior. Questions remain, however, as to whether the proposed explanatory mechanism (i.e., differences in sensorimotor activity) underlies the consequences of

adopting unique visual perspectives during imaginary ingestion.[10] Our final experiment was therefore designed to explore this possibility.

Experiment 3

The previous two studies have demonstrated the impact of visual perspective on the mental representation (i.e., sensory components) and, what is arguably more important, the actual consumption of desirable foods. What remains to be established is the mechanism that drives these effects. According to the theoretical framework proposed here, it is the enhanced sensorimotor activity that accompanies first-person (cf. third-person) imagery that promotes desire and consumption. However, when the simulated sensations that accompany imaginary eating are not particularly enticing, then the vantage point adopted should have less impact on the associated cognitive and behavioral outcomes. A vivid sensory experience of a food that an individual considers to be bland or unappetizing should not evoke a desire for, or prompt increased ingestion of, the imagined item. In other words, unpalatable foods ought to remain that way no matter how they are construed. To test this hypothesis our final study considered the influence of visual perspective on the mental representation of tempting and non-tempting foods. In particular we sought to determine whether or not vantage point indirectly influences the perceived value (i.e., participants' willingness to pay for) of an item by altering the physical sensations that accompany an imaginary eating experience. If the sensorimotor information furnished by each perspective is driving differences in food-related behavior, then a rich sensory representation of a tempting item

[10] There are a number of possible reasons why the ratings of desire in Experiment 2 did not mediate the relationship between visual perspective and consumption. Notably, there is likely a complex relationship between desire and consumption that is influenced by a host of variables such as emotion, social stigma, weight concerns and self-imposed dietary restraints (Dalenberg et al., 2014). In addition, an explicit, unidimensional rating of desire may not be the best measurement of actual desire for tempting foods (see Steptoe, Pollard, & Wardle, 1995).

should increase desire and willingness to pay for the item, whereas a rich sensory experience of a non-tempting item should not.

Method

Participants and Design

One hundred and forty participants were recruited online using Amazon's Mechanical Turk (www.mturk.com, see supplementary materials for more information). No responses came from repeated IP addresses. Fifteen participants failed at least one of the manipulation checks (i.e., incorrectly explained the differences between imagery perspectives or reported the wrong visual perspective for their imagery), thus were excluded from the analysis. Data analysis was performed on the remaining 125 participants (M_{age} = 31.5 years, SD = 10.5, 47 females). The study had a 2 (Visual perspective: first vs. third) x 2 (Temptation Level: tempting vs. non tempting) between-participants design.

Materials and Procedure

A short questionnaire was constructed to investigate the sensory components that accompanied food-related imagery and assess participants' willingness to pay for the imagined food item. Following a short description of the task and consenting to take part in the study, participants saw a list of 6 different types of cake (i.e., German chocolate cake, carrot cake, ice cream cake, strawberry short cake, vanilla bean cheesecake and red velvet cake) and were asked to select the cake that they found most (cf. least) tempting. After identifying their most (cf. least) favorite cake, participants reported how familiar they were with the taste of the item on a 100-point analogue scale with appropriate anchors (not at all familiar, very familiar). Next, participants read a short description of each visual perspective and how it is possible to imagine eating food from either point of view. On a separate page, participants described each perspective in their own words before being asked to imagine eating a piece of cake (participants saw the name of the type of cake they

had previously identified as their most or least favorite) from either a first- or third-person vantage point. To ensure participants engaged in the task, they were asked to write a short description of their imagery experience and then report the visual perspective they had adopted.

The sensory components that accompanied participants' mental simulations were then assessed. Participants were asked if they had imagined the taste, smell, appearance and temperature of the cake (the order of these items was randomized). If they responded 'yes' to imagining any given sensation, a follow-up question about the vividness of the sensory imagery was presented using a slider-bar (0-100 point) scale with appropriate anchors (i.e., not very vivid/very vivid). Next, participants reported their current level of desire for the cake and also how much they would be willing to pay to eat the piece of cake they just imagined on a scale ranging from $0 to $20. Given that willingness to pay serves as an index of spending propensities and an individual's current desire to obtain an item (Rucker & Galinsky, 2008), we expected that a rich sensory experience of a tempting (but not of a non-tempting) cake would increase the amount participants would be willing to pay for the item. Finally, participants reported their age and sex and were thanked and debriefed.

Results

To determine the influence of the sensations that accompany imaginary ingestion on willingness to pay, vividness scores for taste, touch, temperature and smell were combined (Cronbach's alpha = .64) to create a 'Sensory Experience' index. Using the Process SPSS application (Hayes, 2014) a moderated mediation analysis was performed to test our hypothesis that the effect of perspective on sensory experience would impact willingness to pay for tempting, but not non-tempting foods (see Supplementary Materials for additional analyses). Bias corrected 95% confidence intervals were estimated using bootstrapping with 5000 samples. Because participants reported being significantly more familiar with the food they identified as most (cf. least) tempting,

we controlled for this difference by including familiarity as a covariate in our model. Although the analysis yields the exact same pattern of results when not controlling for familiarity, we present the model including the covariate as a more conservative estimate of the impact of perspective via sensation on willingness to pay for an imagined food item. The total model (including the mediator, moderator, covariate and two interaction terms) accounted for 19% of the variance in willingness to pay ($R^2 = .19$, $p < .001$).

Dichotomous variables were coded (first-person = 0, third-person = 1 & tempting = 0, non-tempting = 1) such that unstandardized coefficients represent the effect on willingness to pay when imagining a non-tempting (cf. tempting) food from a third-person (cf. first-person) perspective. As such, negative unstandardized coefficients indicate a decrease in willingness to pay when imagining a non-tempting food or imagining a food from a third-person perspective. Figure 2 reveals the unstandardized regression coefficients for each path of the model (see Table 2 for comprehensive statistics). Two of these findings are germane to the moderated mediation of visual perspective on willingness to pay via sensory experience. First, replicating our basic finding in Experiment 1, visual perspective impacts the sensory components that accompany a simulation 95% CI [-23.14, -7.79], such that adopting a third-person (cf. first-person) perspective decreased overall sensory experience. Second, there was a significant influence of sensory experience on willingness to pay 95% CI [0.16, 1.02] that was qualified by the predicted interaction between temptation level and sensory experience 95% CI [-0.62, -0.02].

Conditional direct effects of perspective on willingness to pay were not significant for tempting 95% CI [-11.32, 6.54] or non-tempting items 95% CI [-3.16, 16.91]. However, consideration of the indirect effects of perspective on willingness to pay via sensory experience at each level of the moderator (tempting vs. non-tempting) revealed a significant indirect effect for tempting 95% CI [-9.52, -0.34], but not the non-tempting food item 95% CI [-2.22, 5.47]. The Hayes (2014) index of moderated mediation revealed that the conditional indirect effects were not

equal in the two groups 95% CI [0.41, 12.47], suggesting a significant difference in the effect of perspective on willingness to pay via sensory experience as a function of tempting/non-tempting condition. Put simply, perspective influenced willingness to pay via sensory experience in the tempting, but not the non-tempting condition (see Supplementary Materials for simple mediation analyses for each condition).

[Insert Figure 2]

[Insert Table 2]

Discussion

Practically speaking, by weakening the associated sensory experience, third-person imagery decreased participants' willingness to pay for a desired food item by between $0.07 and $1.90. Corroborating and extending the findings of our previous studies, these results have important theoretical and practical implications, illustrating a pathway by which visual perspective impacts food-related behavior. Specifically, by stripping a simulation of key sensory components, a third-person perspective can decrease the perceived value of a tempting item. Crucially, such effects were not observed for a non-tempting item. Not only do these findings inform the mechanism by which imagery impacts consumption, but also the components of a simulation that drive an individual's willingness to pay for a desirable food item.

General Discussion

Imaginary eating has the capacity to influence a host of food-related behaviors. Three studies demonstrated that an inherent characteristic of mental imagery — the visual perspective through which an event is viewed — impacts not only how food is characterized in the mind, but

also its value and the quantity that is consumed. Third-person (cf. first-person) simulations were characterized by fewer sensory components, worse evaluations, and a decreased willingness to pay for tempting foods. Most strikingly, however, visual perspective impacted how much participants ate. Consumption of candies (and thus calories) following third-person imagery was approximately half compared to first-person imagery. Beyond the practical implications, the final study offers novel theoretical insight, elucidating a mechanism driving the effects of visual perspective. Specifically, by demonstrating that sensory experience is a pathway through which visual perspective impacts food-related behavior, these results provide support for an embodied account of vantage-point differences in mental simulation.

By emphasizing concrete details (e.g., flavor, aroma, temperature) of imaginary experiences, first-person simulations closely mimic the palpability that drives consumption in everyday life (Davis et al., 2007; Herman & Polivy, 2008; Krishna, 2012; Sorensen, et al., 2003). In contrast, third-person imagery highlights more abstract, contextual aspects of the situation being simulated, subduing the experiential overlap between what is real and imagined (Christian et al., 2015; Maas et al., 2012; Macrae et al. 2013; Kemps & Tiggermann, 2010; Tiggermann & Kemps, 2005; Libby & Eibach, 2011; Nigro & Neisser, 1983). Consistent with these observations and decades of literature on the role of sensory cues and sensitivity associated with consumption, the current findings demonstrated that the disparate outcomes of first- and third-person imagery are driven by the sensory experiences furnished during a simulation (see Mischel & Baker, 1975; Silvers et al., 2014 for related reappraisal techniques). Crucially, that the indirect effect of visual perspective on willingness to pay via sensory experience was moderated by how tempting the participants found the imagined item to be gives credence to the theoretical framework proposed here. These findings not only corroborate an embodied cognition account of first and third-person imagery differences (Christian et al., 2015; Macrae et al., 2013; Miles et al., 2014) and models predicting obesity (Davis et al., 2007), but also suggest that privileged access to self-concepts (e.g., being unhealthy) or

changes in self-awareness alone cannot explain the full range of effects that follow imagery from different points of view. Put simply, if third-person imagery merely heightened self-consciousness or highlighted an unflattering self-concept (e.g., I am an unhealthy eater, see Libby, et al., 2014) the effects seen here would not have been moderated by the hedonic temptation of the imagined food item.

Previously it has been shown that brain regions involved with processing reward are more active when imagining the taste of a tempting food, compared to viewing it passively (Siep et al., 2009). Given that a third-person point of view characteristically deemphasizes the sensations of an imagined eating experience (Experiments 1 and 3) as well as the neural, sensorimotor and behavioral correlates of an imagined event (Christian et al., 2015; Eich et al., 2009; Miles et al., 2014), it follows that this form of simulation is less likely to produce the feelings of reward that heighten motivation to consume (Achtziger, Fehr, Oettingen, Gollwitzer & Rockstroh, 2009; Andrade et al., 2012; Kavanagh et al., 2005; Siep et al., 2009). Future neuroimaging studies will be instrumental in explicating how activation of the so called 'pleasure centers' of the brain, in tandem with those implicated in self-control, influence the relationship between the visual perspective adopted during imaginary eating and actual consumption (Lopez, Hofmann, Wagner, Kelley, & Heatherton, 2014).

Elsewhere, studies have identified particular circumstances in which third-person imagery can increase the likelihood that an activity (e.g., voting) will be performed (e.g., Libby, Shaffer, Eibach, & Slemmer, 2007; Vasquez & Beuhler, 2007). It has been suggested that these effects are the result of third-person imagery providing access to abstract self-knowledge (e.g., active citizenship, see Libby, et al., in press). However, given that these studies explored behaviors that are effortful in execution, a subdued representation of the sensations that accompany the activity is likely to be less aversive, fostering actions that align with positive self-concepts. Much like in real life, high-level goals prevail when there are fewer (or less intense) competing low-level sensations.

It is easy to stick to a diet when your senses are not overwhelmed with the inviting aroma of freshly baked chocolate chip cookies in the same way that you intend to participate in the electoral process until you have to fight through rush hour traffic to cast your ballot. When we are not tempted to take the easier or tastier route, actions tend to line up with our well-intentioned goals. To this end, third-person simulations may either promote or deter a behavior relative to first-person simulations depending upon the approach or avoidance motivation associated with the low-level sensations that accompany an action.

Corroborating this line of reasoning, direct measures of approach and avoidance behavior are consistent with the valence of an imagined event, but only when visualized from a first-person perspective (Miles et al., 2014). As such, if the simulated sensations of the action itself are positive (e.g., the taste of junk food), first-person imagery will likely encourage the behavior (approach) relative to third-person imagery, whereas if they are negative or effortful (e.g., studying, eating gross tasting vegetables), first-person simulations may evoke avoidance. When considering the tension between what we want most and what we want now, explanations that emphasize a reduction in sensorimotor activity and privileged access to abstract self-knowledge during third-person imagery may actually work in concert. Of course, future work that directly compares these mechanisms will be necessary to determine the extent to which each can explain systematic variations in judgments and behavior that stem from adopting different visual perspectives.

The current work suggests that the crucial role of third-person imagery is to provide a buffer from the low-level sensations (e.g., imagined pleasure or pain) that so often derail behavior. Unimpeded by such temptations or aversions, third-person simulations may then cultivate goal-congruent behaviors by highlighting desired self-concepts. For example, imagining eating brussel sprouts from a third-person perspective may not only temper the biting bitter taste, but also highlight the positive self-concept associated with eating your greens. Thus, when immediate gratification competes with a delayed sense of self-satisfaction (as is often the dilemma when it

comes to decision making) a third-person point of view could be especially likely to prompt actions that we will thank ourselves for later.

Conclusion

In a world with constant exposure to food-related cues, the proclivity to simulate eating is often a catalyst for unwanted or unnecessary consumption (Hill & Peters, 1998; Kavanagh et al., 2005; Kemps & Tiggermann, 2010; Moore & Lee, 2012; Papies, 2013; Tiggermann & Kemps, 2005). Of both theoretical and practical significance, here we demonstrated that not all mental simulations are equally enticing. Via changes in simulated sensations, third-person imagery has the ability to decrease participants' craving, consumption and willingness to pay for desired items. The irony is that for most people, imaginary indulgences are spontaneously generated from a first-person point-of-view. Considering the amount of time spent thinking about food and the tendency for simulations to aggravate rather than alleviate temptation (Kavanagh et al., 2005), it is likely that there are particular circumstances when, and individuals for whom (Heatherton & Wagner, 2010; Silvers et al., 2014), a new perspective can be employed to tame temptation and ultimately curb consumption.

Table 1. Descriptive statistics for imaginary sensory measures as a function of visual perspective.

	Visual Perspective		
	First-person	Third-person	95% CI
Experiment 1			
Descriptions			
Physical Sensations**	3.7	1.4	1.3, 3.3
Taste**	0.9	0.2	0.3, 1.1
Touch**	2.0	0.5	0.9, 2.2
Smell*	0.5	0.1	0.04, 0.7
Sight*	0.2	0.5	-0.04, -0.6
Fine details*	4.8	3.1	0.7, 2.8
Peripheral details*	0.9	1.9	-0.1, -2.0
Quality of simulated sensation			
Taste	82.6	79.4	-3.3, 9.6
Temperature**	82.4	66.3	6.2, 26.1
Smell*	85.2	74.2	1.8, 20.3

Note. Measures denoted with an asterisk were significantly different as a function of visual perspective condition: * $p < .05$; ** $p \leq .01$.

Table 2. Unstandardized Regression Coefficients, Standard Errors and 95% CIs for moderated mediation model

Sensory Experience Model			
Predictor	B	SE	95% CI
Constant*	37.22	6.20	24.94, 49.51
Perspective*	-15.46	3.88	-23.14, -7.79
Familiarity (covariate)*	0.26	0.07	0.11, 0.39
Willingness to Pay (WTP) Model			
Predictor	B	SE	95% CI
Constant	11.57	16.76	-21.63, 44.76
Sensory Experience*	0.59	0.21	0.16, 1.02
Perspective	-11.66	10.35	-32.17, 8.84
Temptation	0.47	9.79	-18.92, 19.86
Sensory Experience X Temptation*	-0.32	0.15	-0.62, -0.02
Perspective X Temptation	9.27	6.79	-4.18, 22.72
Familiarity (covariate)	-0.03	0.06	-0.15, 0.10
Conditional Direct Effects of Perspective on WTP at Each Level of Temptation			
Predictor	B	SE	95% CI
Tempting	-2.39	4.51	-11.32, 6.54
Non-tempting	6.88	5.07	-3.16, 16.91
Conditional Indirect Effects of Perspective on WTP Via Sensory Experience at Each Level of Temptation			
Predictor	B	SE	95% CI

Tempting*	-4.16	2.43	-9.52, -0.34
Non-tempting	0.77	1.83	-2.22, 5.47

Note. Measures denoted with an asterisk had 95% Confidence Intervals that excluded zero

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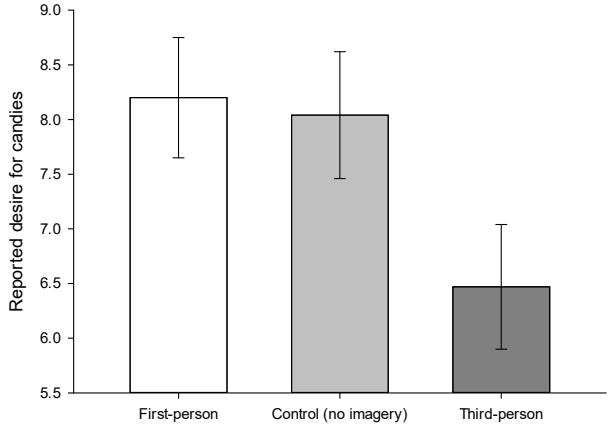
Figure 1. Adjusted means (after controlling for liking) of reported desire (panel A), candies eaten (Panel B) and taste-test ratings (Panel C) as a function of imagery condition in Experiment 2. Error bars = ±1SEM.

Figure 2. Statistical diagram of moderated mediation from Experiment 3 illustrating the unstandardized coefficients for each pathway in the model including the covariate and two interaction terms. Dummy Coding First-person perspective = 0, Third-person perspective = 1.


9.0
8.5
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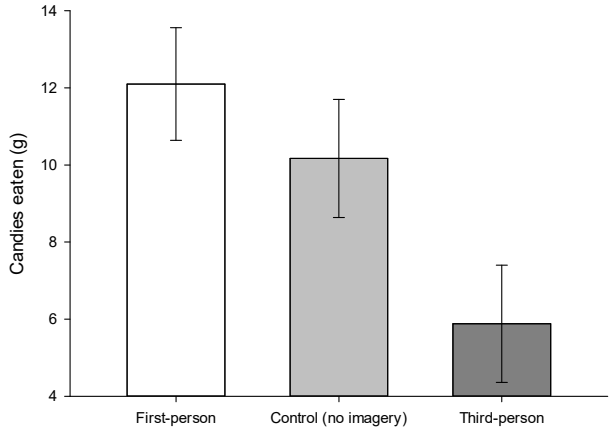
Reported desire for candies
First-person
Control (no imagery)
Third-person


14
12
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8
6
4
Candies eaten (g)
First-person
Control (no imagery)
Third-person

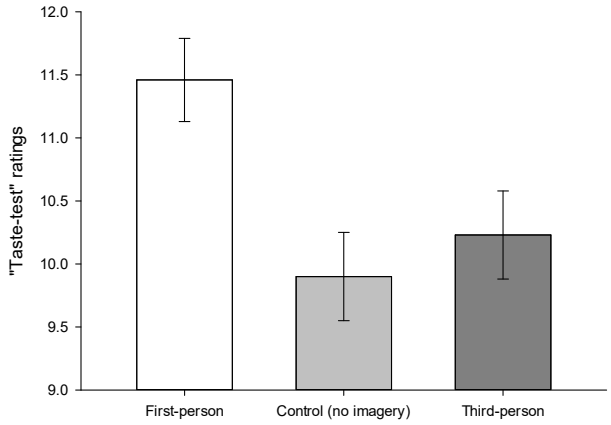

Figure 1.

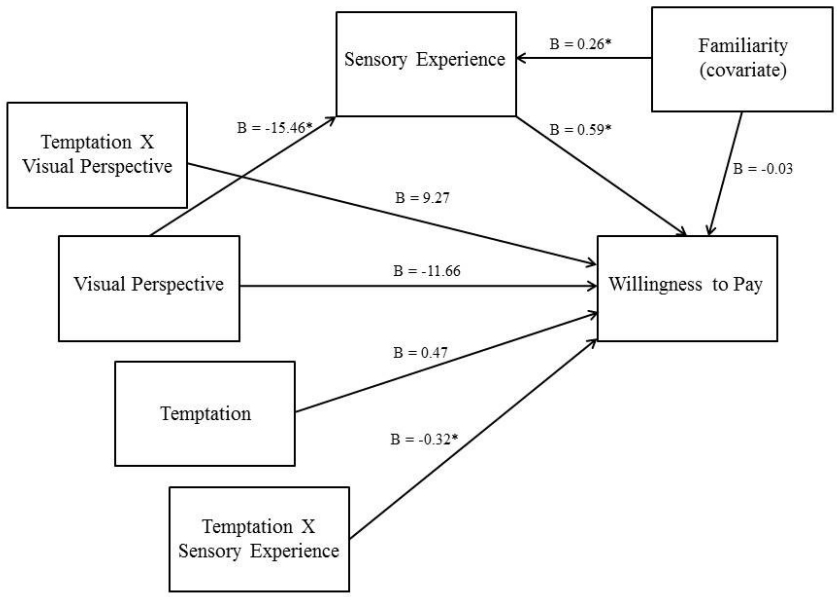

Figure 2.

Supplementary Materials

The purpose of the following supplementary materials is to provide additional information about the methods and results from our preliminary survey as well as present supplementary analyses conducted for Experiment 3. These materials show consistency, provide transparency, and ultimately simplify our analysis for ease of interpretation.

Preliminary Study on the Characteristics of Food-related Mental Imagery

Method

Participants

Three hundred and eleven participants were recruited online using Amazon's Mechanical Turk (www.mturk.com). After reading a brief description of the task, Mechanical Turk workers who chose to take part were linked to a survey, which was generated and administered using Qualtrics (www.qualtrics.com). Mechanical Turk's unique "worker id" numbers and IP addresses were recorded for each submitted survey, thus allowing multiple responses from the same individual to be excluded from data analysis. Twenty-six survey responses came from repeated IP addresses and were eliminated from data analysis. Additionally, 20 participants were excluded due

to incomplete responses on the questionnaire. Data analysis was performed on the remaining 265 participants (M_{age} = 29.8 years, *SD* = 9.9 years; 95 females). The study was reviewed and approved by the School of Psychology, University of Aberdeen Ethics Committee. All participants were informed about the nature of the study prior to agreeing to participate and were able to withdraw at any point.

Materials and Procedure

A short questionnaire was constructed to investigate fundamental characteristics of food-related mental imagery. After reporting on basic demographic information (age, sex), participants were asked to estimate: the percent of food-related thoughts they have that are dominated by healthy and unhealthy items, respectively (i.e., separate estimates according to food type) in addition to the percent of the time they imagine eating food prior to actual consumption. Participants responded using slider-bar scales with appropriate anchors (0%, 100%). Participants were also asked to report the visual perspective (i.e., first or third) they most commonly adopt during imaginary eating by selecting one of the following options: 1. "I cannot see myself (I imagine the scene through my own eyes)"; or 2. "I can see myself (I imagine the scene from an outside perspective)."

Results

According to participants' estimates, actual consumption is preceded by imagined ingestion 37.2% of the time. Further, a paired-samples *t*-test revealed a significant difference in the reported prevalence of unhealthy (60.8%) compared to healthy (33.5%) food-related imagery, $t(264) = 9.42$, $p < .001$, $d = 1.05$. Of particular relevance to the current investigation, 86.0% of participants reported that they usually adopt a 1PP during imaginary eating, a vantage-point preference that was confirmed by a chi-square goodness-of-fit test (expected values 50%), $\chi^2 (1, N = 265) = 137.66$, $p <$

.001. Finally, an independent-samples *t*-test revealed that food-related imagery was reported to precede actual consumption more often for people who imagined eating from a 1PP than 3PP, $t(263) = 2.34$, $p = .02$, $d = 0.42$.

Mechanical Turk Procedure for Experiments 1 and 3

After reading a brief description of the task, Mechanical Turk workers who chose to take part were linked to a survey, which was generated and administered using Qualtrics (www.qualtrics.com). Mechanical Turk's unique "worker id" numbers and IP addresses were recorded for each submitted survey, thus allowing multiple responses from the same individual to be excluded from data analysis. No responses came from repeated IP addresses. The studies were reviewed and approved by the School of Psychology, University of Aberdeen Ethics Committee. All participants were informed about the nature of the study prior to agreeing to participate and were able to withdraw at any point.

Experiment 3 Additional Analyses

Moderated Mediation with a Continuous Measure of Desire

An equivalent analysis conducted using the continuous measures of reported desire (collected after mental imagery) yielded a similar pattern of results. The total model (including the mediator, continuous moderator, covariate and two interaction terms) accounted for 22% of the variance in willingness to pay ($R^2 = .22$, $p < .001$). In particular, the Hayes (2014) index of estimated slope B = -.07, SE = .04, 95% CI [-0.18, -0.006] across multiple levels of the moderator revealed that as desire increased, perspective had a stronger effect on willingness to pay via sensory experience. Put simply, the more participants liked an item, the more adopting a third-person perspective reduced the amount of money they were willing to pay to have the item.

ANCOVA and Individual Mediation Analyses

To simplify the moderated mediation analysis presented in the paper and provide additional transparency, we also conducted a 2 (Visual Perspective: first vs. third) x 2 (Temptation: tempting vs. non-tempting) between subjects ANCOVA (with familiarity as a covariate) on participants' willingness to pay for the item they imagined. This analysis revealed a significant main effect of Temptation, $F(1,120) = 10.74$, $p = .001$, $\eta_p^2 = 0.08$ that was qualified by a Visual Perspective X Temptation interaction, $F(1,120) = 5.16$, $p = .025$, $\eta_p^2 = 0.04$. In order to break down this interaction we also ran two separate mediation models, one for participants in the tempting group (see Figure 3) and one for participants in the non-tempting group (see Figure 4), both included familiarity as a covariate. Although this approach provides a less conservative estimate than the moderated mediation model we present in the paper, the same pattern of results was found such that there was an indirect effect of Perspective on Willingness to Pay via Sensory Experience in the tempting condition 95% CI [-0.22, -5.89], but no significant indirect effect on Willingness to Pay in the non-tempting condition 95% CI [-1.31, 2.42]. Analyses without the covariate revealed identical patterns of results.

[Insert Figure 3]

[Insert Figure 4]

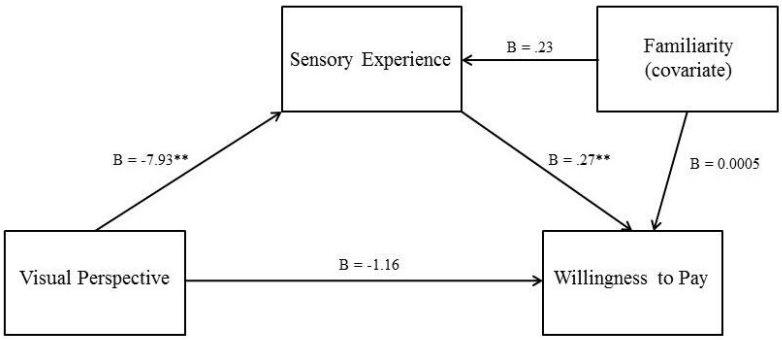
Sensory Experience
B = .23
Familiarity
(covariate)
B = -7.93**
B = .27**
B = 0.0005
Visual Perspective
B = -1.16
Willingness to Pay

Figure 3.

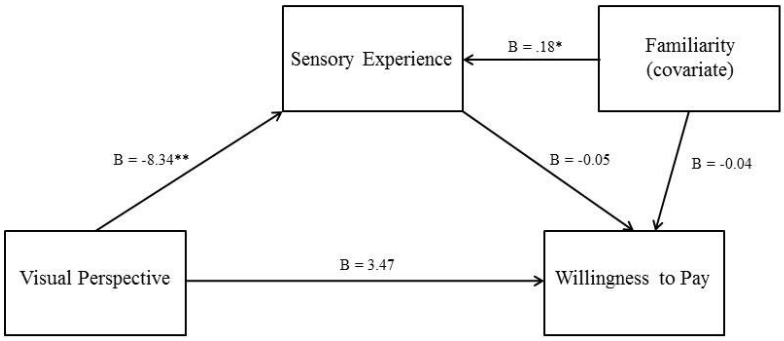

Figure 4.

Figure 3. Statistical diagram of mediation analysis from Experiment 3 illustrating the unstandardized coefficients for each pathway in the model depicting the effect of perspective on willingness to pay via sensory experience for tempting foods. Dummy Coding First-person perspective = 0, Third-person perspective = 1.

Figure 4. Statistical diagram of mediation analysis from Experiment 3 illustrating the unstandardized coefficients for each pathway in the model depicting the effect of perspective on willingness to pay via sensory experience for non-tempting foods. Dummy Coding First-person perspective = 0, Third-person perspective = 1.

Author Contributions

B. M. Christian developed the studies under the guidance of L. K. Miles and C. N. Macrae, B. M. Christian, J. Mattschey and S. Kenyeri collected data, B. M. Christian and L. K. Miles performed data analyses, B. M. Christian, L. K. Miles and C. N. Macrae wrote the manuscript.

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