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Tell me what you imagine and I will tell you what you want: The effects of mental simulation on desire and food choice

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A B S T R A C T

Many people struggle with the classical choice of eating a mouth-watering snack versus a healthier product. One of the reasons behind this is that unhealthier products are appealing for their direct gratification; they deliver pleasure. The present research investigates the effect of mental simulation as a relatively new strategy to possibly shift the balance between direct gratification and the consideration of longer-term benefits necessary to make healthier choices. Specifically we distinguish between imagining the consumption process versus the outcome of eating a specific product, hereafter referred to as mental simulations. In two studies, we show that participants under process simulation, i.e., imagining the process of eating, had a higher desire for the imagined product compared to a control condition, but in a choice task between a healthy and an unhealthier product, more people chose the *unhealthier* product over the *healthier* one. On the other hand, outcome simulation, i.e., imagining the outcome of eating, also generated a higher desire for the imagined product, but in this case people chose the *healthier* option. In terms of underlying process, we explored the role of valence of the imagined experience on desire for the imagined product. This is the first study giving insights into the processes that could be behind the impact of mental simulation on desire and food choices. Although the results are not conclusive, we propose that further research in attentional biases, and possibly emotional activation could enlighten the effect of mental simulation in food desires and choice between healthy and unhealthy alternatives.

1. Introduction

Consumers are often exposed to food cues of, particularly, high caloric foods - in supermarkets, in advertisements, on the street, and even in their own homes. Due to this excessive exposure and accessibility to high caloric foods, which are normally tempting, people struggle to control their food choices and food consumption. Helping people to make healthier food choices could be of imperative importance to follow a healthier diet and contribute to solving the steadily increasing problem of overweight and obesity.

Food products have specific characteristics that make them appealing. Some products are more appealing for its long-term benefits whereas others are commonly known to deliver direct gratification or a short-term benefit. People often tell themselves *"I promise, next Monday I do start my diet"*. This is because we naturally tend to prioritise short-term goals, which provide immediate gratification (i.e., eating the mouth-watering snack) and delay long-term goals (i.e., dieting to achieve a fit body and health). Since long-term goals are further in the future, consumers are often faced to the dilemma of whether to eat or not to eat the mouth-watering snack or to choose a healthier snack. The dilemma in consumers' mind can be seen as the conflict between a long-term goal and a short-term goal.

One way to possibly shift the balance between this more indulgent-mindset (short-term) and health-mindset (long-term) is to use people's imagination. From a grounded cognition perspective, it is referred to as mental simulation, which allows us to recreate previous experiences that deepen our innermost self through perceptual, motor, and introspective states (Barsalou, 2008). Additionally, mental simulation is multimodal and creates the experience of "being there" (Barsalou, 2005); it can even activate gustatory and olfactory cortices in the brain (Spence, 2016). Thus, imagining a favourite food (memory of food) may be more crucial in activating reward-seeking behaviour than the actual food. In other words, fantasising about a palatable food may create an activation in the reward areas of the brain and provoke a strong motivational response such as craving (increased desire) for that food (Pelchat, Johnson, Chan, Valdez, & Ragland, 2004).

The present research differentiates between imagining the eating consumption itself and imagining the benefits/consequences of consuming the food. Although previous research in the food domain refers to an imagined food consumption experience as multisensory imagery (Cornil & Chandon, 2016; Lacey & Lawson, 2013), consumption imagery (Petrova & Cialdini, 2005), sensory simulation (Larson, Redden, & Elder, 2014), or eating simulations (Papies, 2013), these seem to capture only one of two distinct types of mental simulation known as process simulation (Pham & Taylor, 1999; Taylor, Pham, Rivkin, & Armor, 1998). Process simulation evokes the act of using or consuming

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the product (Escalas & Luce, 2004; Escalas & Luce, 2003), and for foods, this includes, for instance, the flavour of food, the sensations while eating, and also an affective component, which can vary from positive to negative. On the other hand, the second type of simulation, referred to as outcome simulation, has received little attention and consists in imagining the benefits/consequences or associated costs of having consumed the product. In the food context, this includes, for example, health constructs, satiety effects, and post-consumption emotions. These two simulation types may be associated with temporal patterns of activation (Trope & Liberman, 2003), i.e., activation of short-term and concrete (process simulation) versus long-term and abstract goals (outcome simulation). The activation of these two constructs in a food consumption event could shift the balance from more concrete and short-term goals (palatability mindset) towards an activation of abstract and long-term goals (health mindset). Hence, in the case of being confronted with a choice between two conflicting food categories (e.g., healthy vs unhealthy), mental simulation could direct the decision making process by means of mindset shift.

The aim of the present research is twofold, we intend to contribute with a better understanding of the mechanisms by which imagined experiences affect consumers' desires and behaviour, and in addition, to find a strategy to make people choose healthier alternatives. Firstly, we explore the role of the valence of the imagined experience on desire for food. Previous research has found that the valence of the imagined experience affects the subjective experience (D'Argembeau & Van Der Linden, 2004). Thus, the valence of the imagined experience is expected to influence people's desires. For example, imagining eating a hamburger and having a positive feeling about it may increase the desire for food, but having negative feelings may decrease desire or appetite for food. Moreover, we cannot neglect the fact that in the event of having to choose between two products, liking for the products would play a role since it is one of the strongest drivers of food choice (Sobal, Bisogni, Devine, & Jastran, 2006).

2. Theoretical framework

2.1. Subjective feeling of desire

The Elaborated Intrusion Theory of desire (EI Theory; May, Kavanagh, & Andrade, 2015) places imagery (mental simulation) as a central concept to understand desire for food. The EI Theory mention the importance of incentives' competition, such as explicit desires and intrinsic desires, and remark its moderating role on the effect of cue-driven thoughts on behaviour (Kavanagh, Andrade, & May, 2005). For example, when consumers have an intrinsic desire to eat a hamburger but they do not want it cognitively because their long-term goal is to eat healthily and lose weight (explicit desire). On another hand, studies based on a grounded cognition perspective support the idea that individuals increase desire for food and even salivate when a food consumption simulation (process simulation in our study) is performed (Keesman, Aarts, Vermeent, Hafner, & Papies, 2016). Although both the EI Theory and the grounded cognition perspective conceptualise mental simulation as a form of spontaneous and intrusive thoughts about the desired element, we believe that people can also be instructed to engage into imagined experiences (instructed mental simulation). This practice may help them to resolve their conflict between intrinsic desires and explicit desires.

Recent research has shown that the effect of instructed mental simulation, namely process and outcome simulation, on the desire for the imagined product, depends on the type of product people imagined (Muñoz-Vilches, van Trijp, & Piqueras-Fiszman, 2019). If the imagined product is highly hedonic (vice product), process simulation stimulated desire for the vice product, but if the imagined product was highly utilitarian (virtue product), outcome simulation stimulated desire for the virtue product. One could wonder what the outcome would be if the imagined product could not be easily classified as being hedonic or utilitarian, and what impact this would have in subsequent food choices. For this reason, we extend this body of research by investigating the effect of these simulations but with an ambivalent product (which could be perceived as evenly hedonic and utilitarian). We expected that both simulations would increase the desire for the imagined ambivalent product in a similar way (H1).

2.2. Effect of mental simulation on desire for the imagined food product through valence

Research has shown that people spontaneously approach positive or attractive stimuli, and avoid negative or aversive ones (Cacioppo, Priester, & Berntson, 1993; Piqueras-Fiszman, Kraus, & Spence, 2014). Hence, motivational approach-avoidance orientations are inherently linked to the perception of a negative or positive event. Moreover, imagining eating a pleasant product is likely to create a positive experience rather than a negative one, unless this act of eating was detrimental for goal achievement (Förster, Liberman, & Friedman, 2007). Since desire for food is a motivational response, we expect that imagining an ambivalent product would generally lead to a positive experience, and thus, it would increase desire for the imagined product. Yet, in the case of having a negative feeling about the imagined experience, people would decrease desire for the imagined product. Hence, the valence of the imagined experience would mediate the effect of mental simulation on desire for the imagined product. Imagining a food experience evaluated as positive (negative) would increase (decrease) the motivation to eat the product they have imagined (H2).

Since the mental simulation research in the food domain is relatively recent, three additional exploratory variables were added: Expected enjoyment, expected healthiness, and expected tastiness. Previous research has established that mental simulation, referred by other authors as 'multisensory imagery' and 'health imagery', influenced portion sizes by means of expected enjoyment (Cornil & Chandon, 2016). Thus, these authors found that focusing on sensory pleasure (through multisensory imagery) made people expect greater expected enjoyment from smaller portion sizes, especially if they were hungry. Moreover, research has found that tastiness and healthiness are closely related. For instance, in an American population unhealthy with tasty were strongly associated (Raghunathan, Naylor, & Hoyer, 2006), whereas in a French population this association was rather healthy with tasty (Werle, Trendel, & Ardito, 2013). This evidence suggests that there is an association between tastiness and healthiness, which in turn affects enjoyment (Raghunathan et al., 2006; Werle et al., 2013). Hence, we believe that expected enjoyment, tastiness, and healthiness may be affected because of the implications that imagining a food consumption situation has on eating motivation (Muñoz-Vilches et al., 2019; Papies, 2013).

The next section will elaborate on a scenario where people have to choose between the two (healthy vs. unhealthy) usually conflicting food categories.

2.3. Effect of mental simulation on subsequent food choice

The grounded cognition theory of desire and motivated behaviour explains the roles of mental simulation in consumer behaviour (Papies, Best, Gelibter, & Barsalou, 2017). Generally, with mental simulation the brain recalls episodic memories, it happens spontaneously and without conscious awareness, and it occurs in response to a choice conflict (Wang, Cohen, & Voss, 2015). In this way, in the absence of an object or event, simulations serve as multimodal pattern completion inferences, helping to anticipate pleasure, taste or other actions associated, which are all involved in decision-making (Papies et al., 2017).

The interaction of cognition and perception is mostly unconscious and spontaneous, and has behavioural consequences. Behavioural studies have shown, for instance, that spontaneous mental simulation drives the effect of product depiction on purchase intention (Elder &

Krishna, 2012). However, we explore a more conscious effect and we aim to manipulate these simulations, to investigate its role on food choice in a more interventional way.

Research has shown the interplay between cognition and perception in different ways. For example, a simple slogan affecting taste perceptions through sensory thoughts (Elder & Krishna, 2010), or appetitive stimuli (food pictures) triggering consumption simulations (Papies, 2013), which in turn affected motivation and behaviour. Robinson, Blissett, and Higgs (2011) found that remembering the positive experience of eating vegetables led to a higher predicted enjoyment and choice for vegetables. In this study, recalling eating broccoli increased the likelihood of choice of broccoli and vegetables in general, but did not generalize to other foods. Other interventional studies have shown that manipulating cognition at the time of eating, as well as conditioning processes (which rely on memory), have profound effects on eating behaviour (Higgs, 2008). Although this evidence is based on recalling experiences, we think that mentally simulating an event would act similarly, and would place people in a certain mindset that would trigger a behaviour.

Inducing people in a certain mindset could imply changes in their attentional focus, which could lead to a change of food choices. For instance, Werthmann, Jansen, and Roefs (2016) found that inducing people into a health compared to a palatability mindset attenuated attention bias for high-calorie food cues in participants with higher eating restraint. Moreover, in a previous study, we observed that process simulation made people focus more on the hedonic attributes of the product and outcome simulation more on the utilitarian attributes, and additionally impacted the ultimate choice between a vice and a virtue product (Muñoz-Vilches et al., 2019). Imagining eating an unhealthy product increased the choice probability of choosing an unhealthy product, whereas imagining the consequences of having eaten a healthy product increased the choice probability of choosing a healthy product. We hereby would like to rule out the possibility that this effect is only present when the product-simulation combination is congruent (imagining having eaten a healthy product, and imagining eating an unhealthy product). By using in this study an ambivalent product that contains both hedonic and utilitarian features, we contribute new insights to the literature by investigating the effect of mental simulation on food choice ruling out this potential congruity effect with the imagined product.

We base our hypothesis on the power that mental simulation has on motivation, build upon the grounded cognition theory of desire and motivated behaviour. Since people focus more on hedonic attributes with process simulation, we hypothesise that performing process simulation with an ambivalent product will induce people in an indulgent mindset, and thus increase the likelihood of choice for the unhealthy product. On the other hand, since outcome simulation make people focus on more utilitarian attributes, outcome simulation will induce a more health mindset, and thus increase the likelihood of choice for the healthy product (H3).

Since the underlying mechanisms of the effect of mental simulation have not yet been explored, we first investigate the effect of valence on the desire for the imagined product, and separately, we investigate the effect of mindset induction on a choice between a healthy and an unhealthy product.

3. Study 1: The effect of mental simulation on desire for the imagined food product

3.1. Materials and methods

Eighty-one participants of Wageningen University & Research participated in an online study. The sample consisted of 69 females and 12 males with an age ranging from 18 to 45 years. The experiment followed a within-subject design and involved three conditions (mental simulations): process, outcome, and control. The target stimulus was a cereal bar (an ambivalent product, as shown in a pretest). All participants started with the control condition (no simulation) to capture baseline measures. One day after, they filled in the first survey, where they were randomly assigned to either the process simulation condition or the outcome condition. Half of the participants started with the process simulation and the other half with the outcome simulation. In a third session, participants filled in the last survey with the remaining experimental condition. We followed the same procedure as in a previous study (Muñoz-Vilches et al., 2019) and used the same manipulation, where we intended to activate both cognitive and affective processing. In the process simulation, the cognitive processing was activated with the question "*which specific features do you think about while consuming the cereal bar)?",* while in the affective processing the question was *"which specific emotions do you feel while consuming the cereal bar)?"*. In the outcome simulation, the cognitive processing was activated with the question "*which specific benefits/consequences do you think about after having consumed the cereal bar?"* and the affective processing with the question *"which specific emotions do you feel after having consumed the cereal bar?"*. Our dependent variable was desire, which was measured after simulation and on a VAS-scale (0 = not at all, 100 = very much) in response to the question *"how much would you want to eat the product now?"*.

3.2. Results

3.2.1. Manipulation check

We first check whether hunger (measured at the beginning of each session) differed between conditions. No differences between conditions were found for hunger [$F(2,160) = 0.81$, $p < 0.447$].

To explore whether our manipulation was triggering thoughts related with the experience in process simulation, and thoughts related with health or functionality in outcome simulation, we analysed the participants' written thoughts that were collected during the study. The most frequent words after process simulation were taste (26), sweet (18), texture (11), bite (15), structure (10), and happy (20). The most frequent words during outcome simulation were words related with feeling-less-hungry (33), energy (15), happy (14), and satisfied (12). Below are some examples.

3.2.1.1. Process simulationI first look at the fruit in the cereal bar and assume that the fruit provides a certain sweetness. I feel it with my fingers and assume that the bar will be crunchy. Then, before I bring the bar to my mouth, I smell it. I take a small bite. I am happy when it matches my expectations, but when the bar is, for example, less crunchy than I expected, I am disappointed. While chewing, I 'hear' the crunchiness.

I want to take little bites to enjoy as long as possible, I like the fact that it's crumbly, I love the taste of the cranberry (which I think are the red parts), I don't want the bar to be too sticky, I want my worst hunger to be stilled by eating this bar.

3.2.1.2. Outcome simulation. I feel less hungry, I feel content about the taste and sad that it's finished, but I might feel guilty that it is a too sweet snack and I should have taken something else.

I feel saturated. I think that I will have a positive feeling since my hunger is over. I will also have a positive feeling because I managed to choose something relatively healthy and not, for example, chose a Mars bar. I probably also feel more energetic: I chewed on the bar quite intensively, because of the crunchiness and additionally, the bar provided energy.

3.2.2. Desire for the imagined product

A repeated measures ANOVA was conducted with desire[1] as the

[1] Liking was measured on a VAS-scale (0 = not at all, 100 = very much) in response to the question "how much you liked the product". In a repeated measures ANOVA, liking ratings were marginally affected by our manipulation

dependent variable, and simulation type (control, process, outcome) as independent variable. It was hypothesised that mental simulation would have an effect on desire (H1). There was a significant effect of mental simulation on desire F (2,160) = 10.66, $p < 0.001$. As predicted, mean desire was increased when process simulation (M = 46.85) and outcome simulation (M = 45.83) was performed compared to control (M = 32.74). This is explained by the nature of our chosen product, which is high in both hedonic and utilitarian dimension (ambivalent product).

Study 1 provides evidence that process and outcome simulation can be used to affect subjective desire of the imagined (ambivalent) food, and thus confirmed our H1. In the next study, we expanded our dependent measure to include participants' food choice between a healthy and unhealthy product. Moreover, we explore the mechanisms underlying the effect of mental simulation on desire for the imagined food and choice between a healthy and an unhealthier product.

4. Study 2: Investigating the mechanisms of the effect of mental simulation on desire and food choice

4.1. Material and methods

4.1.1. Participants

One hundred and eighty students, 108 of whom were female were recruited in the study in exchange for snacks and the possibility to win five vouchers of €20 each. Participants had a mean age of 21.8 years (SD = 4.03) and had on average a body mass index (BMI) of 22.2 kg/m^2 (SD = 3.13). Participants provided written consent to participate. The study was approved by the Ethics Committee of Social Sciences, Wageningen University and Research.

4.1.2. Procedure

Upon arrival, all participants provided written informed consent. Before starting the experiment, participants were asked to rate a cereal bar in terms of its hedonic and utilitarian character. We used the same stimulus as in Study 1 since those results showed that this product was similarly hedonic and utilitarian. They also rated the cereal bar for desire, expected enjoyment, expected healthiness, and tastiness to determine the baseline measurements for this population (see Table 1 and the Measures Section 4.1.3).

The experiment followed this time a between-subject design using again three mental simulation conditions: process, outcome, and a control. During the instructions, the cereal bar was displayed as an image. Participants were randomly assigned to one of the three conditions, they were asked to imagine the (post)consumption of the ambivalent product, or the act of moving a chair if they were allocated to the control condition. After the mental simulation phase, they evaluated the valence of the thoughts evoked by the imagined experience. They also rated the levels of desire for the imagined food, expected enjoyment, expected tastiness, and expected healthiness.

At the end of the session, participants were presented with two transparent containers, one with 65 g of a healthy product (grapes) and another with 65 g of an unhealthier product (chocolate covered raisins). Participants were asked to evaluate the liking of both products before tasting them. Furthermore, they chose one from the two products to do a "taste test". During the taste test, they evaluated the chosen product in terms of liking, tastiness, and healthiness. At the end of the study, participants filled in the questionnaire of eating restraint (DEBQ; van Strien, Frijters, Bergers, & Defares, 1986) to identify eating restraint, emotional eaters, and external eaters. In preliminary analyses it was found that none of these personality traits affected the desire for the imagined product, thus they will not be further discussed. They also filled in some demographical questions as their weight, height, age, and gender. Participants were asked to guess the reason for the study and then were debriefed.

Table 1
Variables involved in the experimental procedure in chronological order.

Baseline measures	Hedonic vs. Utilitarian nature of the imagined product
	Desire for the ambivalent product
	Expected enjoyment for the ambivalent product
	Expected tastiness for the ambivalent product
	Expected healthiness for the ambivalent product
Measures after simulation	Valence of the imagined experience (H2)
	Desire for the imagined ambivalent product (H1)
	Expected enjoyment for the imagined ambivalent product
	Expected tastiness for the imagined ambivalent product
	Expected healthiness for the ambivalent product
Measures before choosing	Liking for the unhealthy product
	Liking for the healthy product
Food choice	Healthy product vs. Unhealthy product (H3)

4.1.3. Measures

Desire was measured on a 7-point scale (1 = not at all, 7 = very much) in response to the question "how much would you want to eat the cereal bar now?".

Expected enjoyment was measured on a 7-point scale (1 = I would not enjoy it at all, 7 = I would enjoy it very much) in response to the question "how much would you enjoy the cereal bar if you ate it now?".

Expected healthiness was measured on a 7-point scale (1 = Very unhealthy, 7 = Very healthy) in response to the question "how healthy is the cereal bar?".

Expected tastiness was measured on a 7-point scale (1 = Not tasty at all, 7 = Very tasty) in response to the question "how tasty is the cereal bar?".

Valence of imagined experience was measured on a 7-point scale (-3 = very negative, 3 = very positive) in response to the question "the emotions I had when I was imagining the event were…"

Liking was measured before tasting and choosing the products on a 7-point scale (1 = Not at all, 7 = Very much) in response to the questions "how much do you like this chocolate covered raisins?" and "how much do you like these grapes?".

Choice was measured as a cover task. Participants were asked to choose one of the two products they were presented with to proceed with a sensory evaluation. The products were chocolate covered raisins (unhealthy product) and grapes (healthy product).

4.2. Results

Different measures and tasks were used to test each mechanism of how mental simulation affects desire in general (measured on the imagined product), and separately, on the choice between a healthy and an unhealthy product. We first analysed the effect of mental simulation on desire for the imagined product and propose valence of the imagined experience as one of the mechanisms (H2). We then analysed the effect of mental simulation and food choice between a healthy and unhealthy product (H3).

First of all, we analysed with a pair sample *t*-test whether our selected product contained both hedonic and utilitarian characteristics. We found that although the cereal bar was high in both dimensions, the product was more hedonic than utilitarian [t(179) = 2.69, $p = 0.008$]. Although hunger differed between the three simulation conditions [(F (2,177) = 3.97, $p = 0.021$], simple contrasts showed that hunger did not differ between process and outcome simulation when both were compared independently to control condition ($M_{control}$ = 4.20, $M_{process}$ = 4.41, $p = 0.399$; ($M_{control}$ = 4.20, $M_{outcome}$ = 3.76,

(*footnote continued*)
(p = 0.071).

Table 2
Results of statistical analysis for baseline measures (before simulation and for the imagined product), M (SD), measured on 7-pt scales.

Baselines	Control (n = 60)	Process (n = 58)	Outcome (n = 62)	Difference between conditions
Desire for the imagined product	3.96 (1.41)	4.34 (1.70)	3.95 (1.45)	F (2,177) = 1.25, p = 0.287
Expected enjoyment for the imagined product	4.03 (1.47)	4.62 (1.51)	4.40 (1.39)	F (2,177) = 2.44, p = 0.090
Expected tastiness of the imagined product	4.35 (1.37)	4.62 (1.26)	4.48 (1.14)	F (2,177) = 0.676, p = 0.510
Expected healthiness of the imagined product	3.95 (1.44)	4.08 (1.53)	3.43 (1.53)	F (2,177) = 3.156, p = 0.45

p = 0.058). In addition, when controlling for hunger in the analysis of desire for the imagined product, it did not change the pattern of the results.

Furthermore, we analysed whether our baseline measures of desire, expected enjoyment, expected healthiness and tastiness differed between mental simulations (see Table 2). We found that desire for the imagined product and its expected tastiness did not show differences between simulations. Although expected enjoyment did not significantly differ between all mental simulations, in a simple contrast we found that people in process simulation rated a higher expected enjoyment than control (p = 0.032). For this reason, in the subsequent analyses these variables were controlled for. Overall, people vividly imagined the process and outcome simulation ($M_{process}$ = 5.3, $M_{outcome}$ = 5.1), there were more difficulties to imagine moving a chair ($M_{control}$ = 4.8), but we still consider it as being vivid.

4.2.1. Mental simulation, desire, and valence of the imagined experience

A mediation analysis was conducted to test whether valence mediates the effect of the process and outcome simulation, each compared independently with the control condition, on desire for the imagined product. The macro PROCESS (model 4) for multicategorical independent variables was used (Hayes, 2018).

The total effect shows that only process simulation positively affected desire for the imagined product [B_1 = 0.68 (0.19), p = 0.012. B_2 = 0.03 (0.27), p = 0.916]. The results of the mediation analysis show that the type of mental simulation indirectly influenced desire for the imagined product through its effect on the valence of people's imagined experience. Both process and outcome simulation influenced valence of imagined experience positively, which in turn affected desire positively. The indirect effect of the mental simulation on desire the imagined product through valence was statistically significant, with the 95% not containing zero (Fig. 1). This effect shows that the valence of people's imagined experience determines the desire for the ambivalent product. The ambivalent product evoked negative thoughts in very few people, thus we could not show that negative imagined experiences would affect desire negatively. However, we suspect that with a product that evokes more negative imagined experiences, we could have observed this effect.

4.2.2. Other variables

An ANOVA was conducted with expected enjoyment, expected healthiness, and expected tastiness of the ambivalent product as dependent variable and mental simulations as independent variable. Notice that as mentioned before, in expected enjoyment and in expected healthiness, baseline measurement where added to control for the differences between mental simulations. Results are displayed on Table 3. When controlling for hunger, pattern of results do not change.

4.2.2.1. Expected enjoyment. We observed a significant effect of mental simulation on expected enjoyment. Simple planned contrasts showed that process simulation affected positively the level expected enjoyment compared to the control condition (p = 0.002). Therefore, only process simulation had a significant effect on increasing expected enjoyment for the ambivalent product compared to control condition.

4.2.2.2. Expected healthiness. We observed no significant effect of mental simulation on expected healthiness.

4.2.2.3. Expected tastiness. We observed a significant effect of mental simulation on expected tastiness. Simple planned contrasts showed that process simulation affected positively the level tastiness compared to the control condition (p < 0.001). Outcome simulation also showed a marginal positive effect (p = 0.082).

The differences between the simulations and the control condition had the same positive pattern in desire, expected enjoyment, and expected tastiness. These variables were favoured by process simulation.

4.2.3. The effect of simulating an ambivalent product on choice for an unhealthy vs. a healthy product

Chi-square test was conducted to analyse to what extent mental simulation had an impact on people's choice between a healthy and unhealthy product (H3). Product choice frequency was our dependent variable, and simulation type our independent variable.

The results presented in Table 4 show that process simulation, outcome simulation, and the control condition had a marginal effect on the probability of choice, χ^2 (2) = 5.571, p = 0.062. In the control condition, 45% chose the unhealthy while the other 55% chose the healthy product. Although the differences between process, and outcome simulation compared to the control condition were not

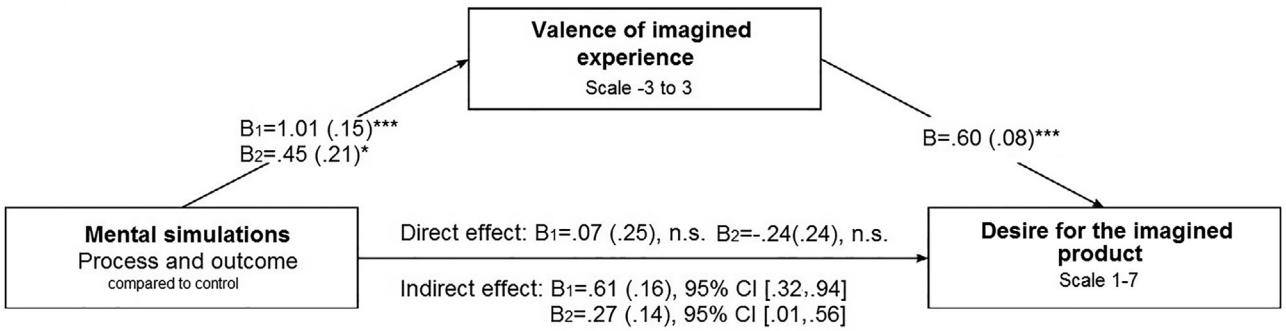

Fig. 1. Mediation model of valence of the imagined experience between mental simulations and desire for the imagined product. Coding = process simulation compared to control (1), outcome simulation compared to control (2); B (SE) = path coefficient (standard error); p < 0.05*, p < 0.01**, p < 0.001***.

Table 3
Results of statistical analyses comparing the variables after the simulation of the ambivalent product, M (SD).

Measures after simulation	Control (n = 60)	Process (n = 58)	Outcome (n = 62)	Difference between conditions
Valence of imagined experience	0.53 (1.01)	1.53 (1.17)	0.98 (1.27)	F (2,177) = 11.00, p < 0.0001
Desire for the imagined product	4.13 (1.50)	4.84 (1.33)	4.16 (1.52)	F (2,177) = 4.49, p = 0.012
Expected enjoyment of the imagined product	4.08 (1.38)	5.03 (1.41)	4.39 (1.41)	F (2,177) = 5.27, p = 0.006
Expected tastiness of the imagined product	4.30 (1.21)	5.24 (1.30)	4.72 (1.50)	F (2,177) = 7.20, p = 0.001
Expected healthiness of the imagined product	3.66 (1.38)	3.89 (1.47)	3.54 (1.59)	F (2,177) = 1.763, p = 0.175

Table 4
Choice frequency (%) of participant's choices in each condition. Different letters across columns represent significant differences between conditions at the 0.05 level.

Product Category	Control	Process	Outcome
Unhealthy product	45.0% a, b	61.0% b	41.9% a
Healthy product	55.0% a, b	39.0% b	58.1% a

significant, imagining eating versus having eaten an ambivalent product significantly differ from each other. Process simulation led to a higher proportion of people choosing the unhealthy compared to outcome simulation (61% vs. 41.9%, respectively), and more importantly, outcome simulation led to a higher proportion of people choosing the healthy product compared to process simulation (58.1% vs. 39%, respectively). These results partially confirm our hypothesis H3, more people in process simulation opted for the unhealthy product and more people in outcome simulation chose for the healthy product, but only when process and outcome simulation are compared (Table 4). Additionally, 93.4% of people did not regret their choice once they have tried the product.

Since liking is known to be a predictor of food choice, a binomial logistic regression with mental simulations, liking for the unhealthy product and liking for the healthy product as independent variables was conducted. Mental simulation had a marginal effect on food choice when liking for both products was added [Wald = 4.757, p = 0.093. Liking for the unhealthy and the healthy product were significant predictors of choice (B = −0.814, Wald = 25.372, p < 0.0001 and B = 0.571, Wald = 9.249, p = 0.002, respectively).

As a summary, we found an effect of both mental simulations on food choice, specifically, process simulation favoured the unhealthy choice while outcome simulation favoured the healthy choice (though only when compared to the process simulation).

5. General discussion

5.1. Mental simulation, valence, and desire

The aim of this research was to investigate the effects of different types of mental simulation on desire and food choice. We first investigated the effect of process and outcome simulation on desire for an imagined product. Previous research has established that the effect of process and outcome simulation depends on the product that is being imagined. If people imagine a vice product, process simulation favours choice for the vice product, whereas if people imagine a virtue product, outcome simulation favours choice for the virtue product (Muñoz-Vilches et al., 2019). According to these results, we first sought to show that imagining an ambivalent product (i.e., a product that shares both hedonic and utilitarian characteristics) would increase its desire, regardless of the type of mental simulation (H1).

In Study 1 the cereal bar was equally hedonic and utilitarian across conditions, but in Study 2 we found that the product was generally more hedonic than utilitarian, although both dimensions were highly present. This product perception could explain why desire for the imagined product was higher in the process simulation in the Study 2, which would be in alignment with our previous findings.

Results of Study 1 and 2 can be explained by the evolutionary shaping of our consummatory responses toward a conditioned-cue such as the smell of food (Berridge, 2009) or the vivid imagination of a food and how would be to eat it (EI theory; May et al., 2015), that provoke augmented desire for food. If the imagined food were extremely hedonic or utilitarian, the subjective desire would have been decreased in their non-congruent simulation (outcome simulation and vice product; Muñoz-Vilches et al., 2019). We believe that this happens because of the valence of the imagined experience. When the valence of the imagined experience tends to be positive, as in the case of the ambivalent product, desire increases in both simulations. One could think that any positive experience (e.g., being in a positive mood) would influence this result. Previous research, indeed, has shown that positive mood increases, for instance, food intake (Collins & Stafford, 2015). That could be the case, but in our experiment it was clear that at least intensity of the valence of the imagined experience was influencing desire, which is shown through the mediation effect. We speculate that if we had used a hedonic unhealthy product, it is likely that more negative imagined experiences would have emerged, especially in outcome simulation, and that desire for the product would have decreased, as we observed in Muñoz-Vilches et al. (2019). This is important to mention because outcome simulation could be used to control desire for vice products, which could contribute to the choice of healthier products.

5.2. Mental simulation and choice

Consumers are motivated to choose options that serve their active goals (Giacalone & Jaeger, 2019; Markman & Brendl, 2000). We expected that process simulation would induce an indulgent mindset and that outcome simulation would induce a health mindset. For this reason, we hypothesised that process simulation would increase preference for unhealthy products, while outcome simulation would increase preference for healthy products. Indeed, our results confirmed our hypothesis, showing a higher frequency of the unhealthy choice with process simulation and a higher frequency of the healthy choice with outcome simulation. These results are consistent with previous research, showing that people have more positive attitude and higher purchase intentions towards the match product-simulation (e.g., process simulation and vice product; Xie, Minton, & Kahle, 2016). These evaluations are also observed in choice, people choose more frequently vice products when process simulation is performed and virtue products when outcome simulation is performed (Muñoz-Vilches et al., 2019). The comparison between process simulation and outcome simulation is important since food products are often advertised focusing on sensory properties and taste, which are very process simulation-like thoughts. Hence, these results show that one could employ outcome simulation as a strategy to boost healthier food choices. Having said that, further research should be conducted to test the robustness of these effects, since it is also well known that consumers often tend to compensate (Khan & Dhar, 2006); that is, if they have eaten a low-caloric food/meal and are satisfied, they might then opt for a more caloric option in a next eating occasion. However, we could argue that in the food domain this compensation effect is more likely in the real event of eating, or having eaten a food, and not necessarily after having imagined such situations.

Liking, just as desire, is a component of food reward (Berridge,

2009; Finlayson, King, & Blundell, 2007). Previous research has indeed shown the strong power of liking in predicting food choices (Sobal et al., 2006), and we confirmed so in our results. Moreover, we found that in process simulation, the liking for the unhealthy product was higher than the liking for the healthy product when compared to the control. On the other hand, in outcome simulation liking for the healthy product was higher than in the control and process simulation conditions. However, since liking was only measured after each simulation, we cannot claim that liking is the mechanism by which mental simulation affected food choice. Further research should explore whether mental simulation is able to affect a more stable hedonic measure such as liking.

5.3. Future research and implications

Finally, our results have practical implications. Our results support the idea that imagining a food consumption event versus a post-consumption event matters.

Due to the accessibility of highly hedonic foods that we face every day, it is often difficult to resist temptations. In fact, many times one would picture the food to the point that it can be seen in his mind, and experience the consumption event. Mental simulation is a promising technique to change from immediate gratification to a more future-oriented outlook. This research contributes to the idea that our imagination is rich in experiences, and that is controllable. If one instead of imagining how tasty a bar of chocolate is, vividly imagine about the consequences of eating it, it is likely that the desire for chocolate will be reduced and will help to resist the temptation. On the other hand, if we focus and imagine the benefits of eating something healthy, it is more likely that our choice between healthy and unhealthy food will be the healthiest. We also demonstrate that this not only works for the imagined product, but that is transferred to a subsequent choice of two products different in nature (healthy versus unhealthy).

More research is needed to elucidate the mechanisms by which mental simulation impacts desire and food choice. Further research could explore whether mental simulation affects working memory by distracting people, generating attentional biases or exhausting cognitive resources. Alternatively, future research could also investigate whether mental simulations could correspond to a more emotional activation, and not necessarily to a semantic activation.

This study contributes to the development of a strategy that can be used by individuals or by public institutions, by introducing communication campaigns that frame the type of product in a way that will be attractive to people, and effective to generate an impact in their behaviour. This remains yet a challenge in the realm of healthy behaviour. Most efforts are being put in providing information to consumers in packaging (such as “low/high in calories”) but this does not necessarily make consumers think of the consequences, and other aspects might dominate and evoke more intensely process-related simulations. In addition, consumers often do not take the time to engage with information or advertisement. In this sense, we envision immersive communication, where consumers could project themselves in the evoked scenario (as some holiday advertisements do) to allow outcome simulation. Also, nutritionists could encourage consumers to exercise focusing on the consequences (taking time) before selecting foods (this is related to the notion of mindful eating; van de Veer, van Herpen, & van Trijp, 2016). Certainly, future research should investigate ways of applying these findings in realistic ways. It can also be used by companies, to create more effective messages in advertisement or packaging. Our results showed that inducing people with mental simulations focused on the process tends to increase the temptation for unhealthy products, while inducing them to a mental simulation focused on the result, helps people to choose a healthier product.

6. Conclusions

Mental simulation can be used to affect desire and food choices at the convenience of a given situation. Simulating the process of eating and the outcome of having eaten an ambivalent product increases desire for that product, however, process simulation causes a preference in choice for the unhealthier product while outcome simulation causes a preference for a healthier product. Although some of the mechanisms that explain this effect could not be fully elucidated, this study contributes to a better understanding of how a mental simulation can momentarily affect liking for different product categories and also impact our dietary decisions. More research is needed to determine the mechanism underlying mental simulations and food choice. Specifically, we believe that mechanisms related to emotional activation and attentional alterations could contribute to a better understanding of this process.

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CRediT authorship contribution statement

Naomí C. Muñoz-Vilches: Conceptualization, Methodology, Formal analysis, Investigation, Writing - original draft. **Hans C.M. van Trijp:** Methodology, Supervision, Writing - review & editing. **Betina Piqueras-Fiszman:** Methodology, Visualization, Investigation, Supervision, Writing - review & editing.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.foodqual.2020.103892.

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